

# Assessment of the Environmental Public Health Indicators for Houston

L. James Lester [\[1\]](#), I. Debo Awosika-Olumo [\[2\]](#) and  
R. Raouf Arafat [\[3\]](#)

[\[1\]](#) Houston Advanced Research Center

[\[2\]](#) Bureau of Epidemiology, Office of Surveillance and  
Public Health Preparedness, Houston Department of  
Health and Human Services

[\[3\]](#) Office of Surveillance and Public Health  
Preparedness, Houston Department of Health and  
Human Services

# Environmental Context

- Coastal location with subtropical climate
- Large diverse urban and suburban population

- Center of petrochemical manufacturing
- Sprawled development dependent on automobiles



# Indicator Project Objectives

- Produce a set of EPH indicators
  - Hazards
  - Exposures
  - Health Impacts
- Disseminate via website to public (and decision makers)

# Indicator Characteristics

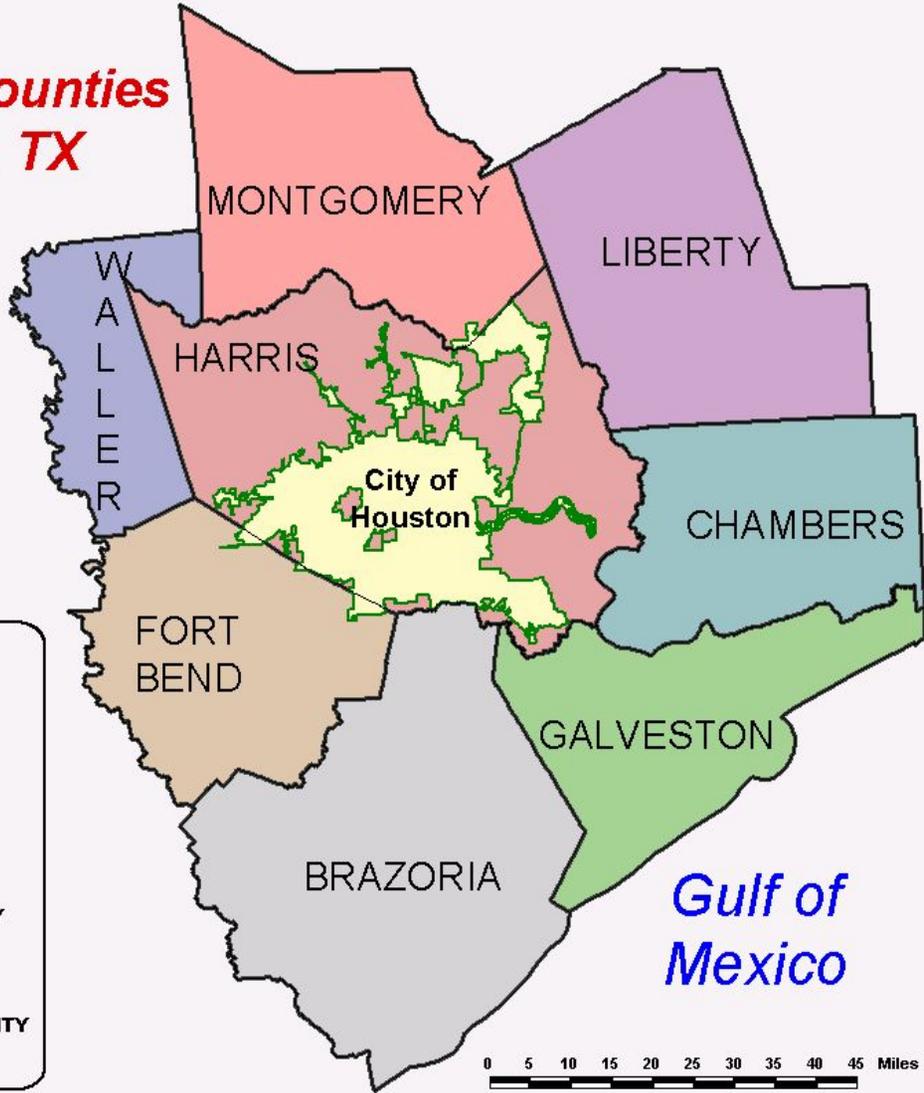
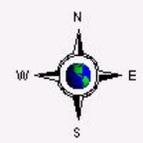
- **Relevance:** Answer questions the public cares about
- **Feasibility:** Select variables with reliable, robust data
- **Variability:** Choose indicators with spatial or temporal change
- **Interpretation:** Incorporate risk assessment
- **Utility:** Employ simple format

# Priority List of Environmental Health Issues

- Hazards: ambient air pollution, indoor air pollution, lead concentration in residential areas, drinking water contaminants
- Exposure: childhood blood lead level
- Health impacts: asthma and bronchitis, lead poisoning, cancer, birth defects

# Map of Houston, Texas and its surrounding counties, 2003.

## Surrounding Counties of Houston, TX



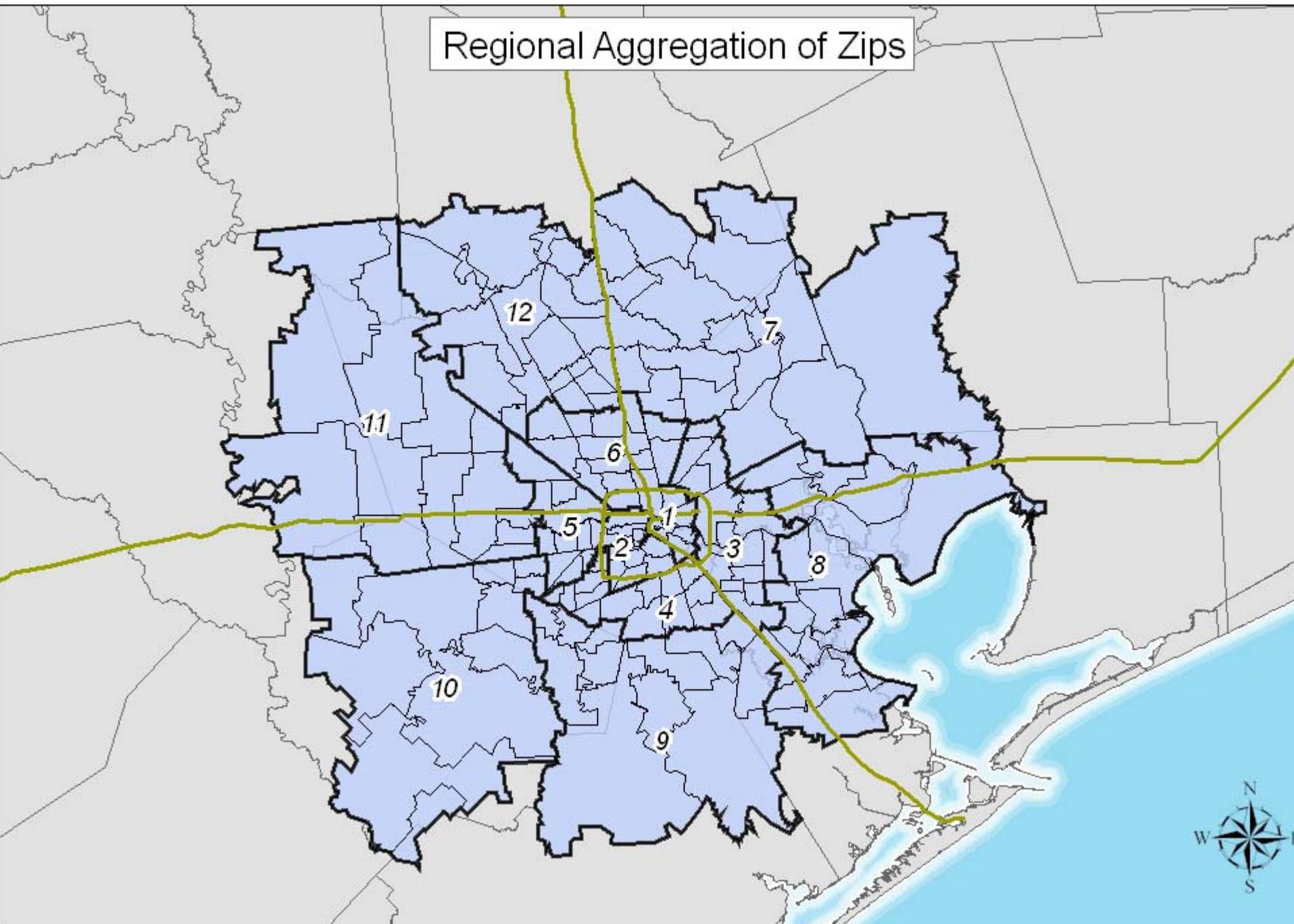
**Legend**

Houston, TX

**Surrounding Counties**

- BRAZORIA COUNTY
- CHAMBERS COUNTY
- FORT BEND COUNTY
- GALVESTON COUNTY
- HARRIS COUNTY
- LIBERTY COUNTY
- MONTGOMERY COUNTY
- WALLER COUNTY

