

# Cumulative Effects of Exposure

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## Overburdened Environmental Justice Communities

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CEET

CENTER OF EXCELLENCE IN ENVIRONMENTAL TOXICOLOGY

# Exposures in Communities





# Cumulative Environmental Impacts





# Cumulative Environmental Impacts

◆ Direct: air, water, seafood



Indirect: traffic due to industrial activity

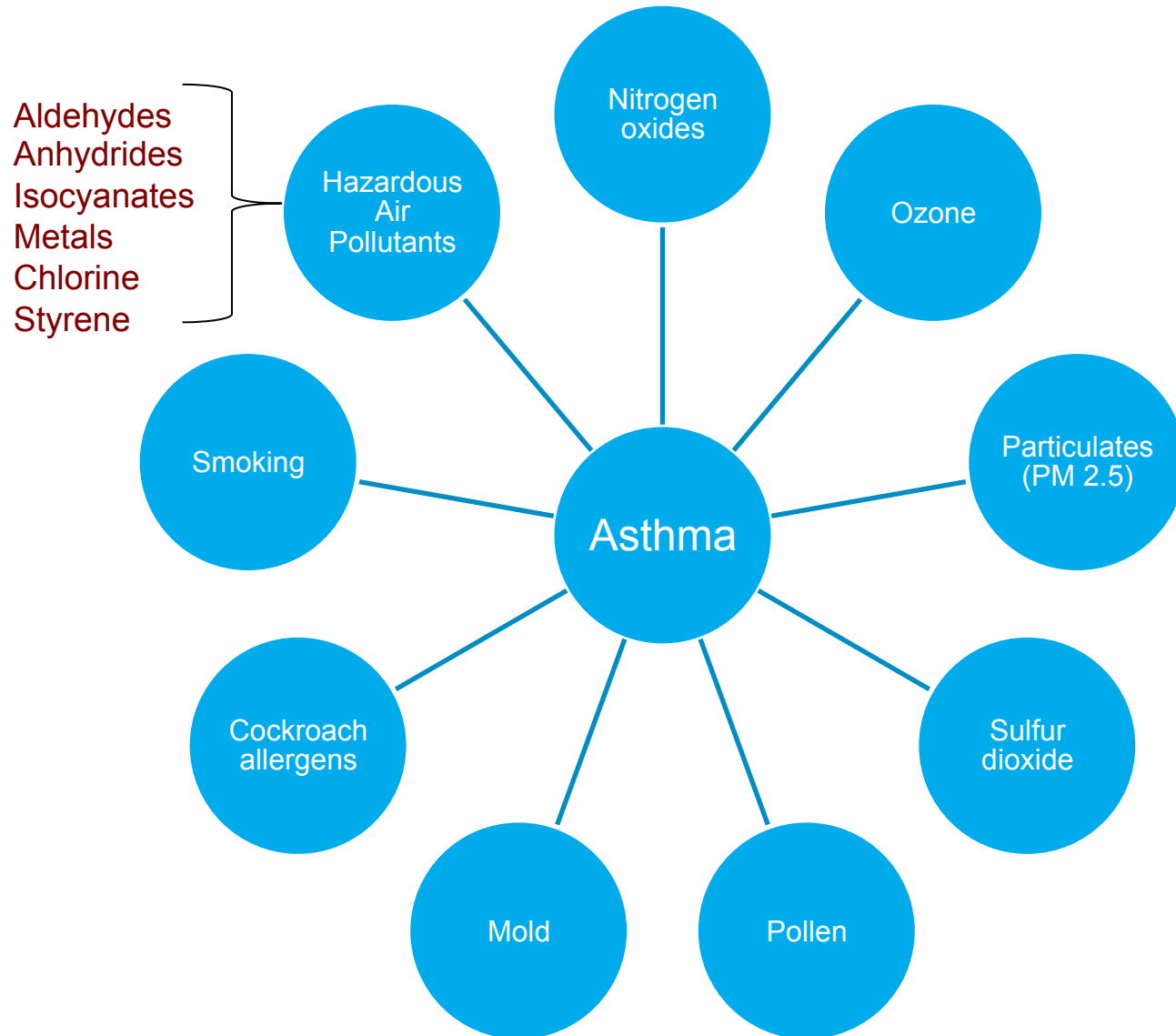


**Cumulative:  
multiple  
landscape  
changes**

# Health Effects from Environmental Exposures

- ♦ **Asthma**
- ♦ **Lung Disease**
- ♦ **Cardiovascular Disease**
- ♦ **Autism**
- ♦ **Breast Cancer**
- ♦ **Cancer**
- ♦ **Lupus**
- ♦ **Parkinson's Disease**
- ♦ **Neurologic Disorders**
- ♦ **Reproductive Impacts**