# Regional Aggregation of Zips

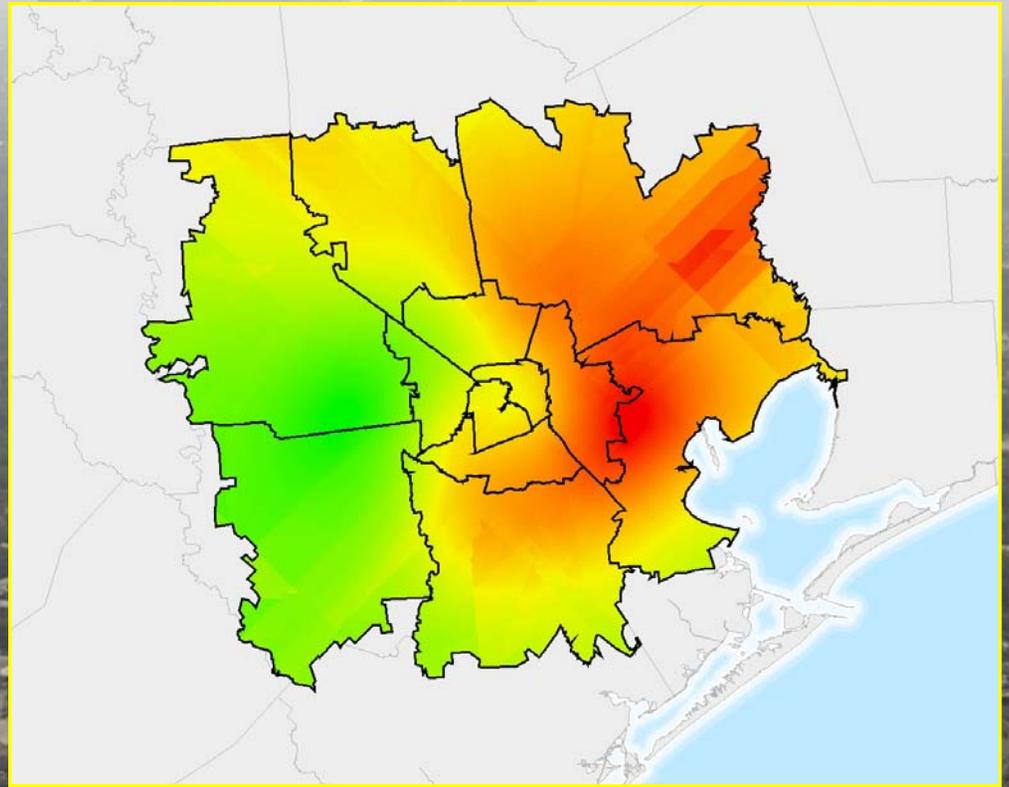


# Selected Air Pollutants (EPA standards)

- $O_3$  (80 ppb/8 hr)
- $NO_x$  (53 ppb/ annual)
- Benzene (1 ppb/annual ESL)
- 1,3 butadiene (5 ppb/annual ESL)

# Air Pollution Modeling

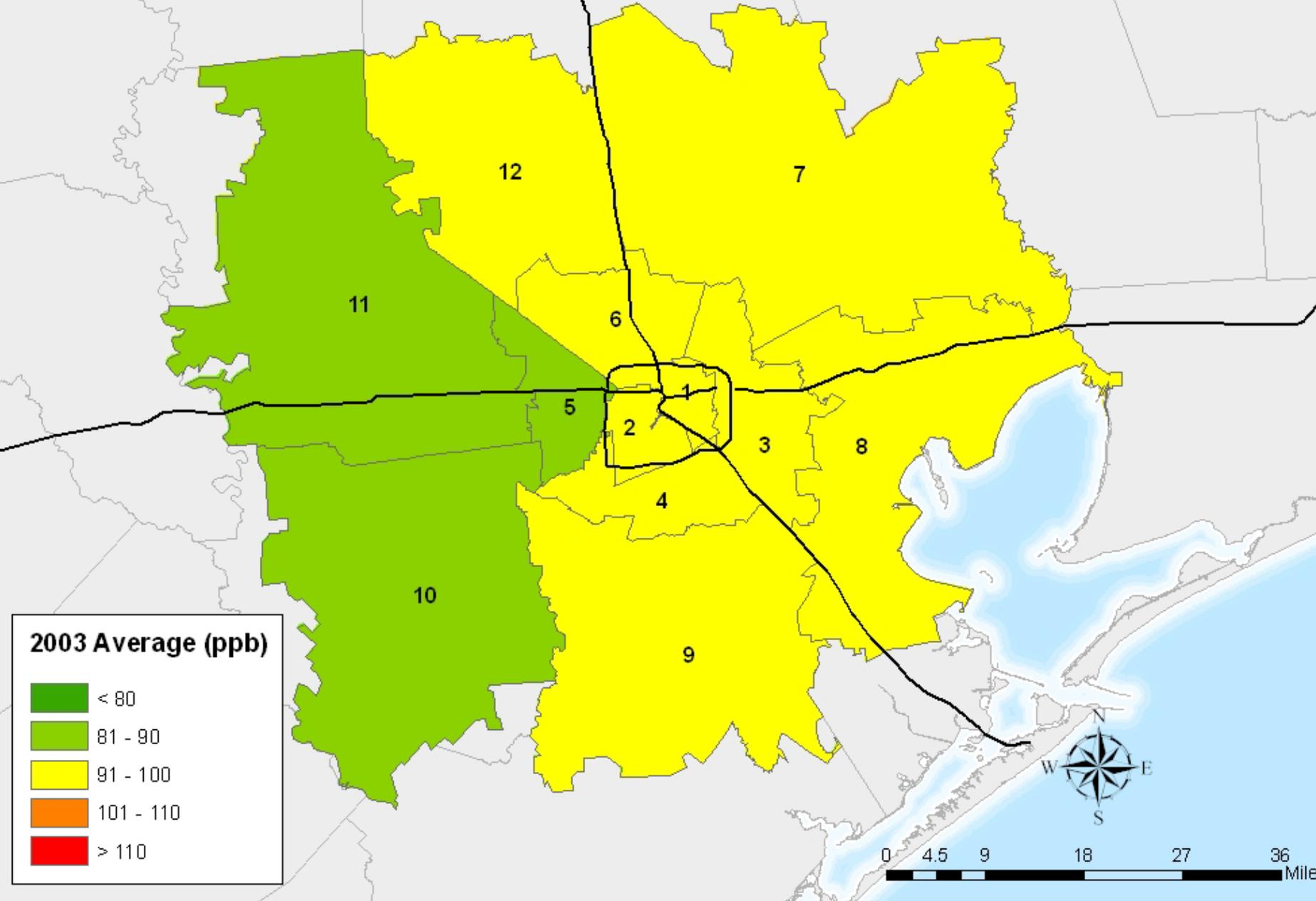
- Acquire datasets
- Join datasets
- Perform Kriging operation
- Zonal statistics
- Final output



# Ozone Indicator

- Select days classified as health risks for one hour standard (e.g.  $O_3 > 120$  ppb)
- Obtain highest value of all monitors on those days (23 days in 2003)
- Produce daily spatial distribution and regional average
- Annual average for bad ozone days
- Color-coded map of spatial regions based on 8 hour and 1 hour standards

# Ozone (ppb): 2003 Average



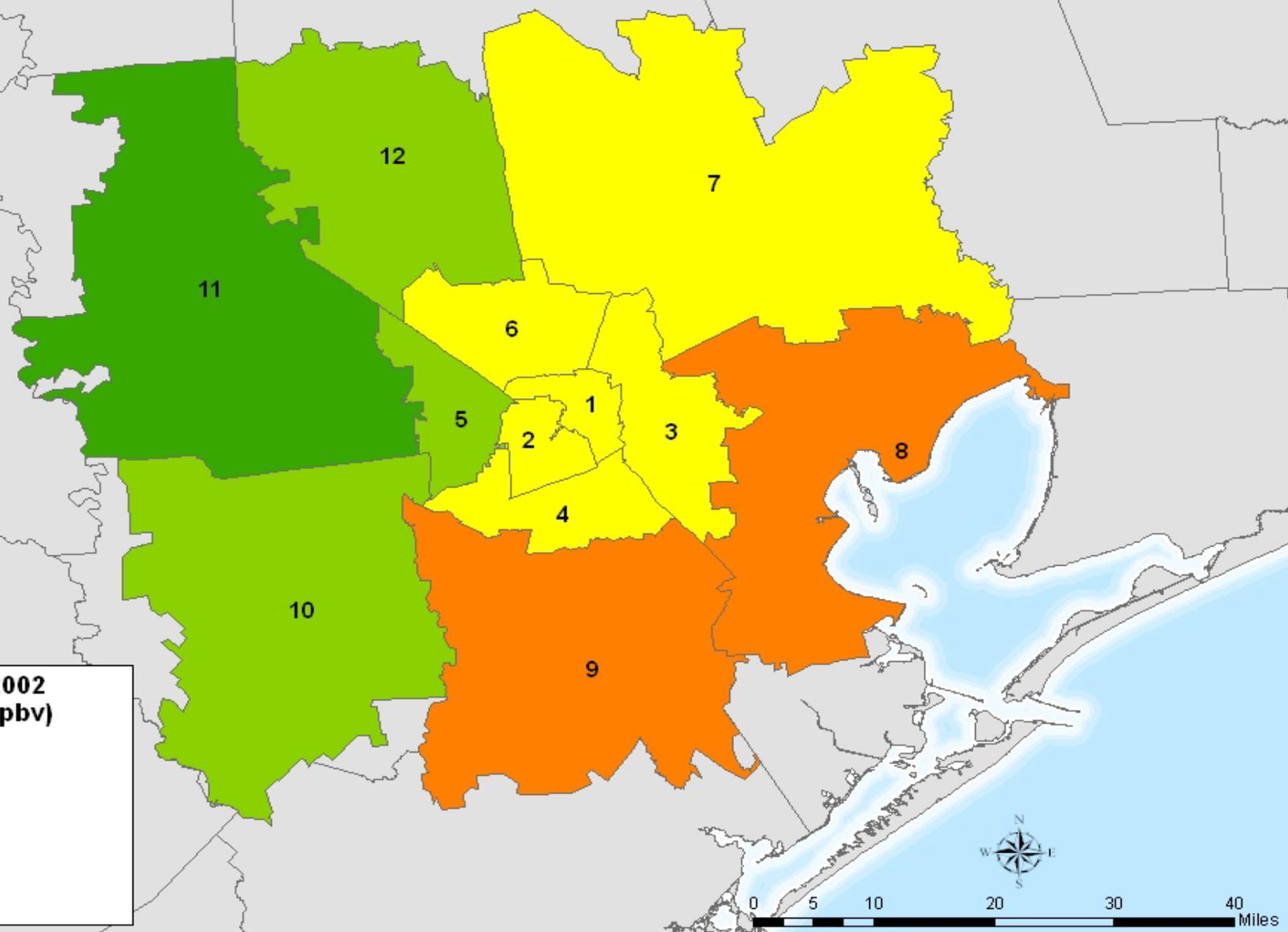
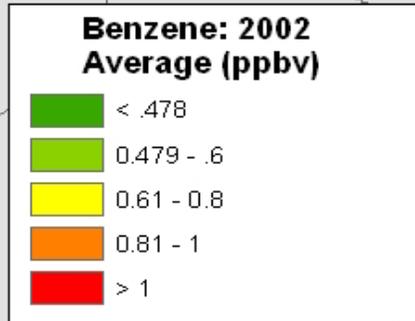
## 2003 Average (ppb)