# Combined Effects of Environmental Exposure



# Exposome

- ♦ **Measure of all exposures of an individual in a lifetime and how these exposures relate to health**
- ♦ **Begins before birth**
- ♦ **Environmental sources**
- ♦ **Occupational sources**
- ♦ **Challenges- Everyone's exposome is different**  
**How do we measure all exposures?**  
**Impact of exposure varies throughout life**
- ♦ **Biomarkers- measure of internal exposure or effect**
- ♦ **Goal:** Understand the exposures and see the effects of cumulative exposures in order to prevent disease

# How are Cumulative Exposures regulated now?



# DEP Regulatory Framework

- ◆ **Regulators use standards to determine compliance**
- ◆ **Standards are set using a risk assessment model that is focused on the chemical or industrial process**
- ◆ **Focus: Singular chemical or process**
- ◆ **There is no requirement for a regional or cumulative approach**
- ◆ **Regional assessment does occur in areas of noncompliance with NAAQS for example**

# EPA Recommended Approach

## Consider Cumulative Exposures when:

- ♦ A resource is especially vulnerable to incremental effects
- ♦ The proposed action is one of several similar actions in the same geographic area
- ♦ Other activities in the area have similar effects on the resource
- ♦ These effects have been historically significant for this resource
- ♦ Other analyses in the area have identified a cumulative effects concern

Recommended Not Required

# Exposome of the Community

- ♦ **Identify, quantify and prioritize exposures**
- ♦ **Describe health disparities**
- ♦ **Determine community vulnerabilities**
- ♦ **Associate exposed communities with vulnerable communities and those with health disparities**
- ♦ **Inform policy change to prioritize at risk communities**

# CALIFORNIA COMMUNITIES ENVIRONMENTAL HEALTH SCREENING TOOL, VERSION 2.0 (CALENVIROSCREEN 2.0)

## GUIDANCE AND SCREENING TOOL



August 2014

Matthew Rodriguez, Secretary  
California Environmental Protection Agency

George V. Alexeeff, Ph.D., Director  
Office of Environmental Health Hazard Assessment





**“Cumulative impacts means exposures, public health or environmental effects from the combined emissions and discharges, in a geographic area, including environmental pollution from all sources, whether single or multi-media, routinely, accidentally, or otherwise released. Impacts will take into account sensitive populations and socioeconomic factors, where applicable and to the extent data are available.”**