- < 80
- 81 - 90
- 91 - 100
- 101 - 110
- > 110



# Air Toxics: Annual Average from Weekly Samples

Benzene: 2022 Average



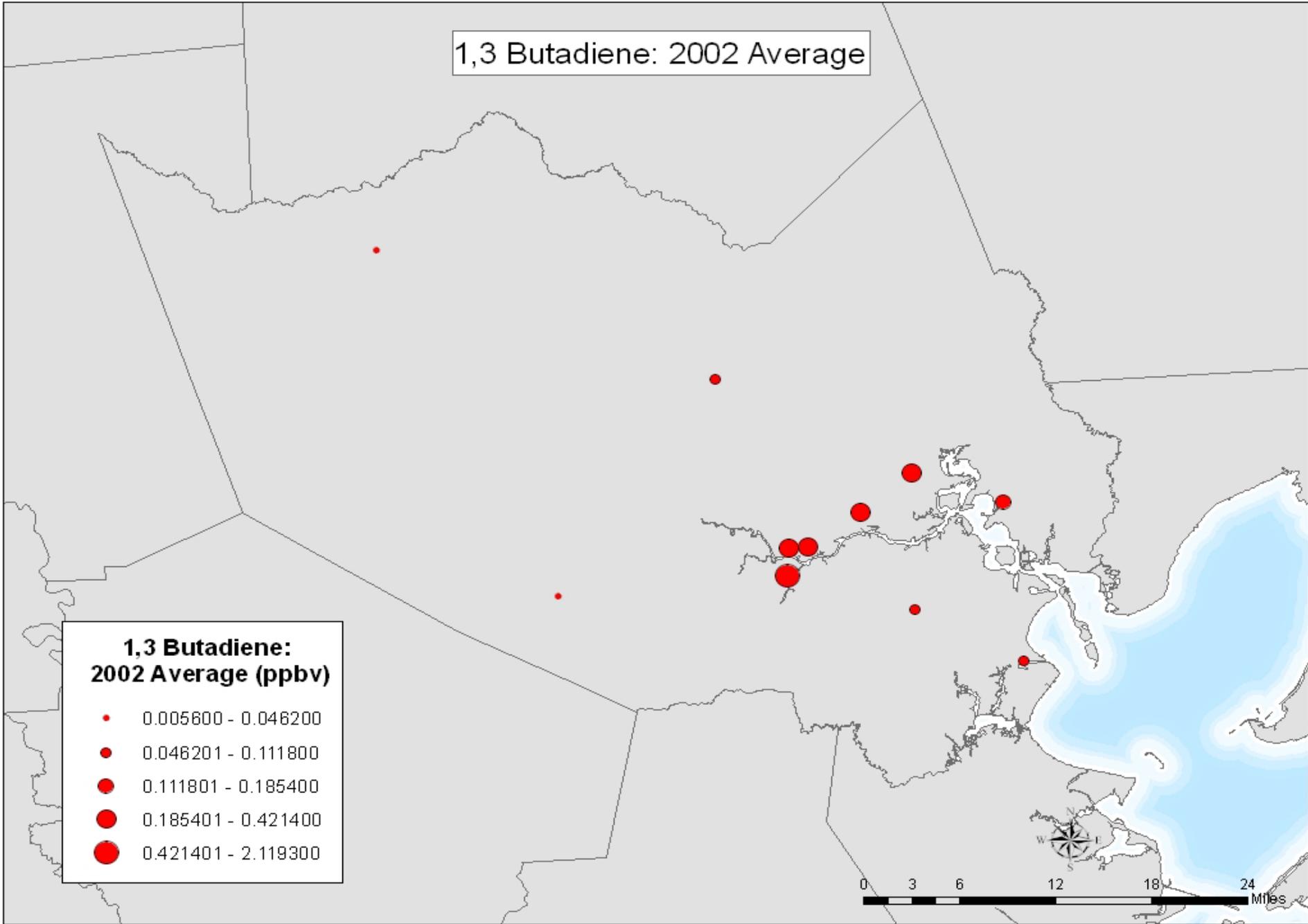
# Air Toxics with Hot Spots

1,3 Butadiene: 2002 Average

**1,3 Butadiene:  
2002 Average (ppbv)**

- 0.005600 - 0.046200
- 0.046201 - 0.111800
- 0.111801 - 0.185400
- 0.185401 - 0.421400
- 0.421401 - 2.119300

0 3 6 12 18 24 Miles



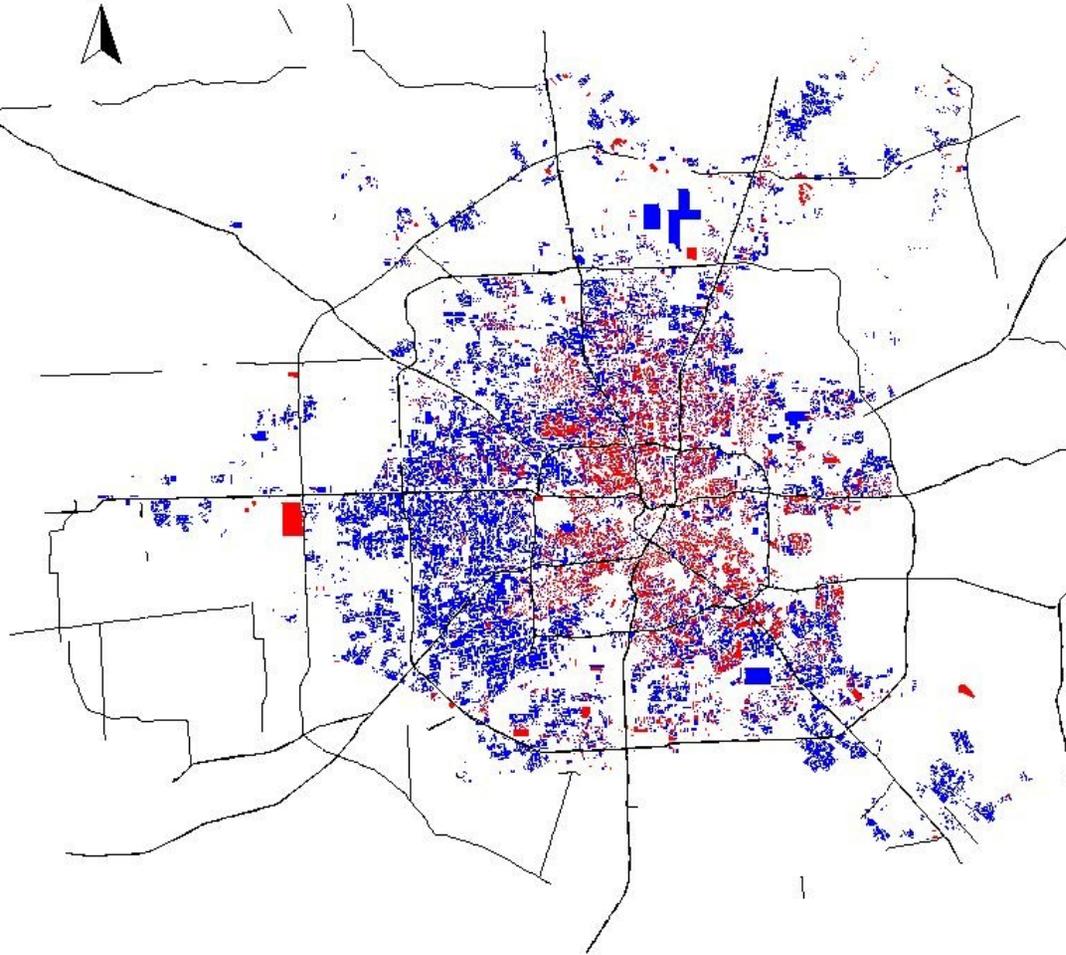
# Indoor Air Quality Hazard

- Behavioral Risk Factor Surveillance System annual survey (500 respondents in Harris Co.)
  - Module 9: Exposure to combustion products and mold
  - Module 10: Potential exposure to pesticides
  - Modules 15 and 16: Potential exposure to cigarette smoke

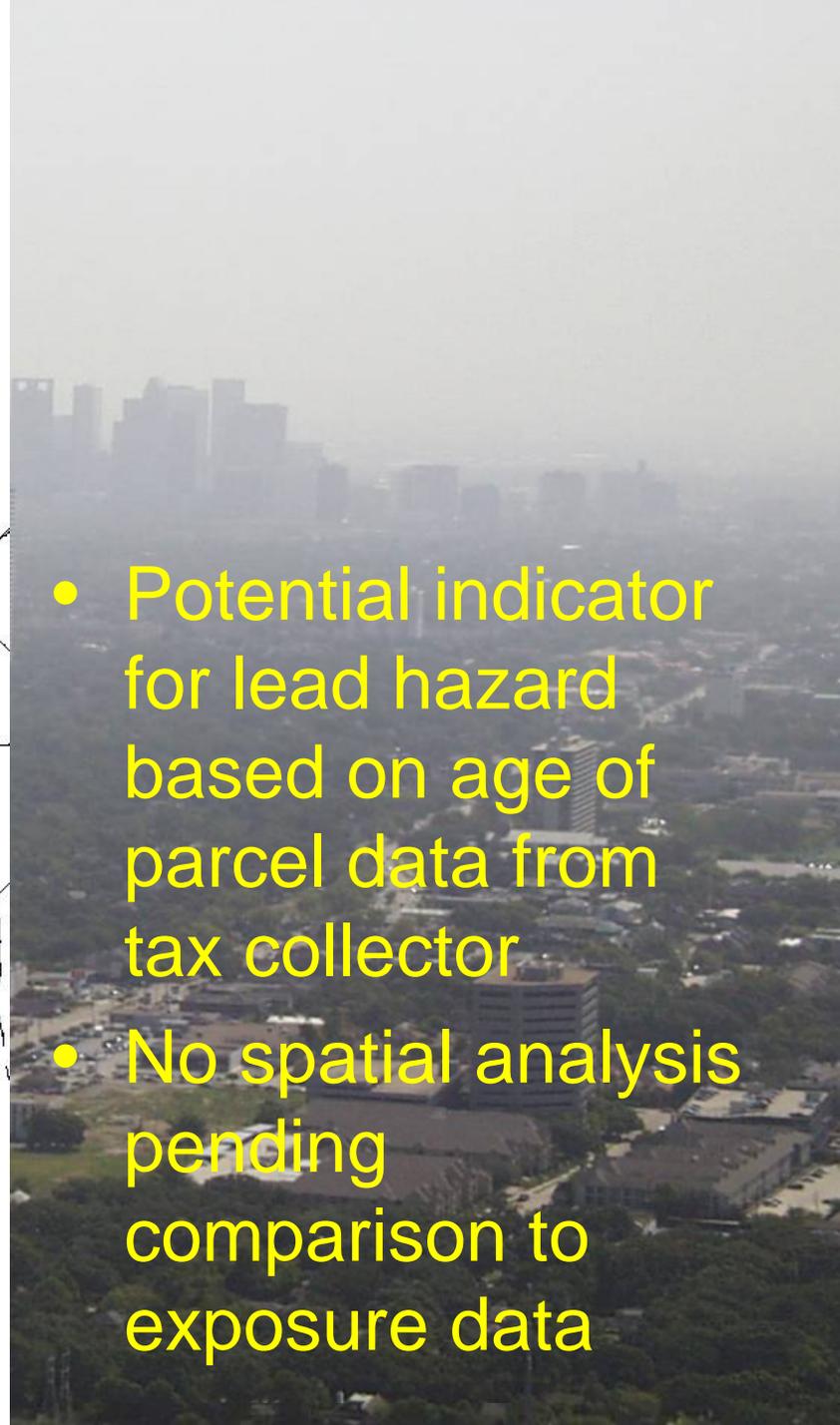
# Lead Hazard Indicators

- Limited data on ambient lead concentrations in soil
- Prevalence of potential sources of lead, e.g. pre-1950 houses (135,000 recorded in Harris County)
- More data on houses than soil, better distribution of information

- Major Corridors
- Parcels Built Before 1950
- Parcels Built Between 1951 and 1978



- Potential indicator for lead hazard based on age of parcel data from tax collector
- No spatial analysis pending comparison to exposure data



# Diagnoses in Hospital Discharge Data Proposed for Environmental Indicator Development

- Bronchitis
- Asthma
- Pulmonary heart disease

# Health Effects Indicators

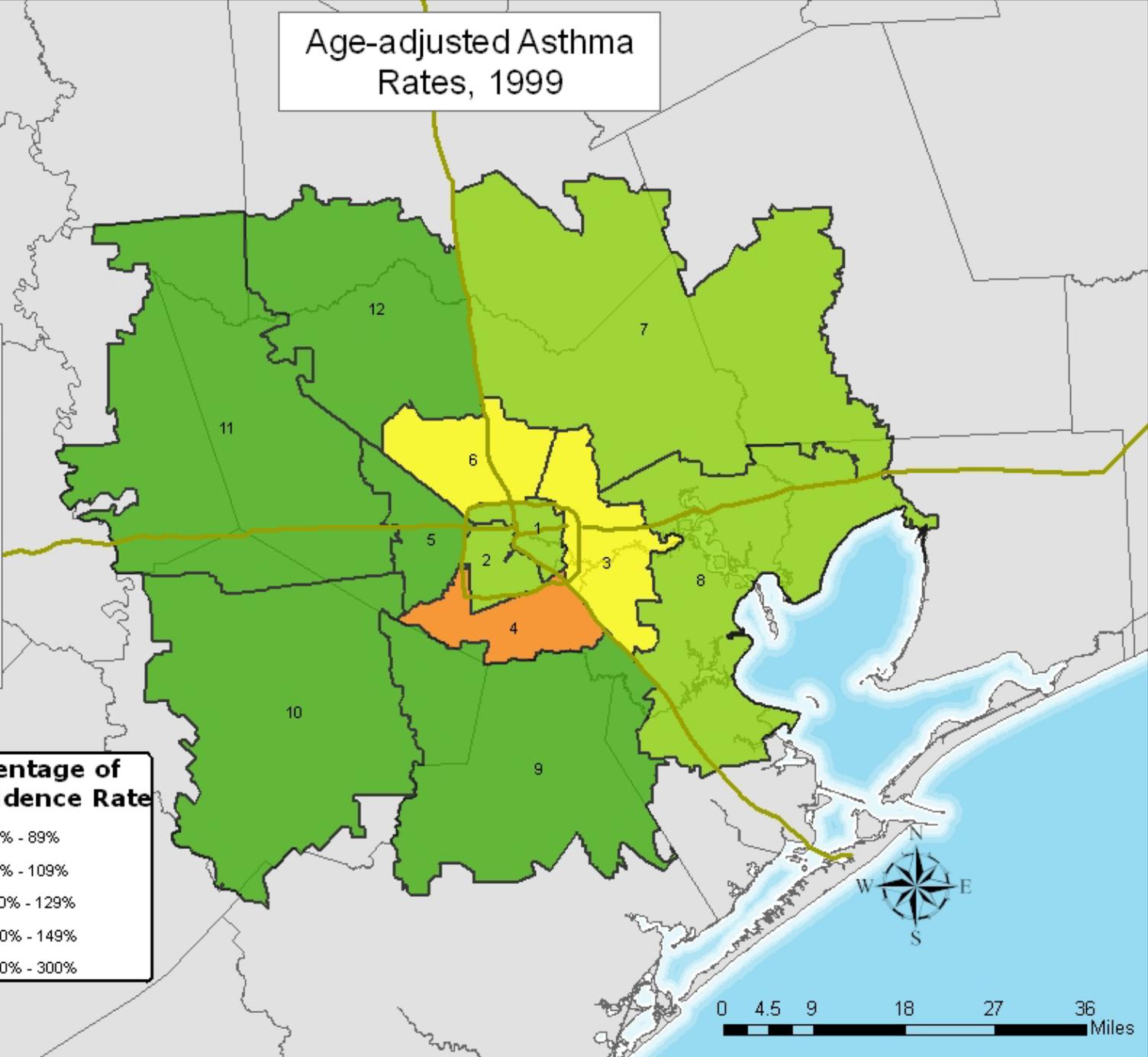
- Obtain cases and population data by zip code
- Compile data by region
- Calculate age adjusted incidence rates by region
- Use percent of state average rate to assess risk

# Age-adjusted Asthma Rates, 1999

Region	Incidence Rate
1	379.7
2	377.8
3	399.5
4	493.6
5	224.4
6	391.2
7	359.1
8	341.1
9	309.5
10	250.5
11	249.8
12	314.5
Avg	340.9
Texas (1999)	358.1
Std. Dev.	73.1