# CalEnviroScreen 2.0

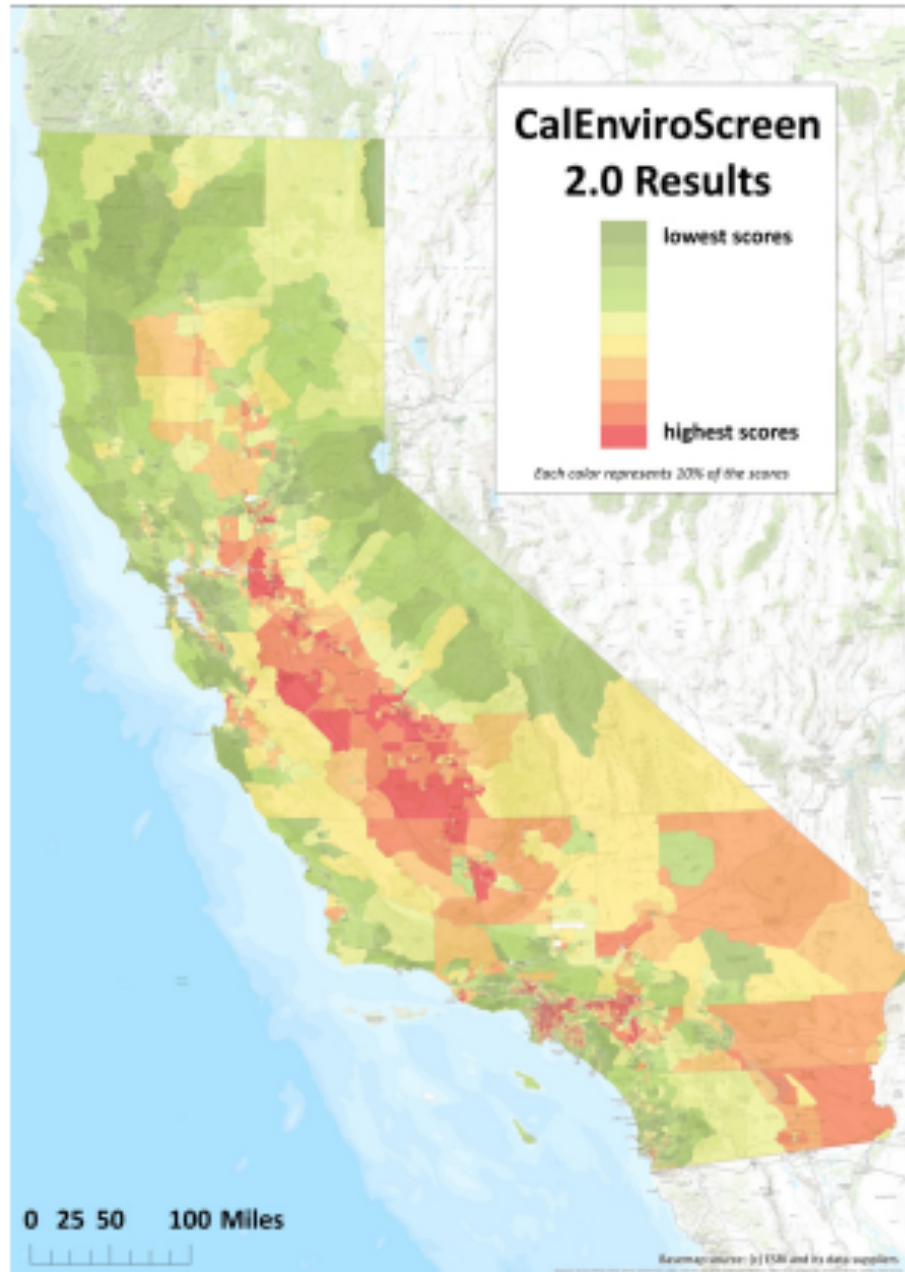
## Population Burden

- ♦ Ozone concentrations
- ♦ PM2.5 concentrations
- ♦ Diesel PM emissions
- ♦ Pesticide use
- ♦ Toxic releases from facilities
- ♦ Traffic density
- ♦ Drinking water contaminants
- ♦ Cleanup sites
- ♦ Groundwater threats
- ♦ Hazardous waste
- ♦ Impaired water bodies
- ♦ Solid waste sites and facilities

## Population Characteristics

- ♦ **Children and elderly**
- ♦ **Educational attainment**
- ♦ **Linguistic isolation**
- ♦ **Poverty**
- ♦ **Unemployment**
- ♦ **Low birth-weight births**
- ♦ **Asthma emergency department visits**