## Legend: Percentage of Texas-wide Incidence Rate

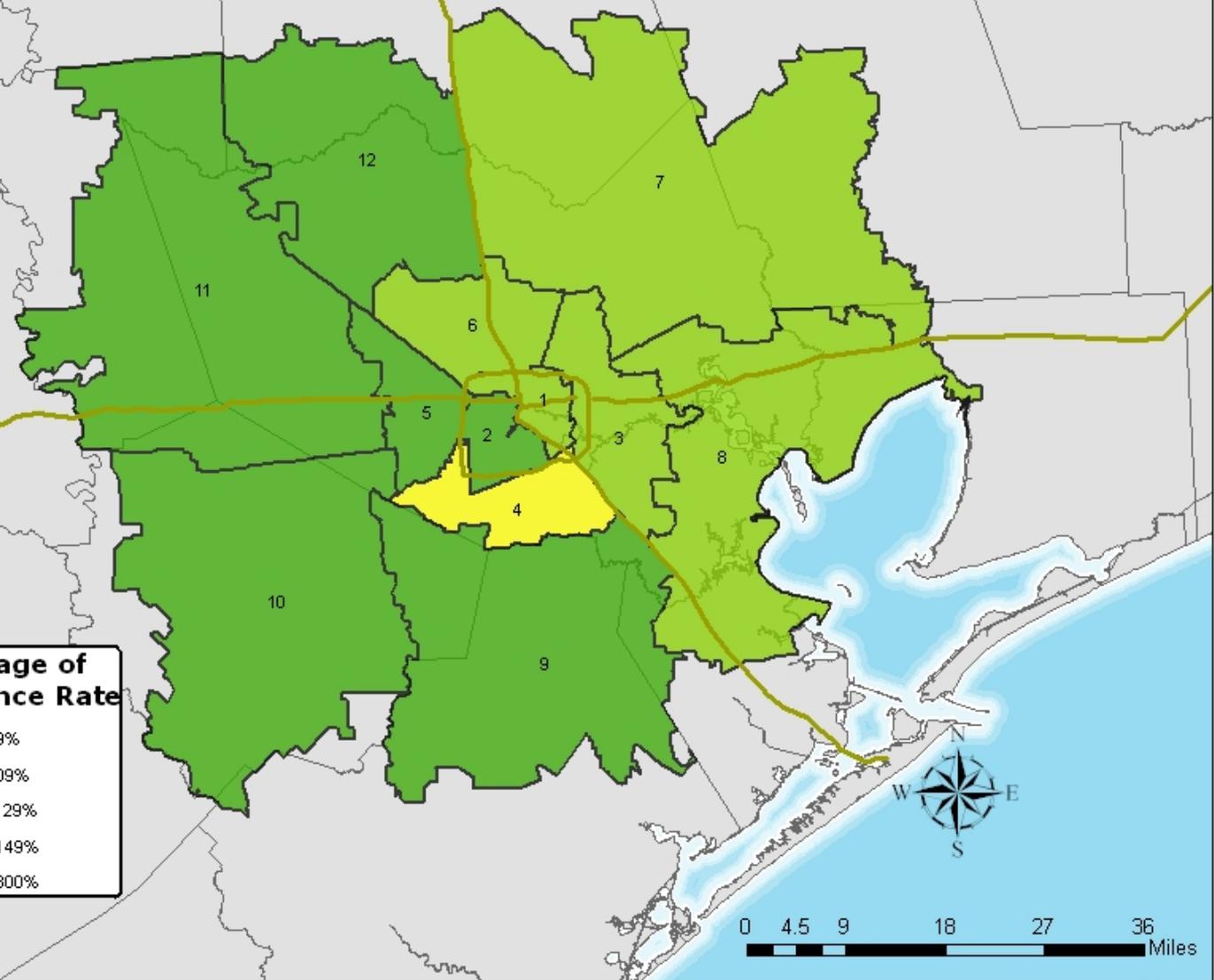
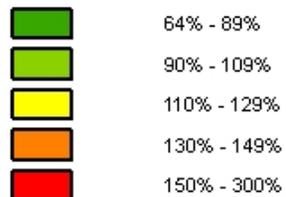
- 63% - 89%
- 90% - 109%
- 110% - 129%
- 130% - 149%
- 150% - 300%



# Age-adjusted Asthma Rates, 2002

Region	Incidence Rate
1	438.1
2	413.5
3	475.4
4	582.8
5	306.1
6	456.9
7	489.6
8	455.2
9	409.3
10	327.0
11	363.7
12	405.8
Avg	427.0
Texas (2002)	477.7
Std. Dev.	71.8

## Legend: Percentage of Texas-wide Incidence Rate

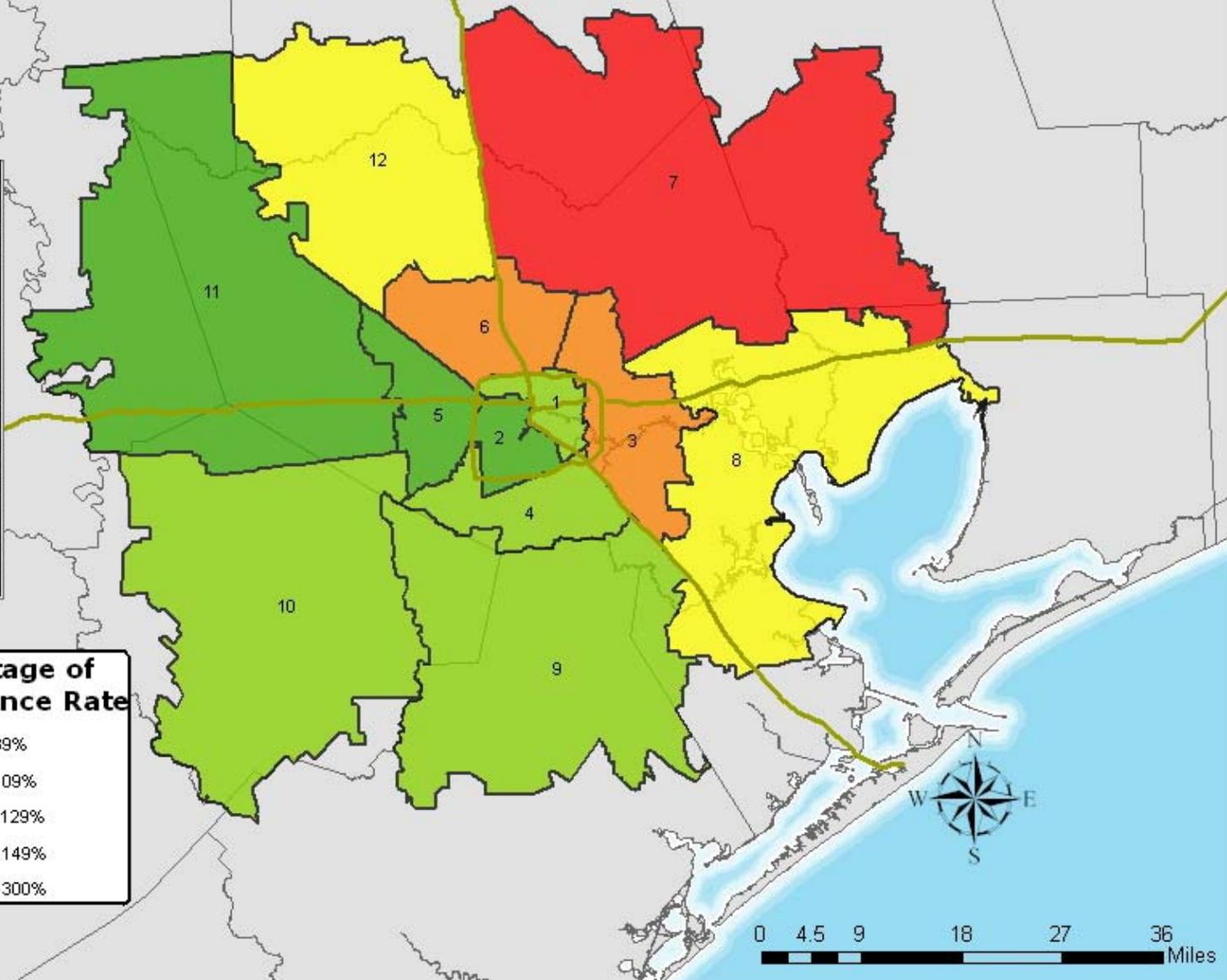


# Age-adjusted Bronchitis Rates, 1999

Region	Incidence Rate
1	402.5
2	287.0
3	591.3
4	371.1
5	228.9
6	601.1
7	794.8
8	511.3
9	429.5
10	404.9
11	293.0
12	513.6
Avg	452.4
Texas (2002)	405.5
Std. Dev.	152.9