# CALENVIROSCREEN STATEWIDE RESULTS





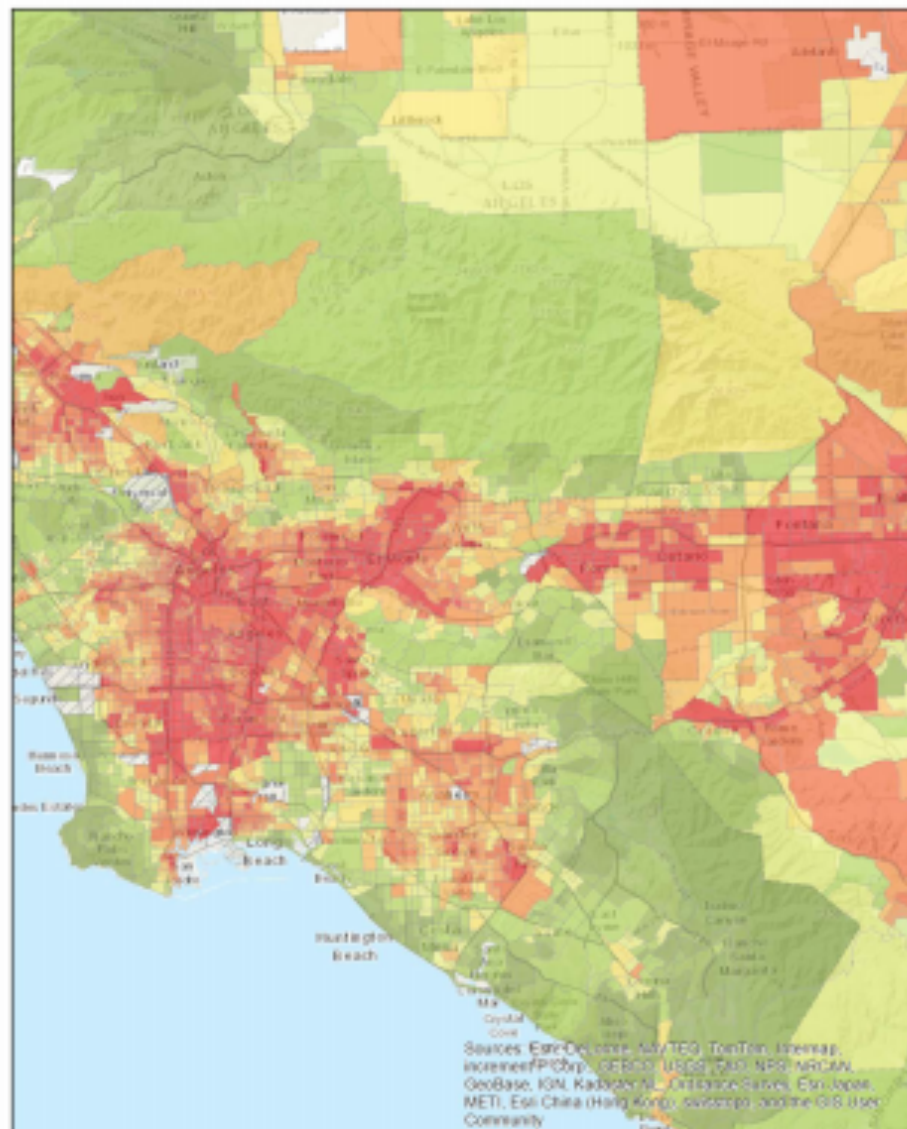
## CalEnviroScreen 2.0 Results

Top 20% pollution, low population

lowest  
scores

highest  
scores

Each color represents 10% of the scores



Los Angeles Area

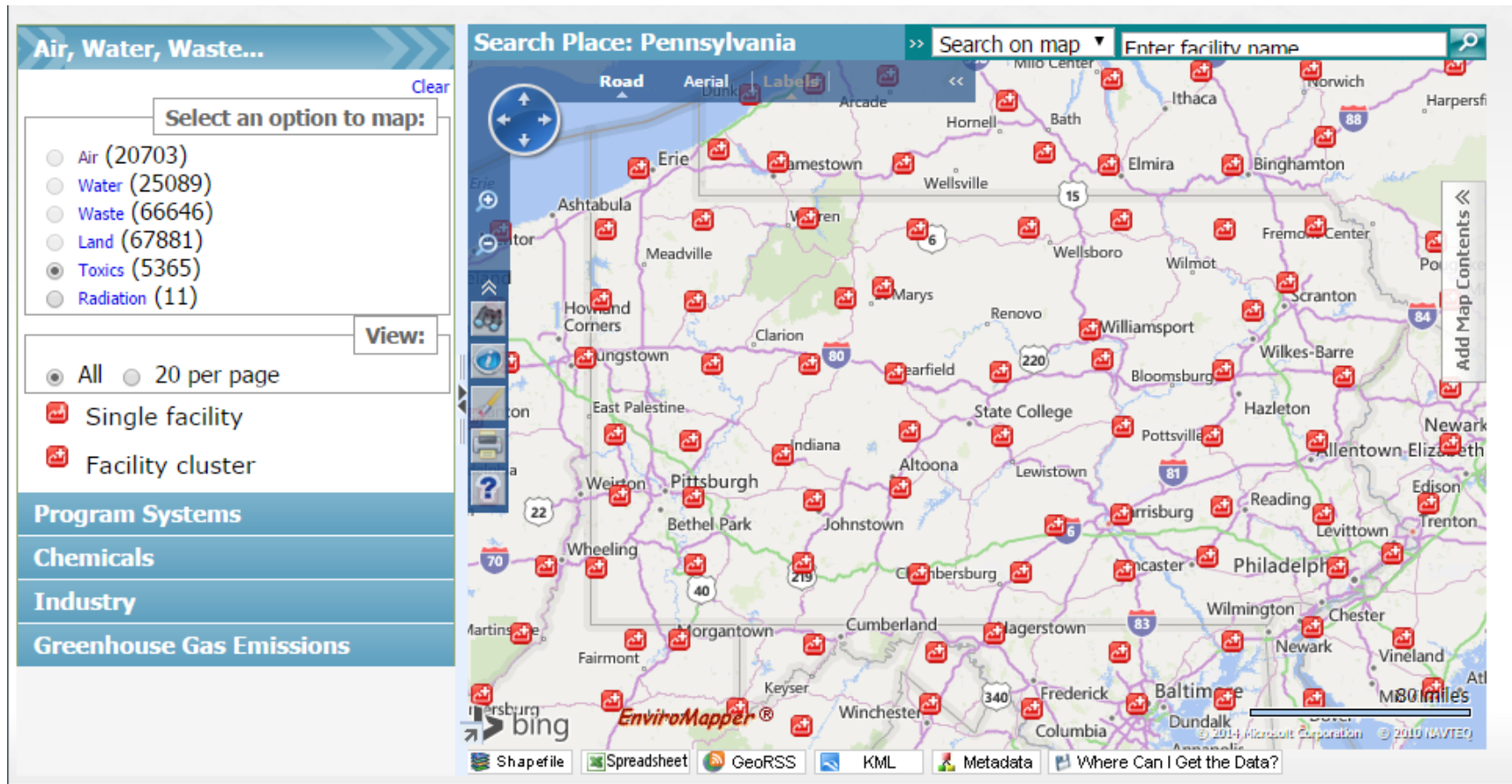
Basemap source: (c) ESRI and its data suppliers

0 5 10 20 Miles



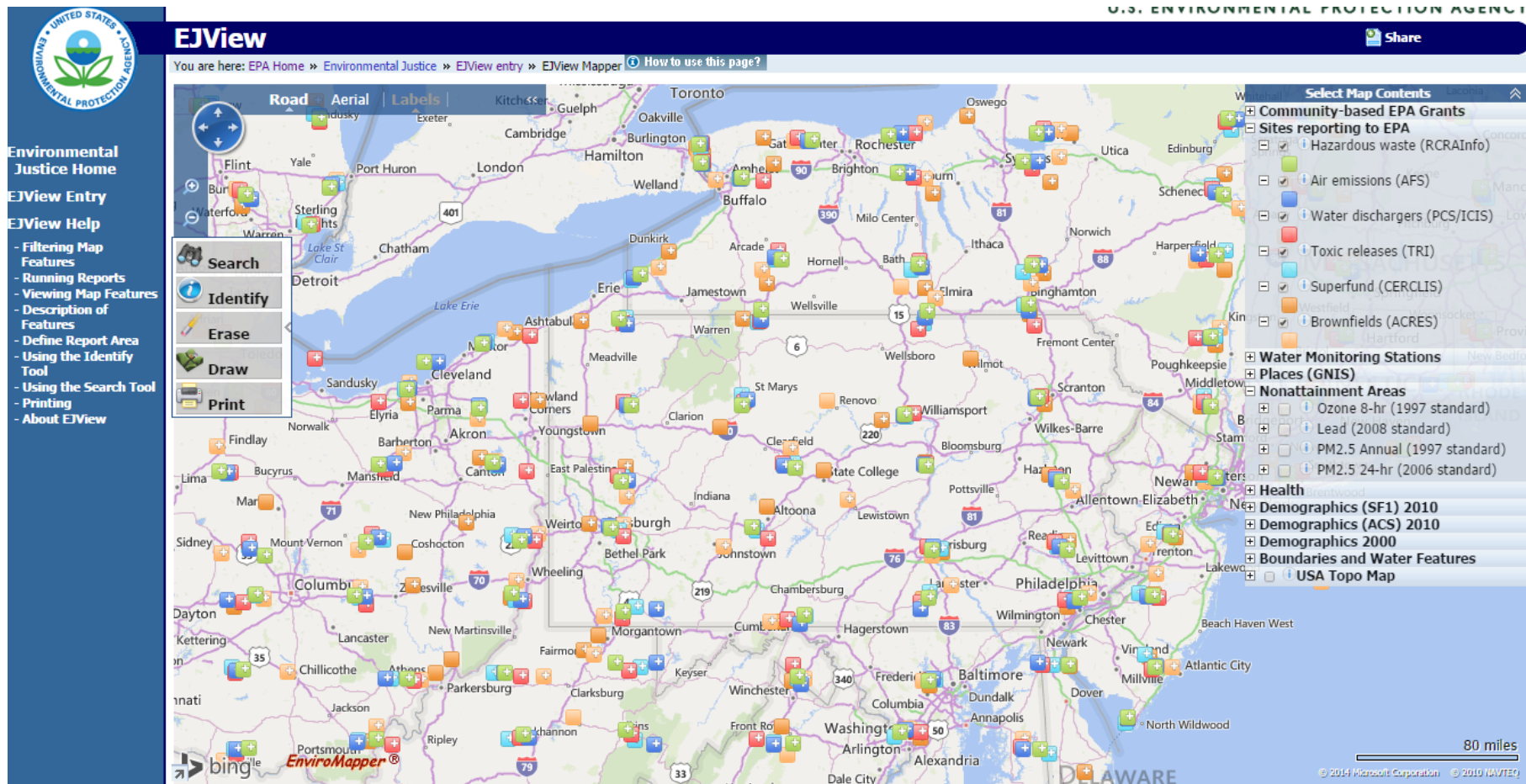
# Applying this Approach in Pennsylvania