## Legend: Percentage of Texas-wide Incidence Rate

	56% - 89%
	90% - 109%
	110% - 129%
	130% - 149%
	150% - 300%



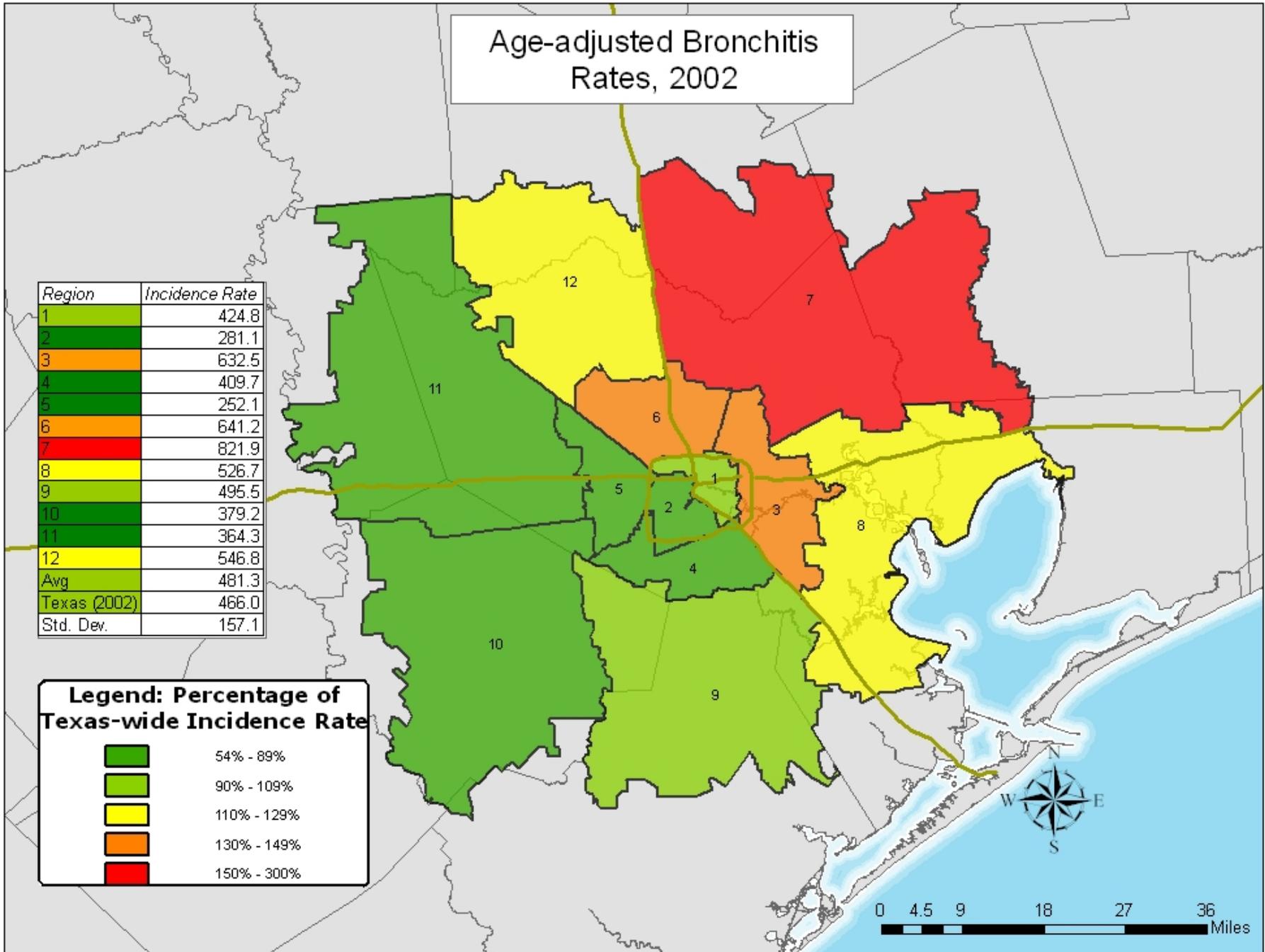
# Age-adjusted Bronchitis Rates, 2002

Region	Incidence Rate
1	424.8
2	281.1
3	632.5
4	409.7
5	252.1
6	641.2
7	821.9
8	526.7
9	495.5
10	379.2
11	364.3
12	546.8
Avg	481.3
Texas (2002)	466.0
Std. Dev.	157.1

## Legend: Percentage of Texas-wide Incidence Rate

	54% - 89%
	90% - 109%
	110% - 129%
	130% - 149%
	150% - 300%

0 4.5 9 18 27 36 Miles

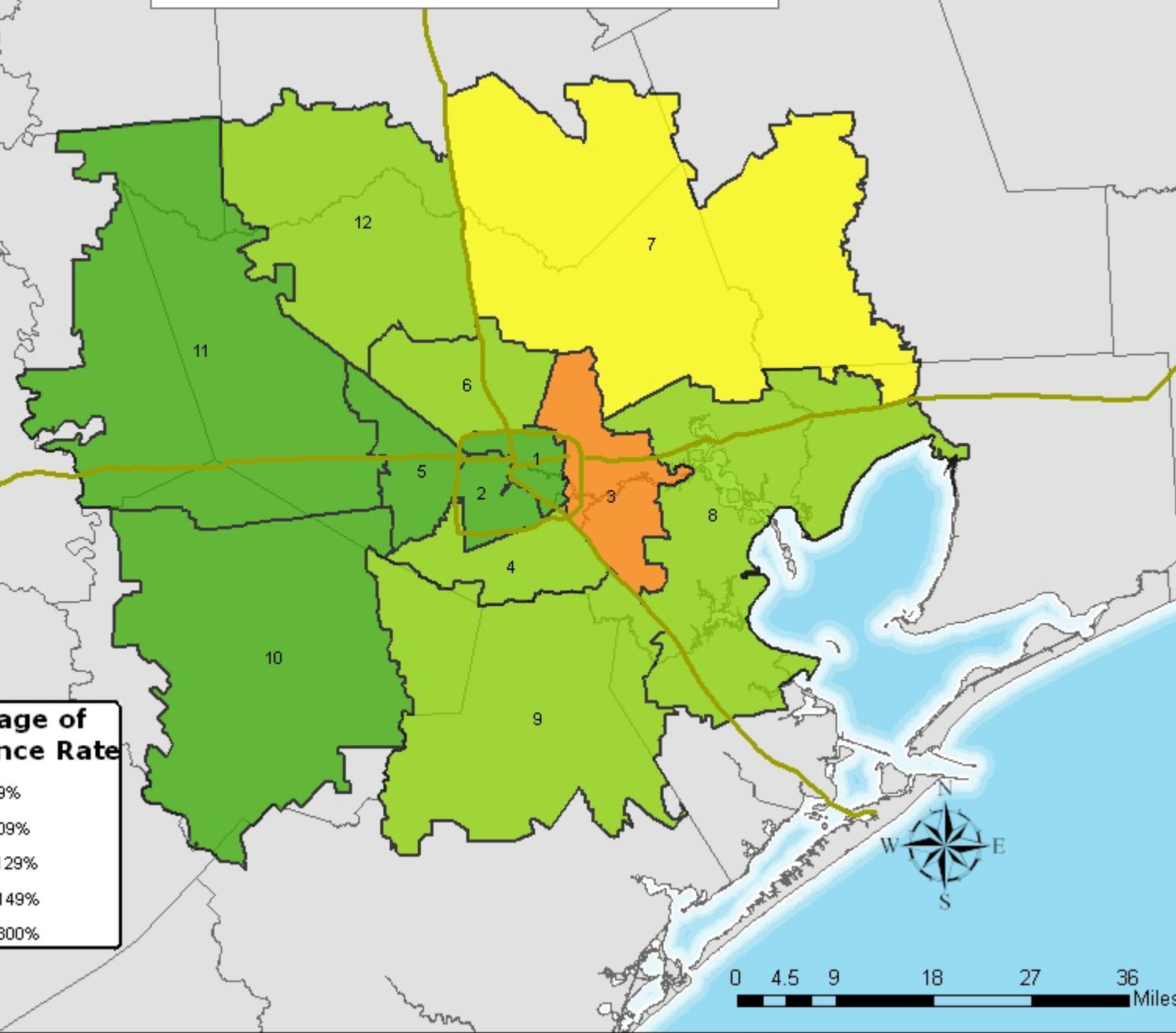


# Age-adjusted Pulmonary Heart Disease Rates, 1999

Region	Incidence Rate
1	107.1
2	112.1
3	190.9
4	137.2
5	84.9
6	145.4
7	169.4
8	135.0
9	134.2
10	72.2
11	114.4
12	132.8
Avg	128.0
Texas (1999)	133.7
Std. Dev.	31.6

**Legend: Percentage of Texas-wide Incidence Rate**

	54% - 89%
	90% - 109%
	110% - 129%
	130% - 149%
	150% - 300%



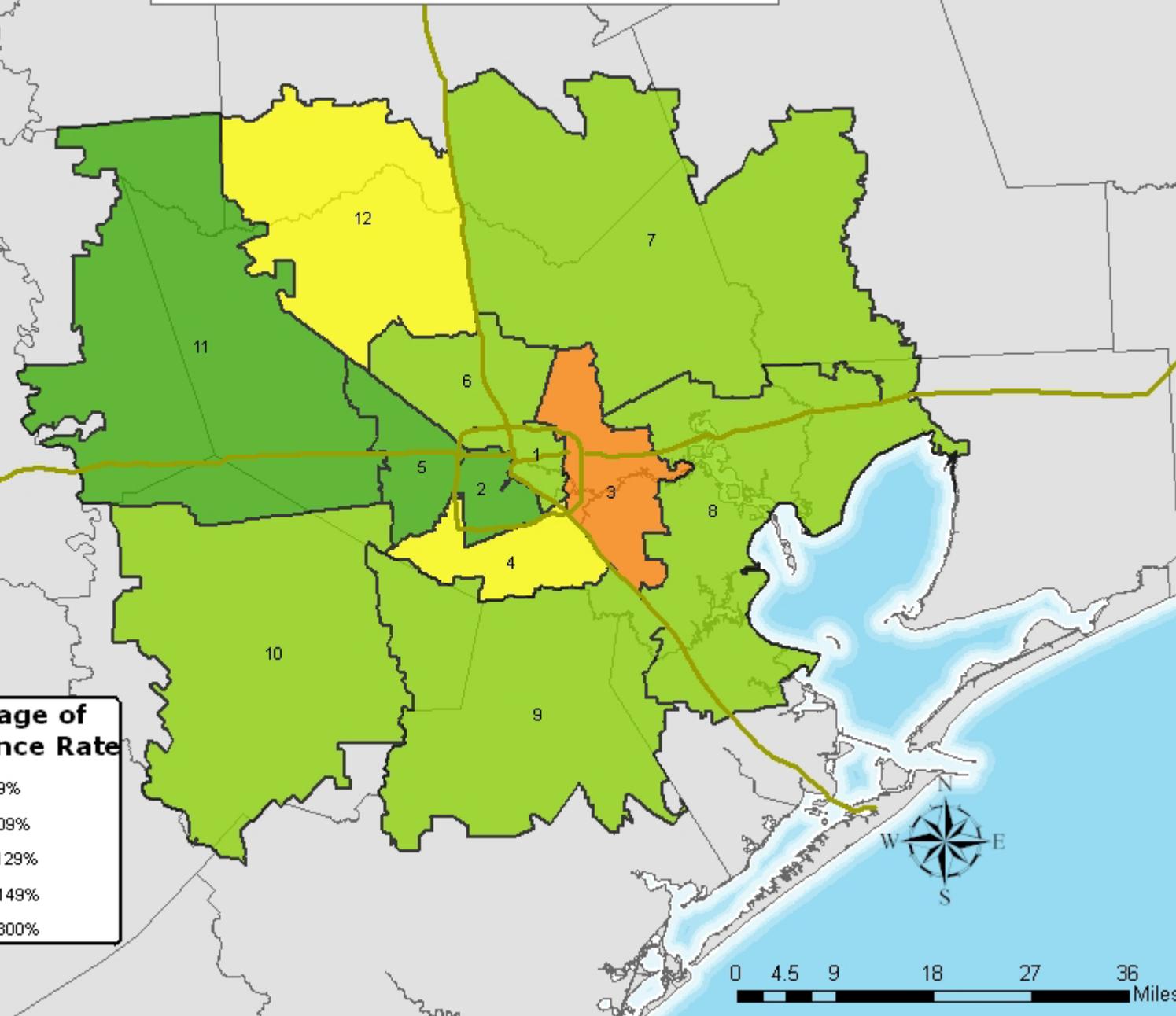
0 4.5 9 18 27 36 Miles

# Age-adjusted Pulmonary Heart Disease Rates, 2002

Region	Incidence Rate
1	164.1
2	140.7
3	214.1
4	179.8
5	99.7
6	159.7
7	162.4
8	157.1
9	164.5
10	155.4
11	132.0
12	174.1
Avg	158.6
Texas (2002)	159.4
Std. Dev.	26.4