- ◆ Identify, quantify and prioritize exposures
- ◆ EPA's EnviroMapper



<http://www.epa.gov/emefdata/em4ef.home>

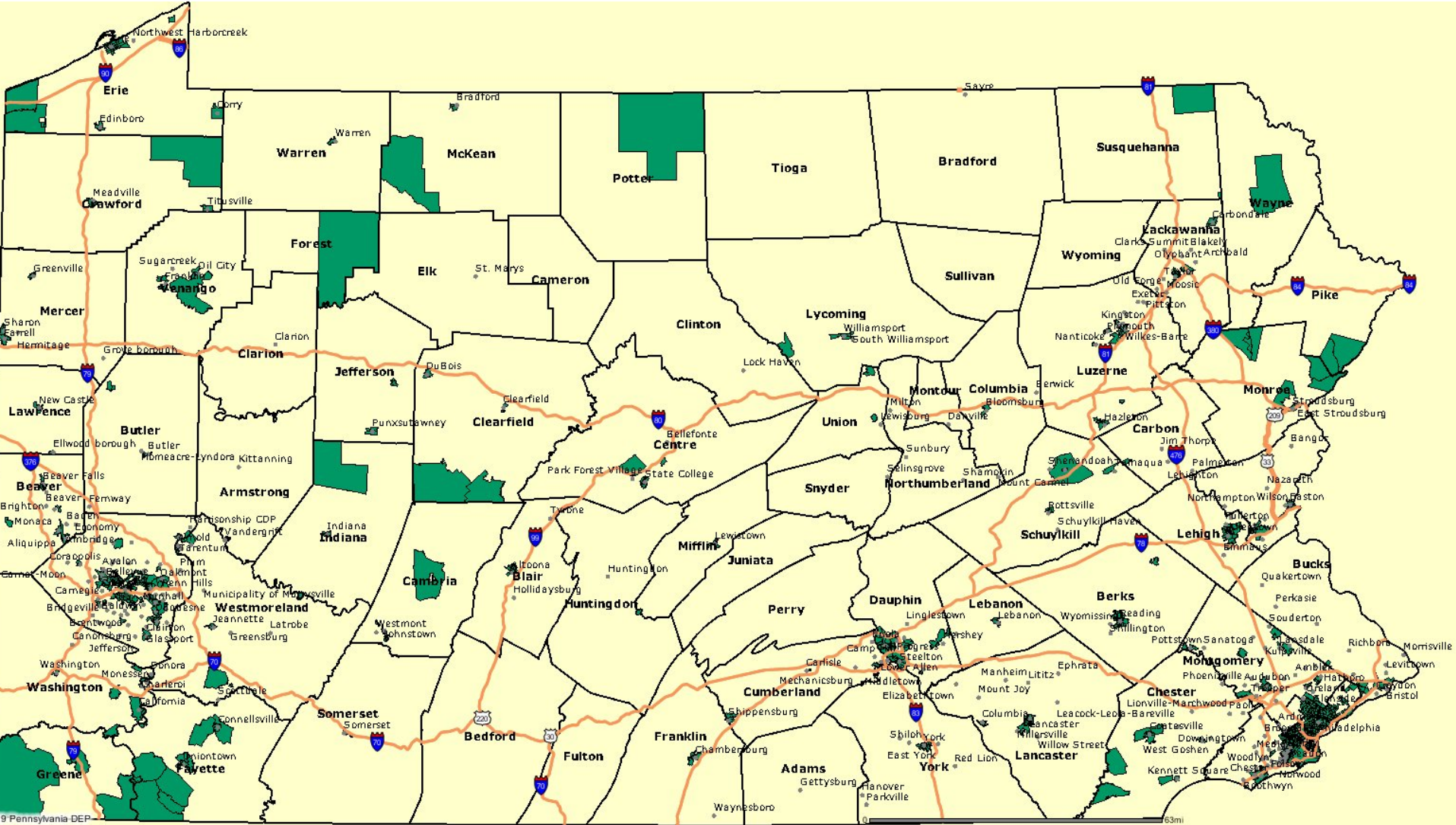
# EPA's EJView: Prioritize Communities



<http://epamap14.epa.gov/ejmap/entry.html>



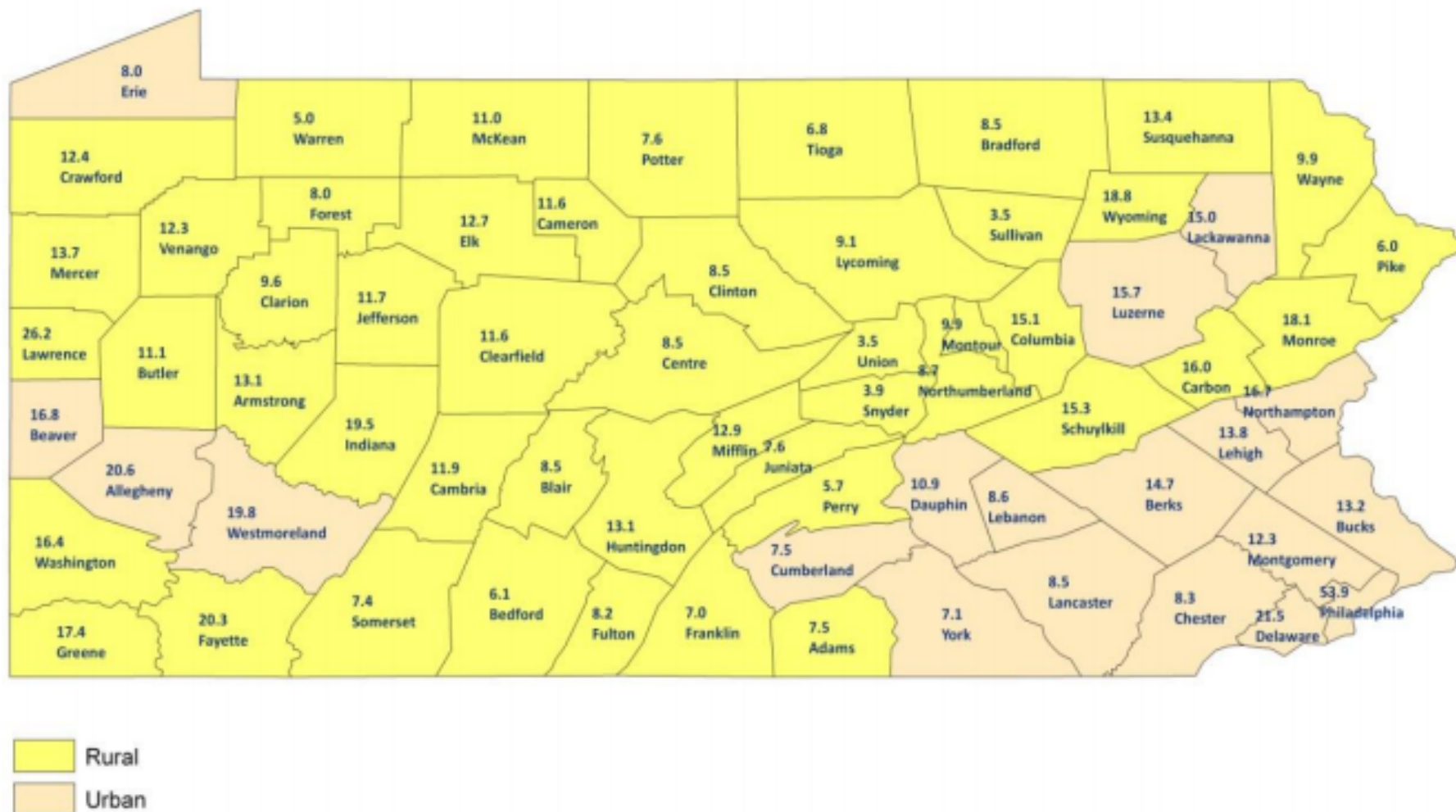
# eMapPA: Environmental Justice Areas





# Describing Health Disparities

**Figure 3-9: Age-Adjusted Rates for Inpatient Hospitalization with Asthma as the Primary Discharge Diagnosis by Urban vs. Rural County, PA 2006-2010**



Data Source: Pennsylvania Health Care Cost Containment Council (PHC4)

Note: according to Center for Rural Pennsylvania Definition there are 19 urban and 48 rural counties. The Center considers a county to be rural when its population density or the number of people per square land mile is below the statewide average of 284. County is urban when its population density is at or above the statewide density.

# Rates of Hospitalization for Asthma in PA

## 10 Highest Counties

- ♦ **Philadelphia County 53.9**
- ♦ **Lawrence County 26.2**
- ♦ **Delaware County 25.5**
- ♦ **Allegheny County 20.6**
- ♦ **Fayette County 20.3**
- ♦ **Westmoreland County 19.8**
- ♦ **Indiana County 19.5**
- ♦ **Wyoming County 18.8**
- ♦ **Greene County 17.4**
- ♦ **Beaver County 16.8**

## 10 Lowest Counties

- ♦ **Sullivan County 3.5**
- ♦ **Union County 3.5**
- ♦ **Snyder County 3.9**
- ♦ **Warren County 5.0**
- ♦ **Perry County 5.7**
- ♦ **Pike County 6.0**
- ♦ **Bedford County 6.1**
- ♦ **Tioga County 6.8**
- ♦ **Franklin County 7.0**
- ♦ **York County 7.1**

Red represents counties with Environmental Justice Communities

# Cancer Rates in PA

## Counties Significantly higher than expected

### Both Men and Women

- ♦ Philadelphia
- ♦ Lawrence
- ♦ Delaware
- ♦ Allegheny
- ♦ Chester
- ♦ Montgomery
- ♦ Berks
- ♦ Crawford
- ♦ Washington
- ♦ Cambria

## Counties Significantly lower than expected

### Men

- ♦ Adams
- ♦ Cumberland
- ♦ Juniata
- ♦ Dauphin
- ♦ Pike
- ♦ Wayne

### Women

Wayne  
Indiana

Red represents counties with Environmental Justice Communities

# Lung Cancer Rates in PA

## Counties Significantly higher than expected

### Both Men and Women

- ♦ Philadelphia
- ♦ Delaware
- ♦ Allegheny
- ♦ Crawford
- ♦ Washington
- ♦ Erie
- ♦ McKean
- ♦ Monroe

## Counties Significantly lower than expected

### Men

NONE

### Women

Snyder  
Somerset  
Bedford  
Fulton  
Lancaster  
Cambria  
Indiana

Red represents counties with Environmental Justice Communities

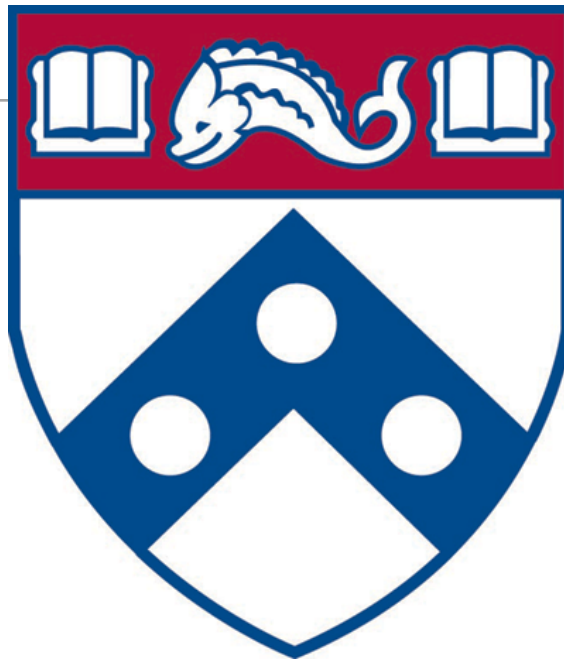


# Cumulative Impacts Assessment in PA

- ◆ **We have evidence of cumulative impacts of exposure on health in PA**
- ◆ **We have some exposure data that is tracked geographically**
- ◆ **We have some data documenting health disparities tracked geographically**
- ◆ **We know where EJ communities are in PA**

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**So what are the barriers to a cumulative impacts approach to regulation in PA and how do we overcome them?**



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