**Legend: Percentage of Texas-wide Incidence Rate**

- 63% - 89%
- 90% - 109%
- 110% - 129%
- 130% - 149%
- 150% - 300%



# Diagnoses in Texas Cancer Registry Proposed for EPH Indicator Development

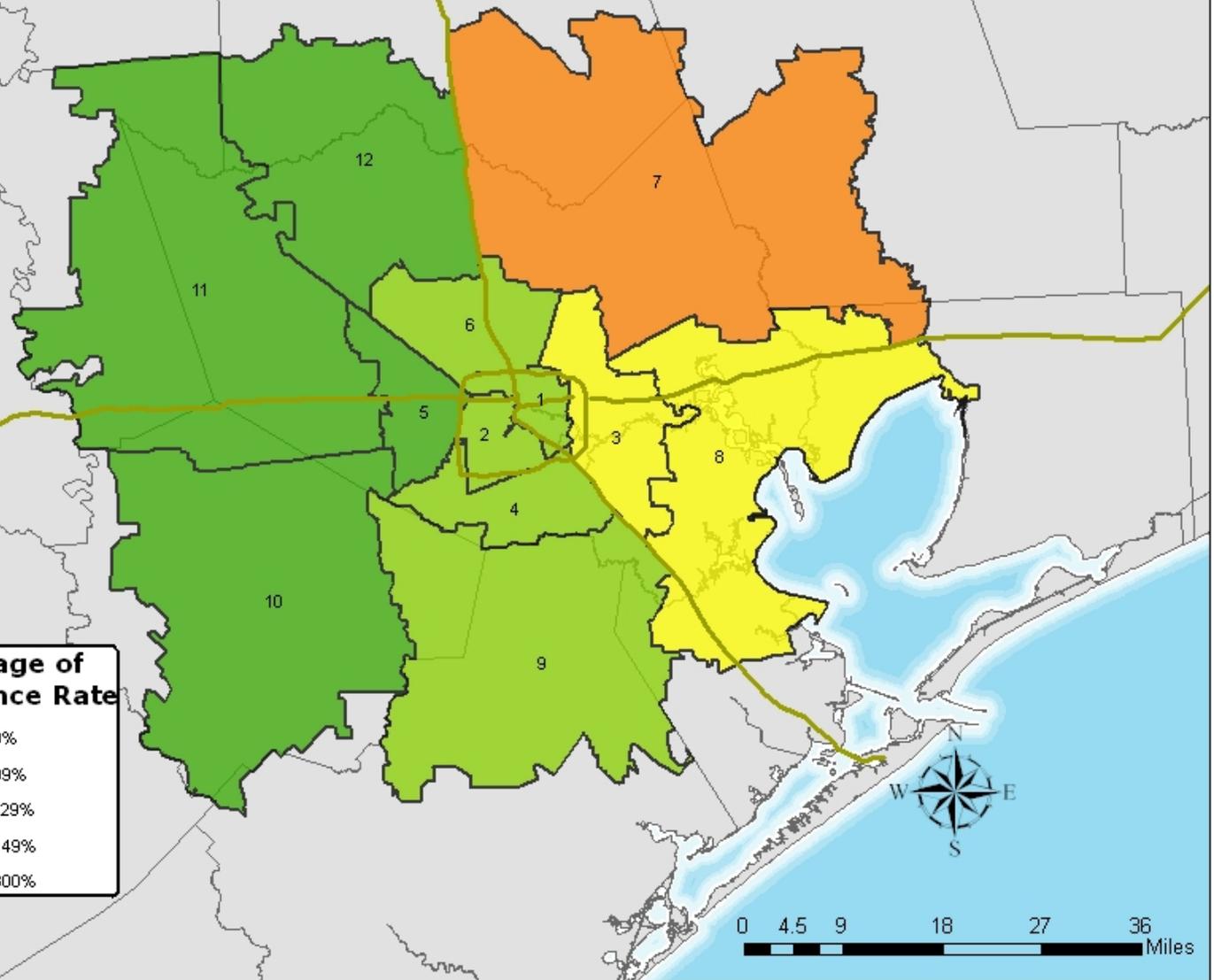
- Cancer of the lung and bronchus
- Cancer of the bladder
- Non-Hodgkin's lymphoma (nodal)
- Leukemia

# Age-adjusted Lung Cancer Rates, 1999 - 2001 Average

Region	Incidence Rate
1	61.9
2	68.5
3	79.3
4	65.0
5	55.1
6	66.7
7	89.5
8	76.7
9	70.7
10	55.7
11	56.1
12	59.0
Avg	67.0
Texas (2000)	66.6
Std. Dev.	10.2

**Legend: Percentage of Texas-wide Incidence Rate**

- 83% - 89%
- 90% - 109%
- 110% - 129%
- 130% - 149%
- 150% - 300%

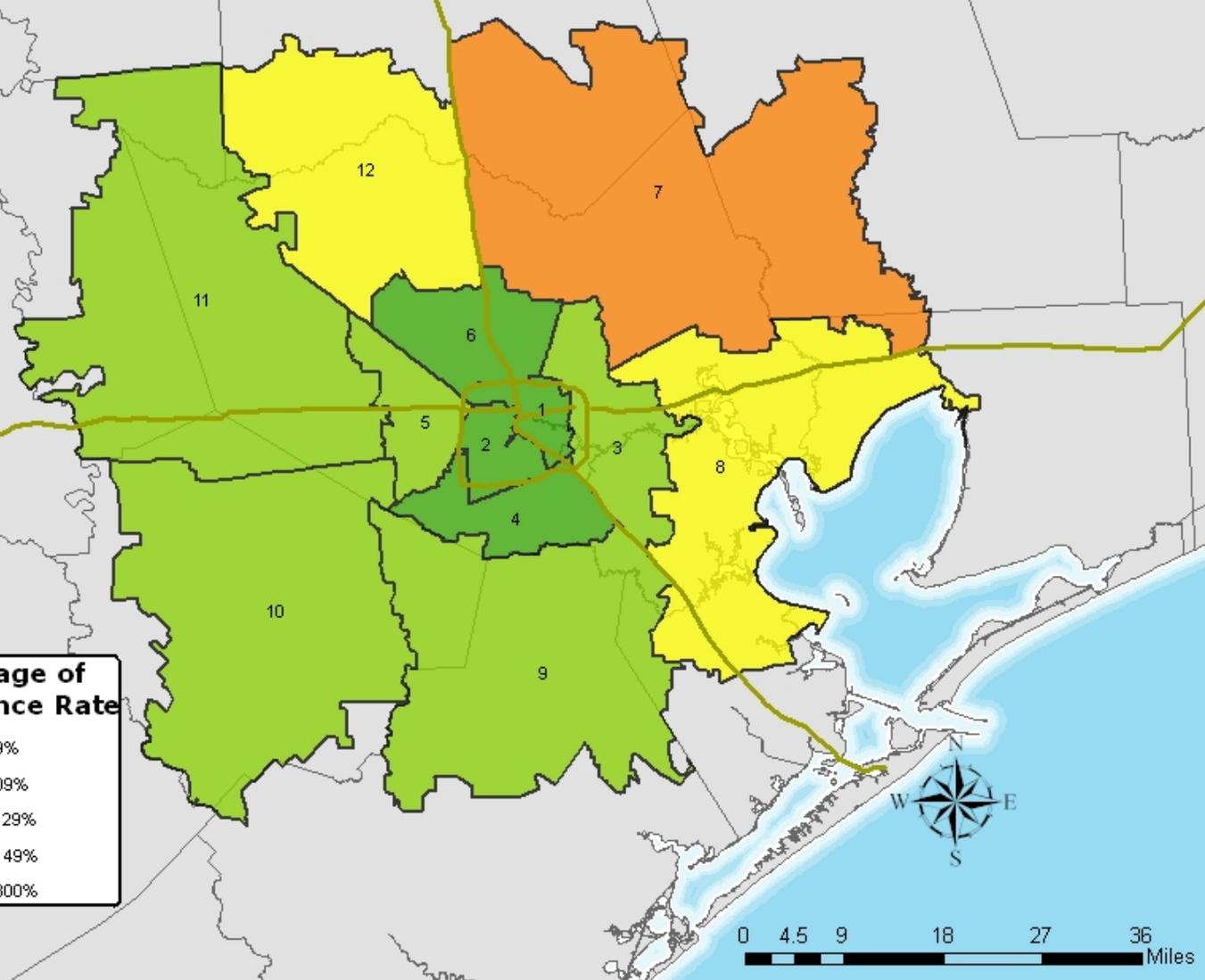


## Age-adjusted Bladder Cancer Rates, 1999 - 2001 Average

Region	Incidence Rate
1	11.9
2	13.9
3	15.4
4	13.8
5	16.2
6	11.4
7	23.3
8	18.7
9	14.6
10	16.8
11	16.0
12	20.5
Avg	16.0
Texas (2000)	16.0
Std. Dev.	3.3

### Legend: Percentage of Texas-wide Incidence Rate

	71% - 89%
	90% - 109%
	110% - 129%
	130% - 149%
	150% - 300%

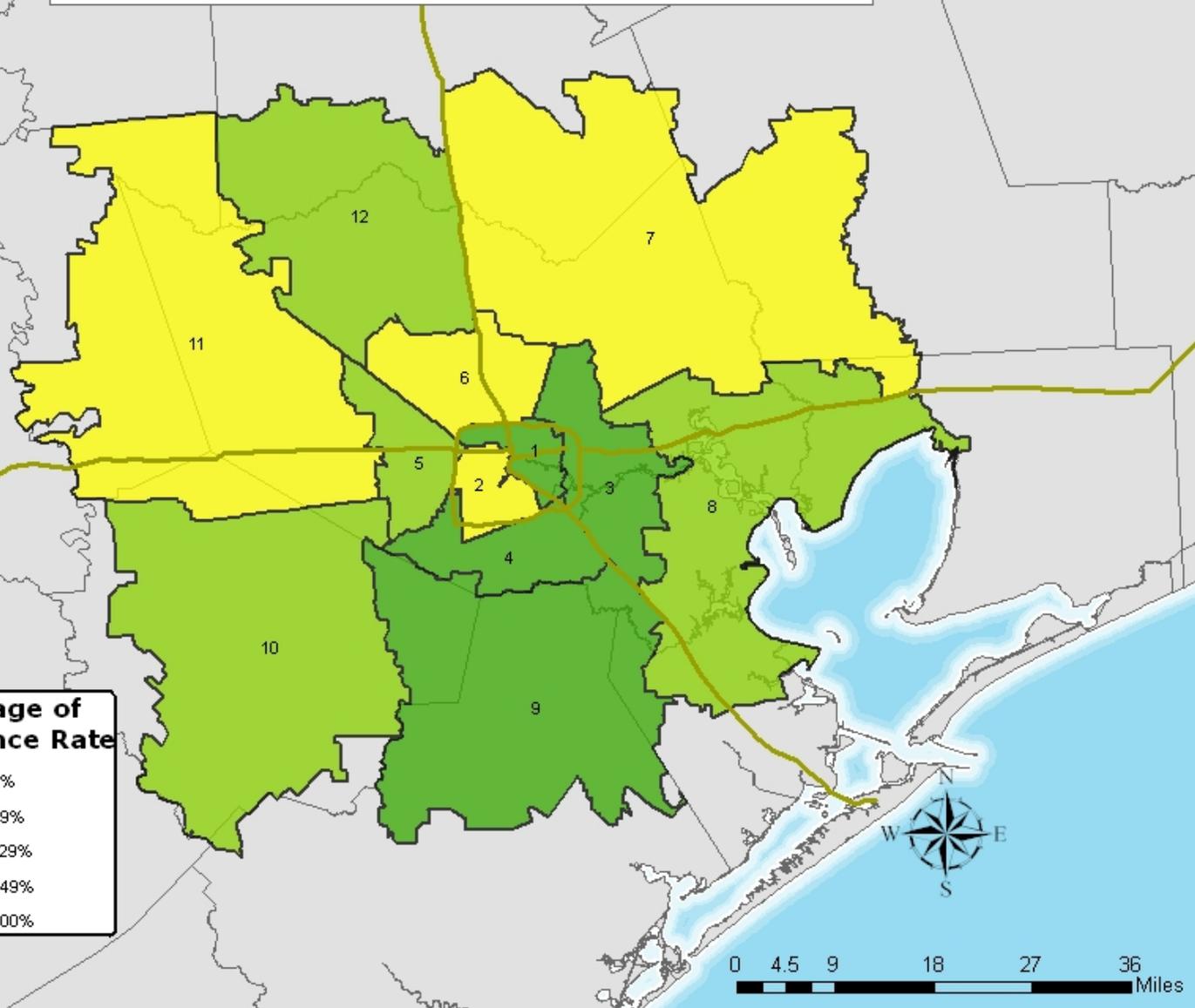


## Age-adjusted Non-Hodgkin's Lymphoma - Nodal Cancer Rates, 1999 - 2001 Average

Region	Incidence Rate
	7.4
2	12.9
3	9.0
4	9.6
5	11.4
6	12.6
7	12.7
8	10.9
9	8.2
10	11.6
11	12.9
12	11.9
Avg	10.9
Texas (2000)	11.3
Std. Dev.	1.8

### Legend: Percentage of Texas-wide Incidence Rate

	65% - 89%
	90% - 109%
	110% - 129%
	130% - 149%
	150% - 300%

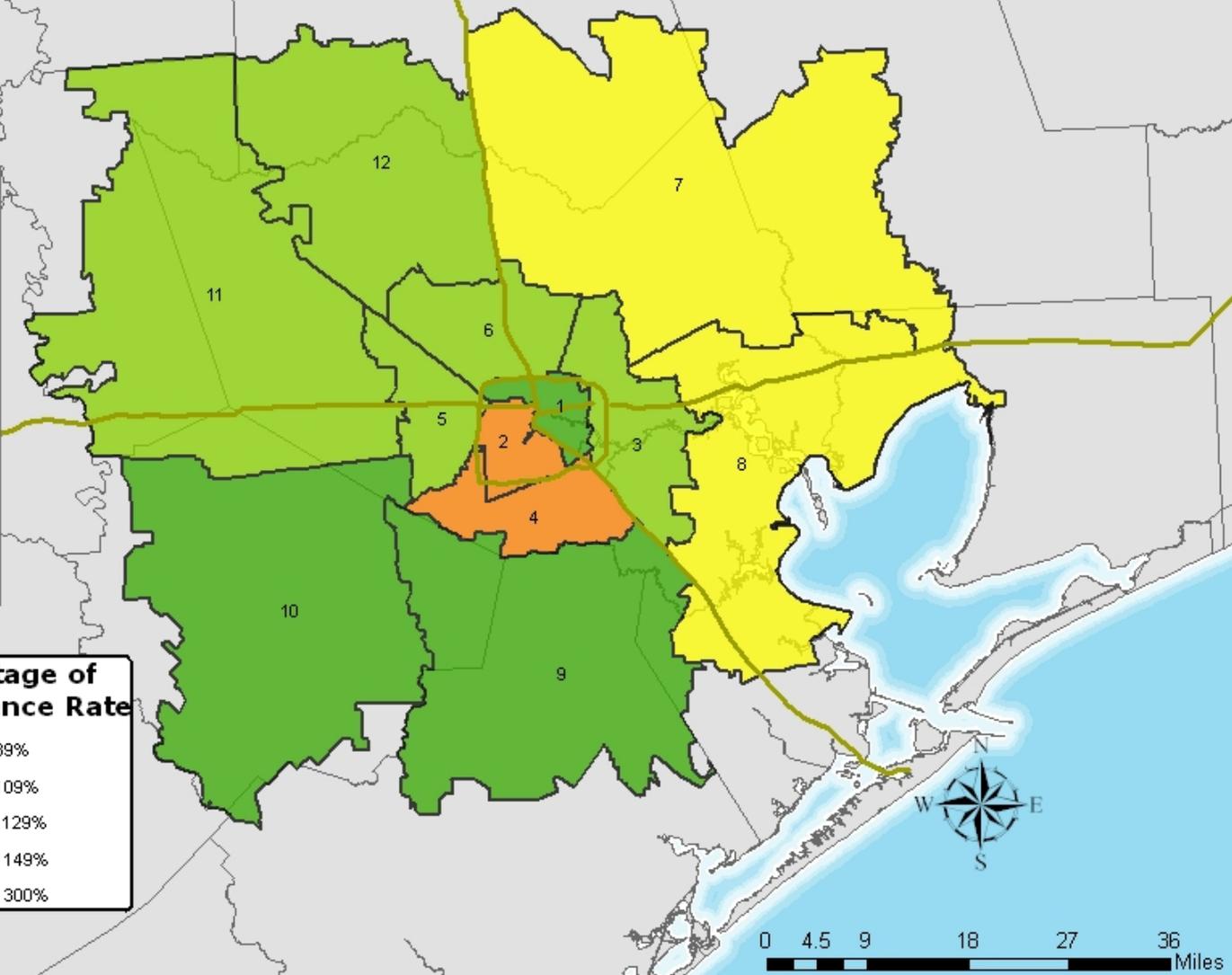


## Age-adjusted Leukemia Cancer Rates, 1999 - 2001 Average

Region	Incidence Rate
1	9.2
2	15.8
3	10.2
4	15.0
5	12.2
6	10.7
7	12.7
8	12.6
9	7.7
10	6.5
11	10.8
12	11.8
Avg	11.3
Texas (2000)	11.4
Std. Dev.	2.6

### Legend: Percentage of Texas-wide Incidence Rate

	57% - 89%
	90% - 109%
	110% - 129%
	130% - 149%
	150% - 300%



0 4.5 9 18 27 36  
Miles

# Conclusions

- Data are biased and incomplete
  - Monitors concentrated around industry
  - Social groups differ in mobility and use of health institutions
- Serious shortage of exposure data
- Significant spatial variation in risk from hazards and some diseases
- EPH indicators could help policy makers

An aerial photograph of Houston, Texas, showing a dense urban landscape with numerous skyscrapers and residential buildings. The sky is hazy, and the foreground shows a mix of greenery and built-up areas. The text is overlaid in a bright yellow color.

# Houston EPH Indicators: A Work in Progress

Your attention is appreciated and  
your advice is welcome