# Modeling Tuberculosis Dissemination in Harris County, Texas, 1995-1998, with Spatial Analysis and Geographic Information Systems (GIS)

Matthew L. Stone, MPH
The Center for Health Policy Studies
The University of Texas School of Public Health
Houston, Texas; Email: mstone@sph.uth.tmc.edu

Edward A. Graviss, Ph.D., MPH

Houston Tuberculosis Initiative

Email: egraviss@bcm.tmc.edu

2002 International Conference on Emerging Infectious Diseases

UT★HOUSTON
SCHOOL *of* PUBLIC
HEALTH

COLLEGE OF MEDICINE · BAYLOR · RESEARCH · EDUCATION · SERVICE
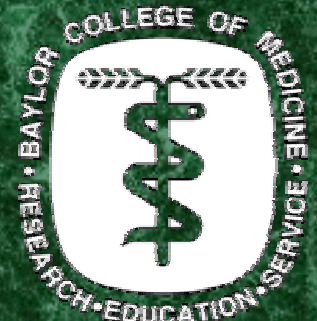
TB Incidence in Texas and Harris County

- **Steady decrease in incidence rates during 1995-1998 in Texas.**

    - **From 12.7 cases/100,000 to 9.2 cases/100,000**
        - **High compared to the national rate**

    - **Majority of prevalence among 25-44 age group**

        - **Hispanics (47.5%)**
        - **African-Americans (24.3%)**
        - **Whites (18.5%)**

- **In Harris County, Texas incidence decreased from 25.6/100,000 in 1995 to 14.4 cases/100,000 in 1998.**

Factors associated with TB clustering in Harris County, Texas

- **Increased Risk**

  - Birth in U.S.
  - Homelessness
  - Pulmonary disease
  - HIV+
  - 5+ persons in household
  - Use of public transportation

- **Decreased Risk**

  - Asian ethnicity
  - As age increases, odds decrease

Data from Final Multivariate Model (de Bruyn et al., 2001)

Purpose of GIS and Spatial Analysis

- **Visualization**
- **Exploratory analysis**
- **Hypothesis generation**
- **Model-building**
- **Promote active case finding among high-risk populations**
- **Database management to incorporate attribute data**
- **Capability to link together health information from a variety of data sources**
- **Suggest where cost-effective public health interventions should take place**

Overall Research Objectives

- **Describe the spatial distribution of TB cases in Harris County, Texas from October 1995 through September 1998.**

- **Describe and assess the statistical significance of the spatial intensity patterns of TB cases in Harris County, Texas from October 1995 through September 1998.**

- **Show and determine the statistical significance of the areas where low or high incidence rate areas occur based on 2000 U.S. Census data.**

- **Describe and determine the spatial distribution and apparent clustering of TB cases of the same genetic type in reference to a specific mode of public transportation.**
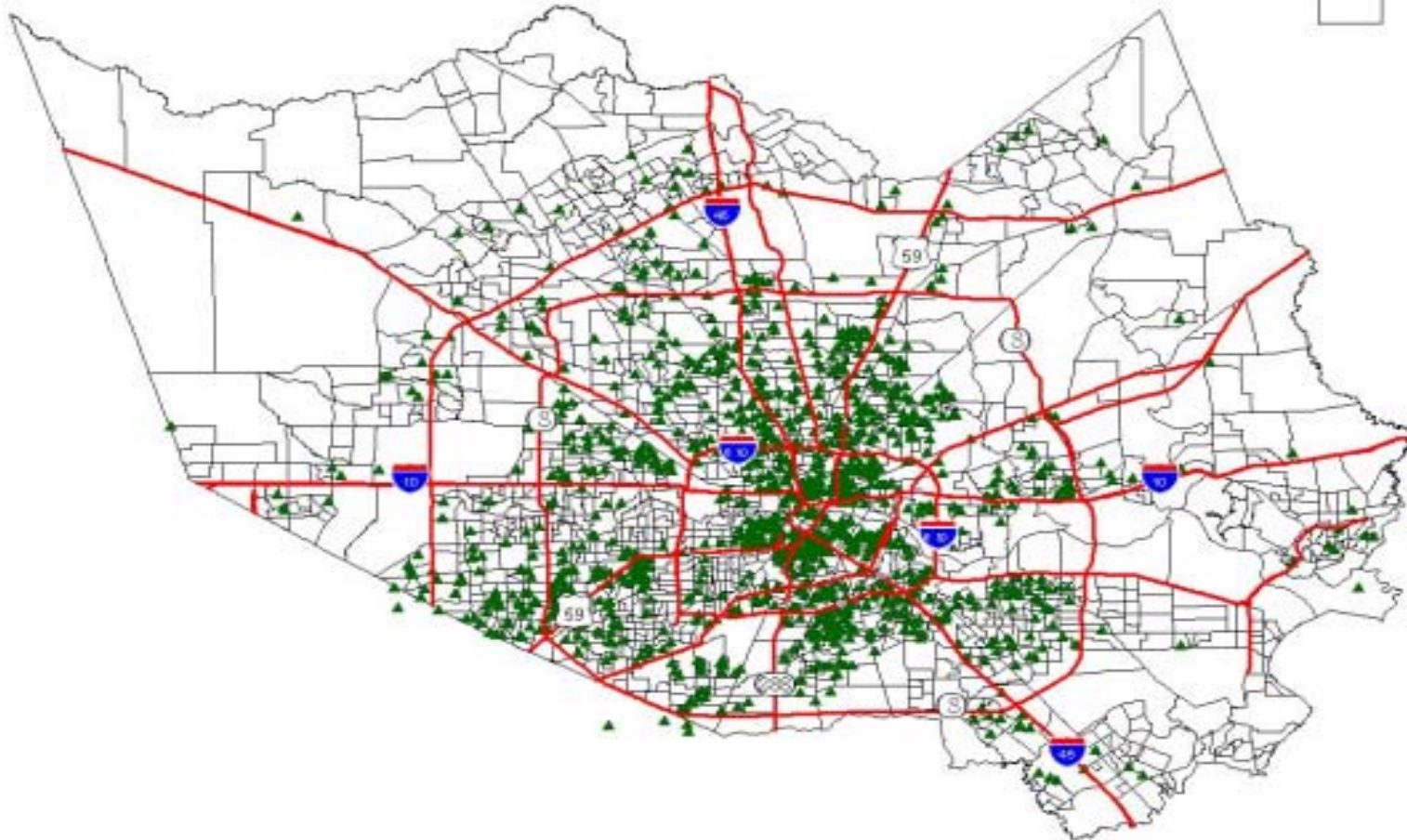
Methodology

Spatial Analytical Methods

- **Kernel Estimation**
- **Nearest Neighbor Distances**
- **Spatial Filtering Method**
- **Space-Time Scan Statistic**
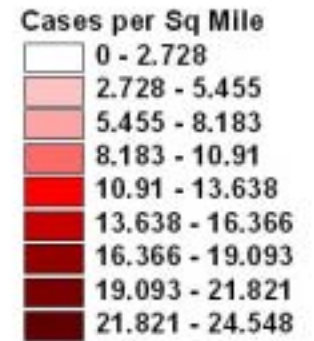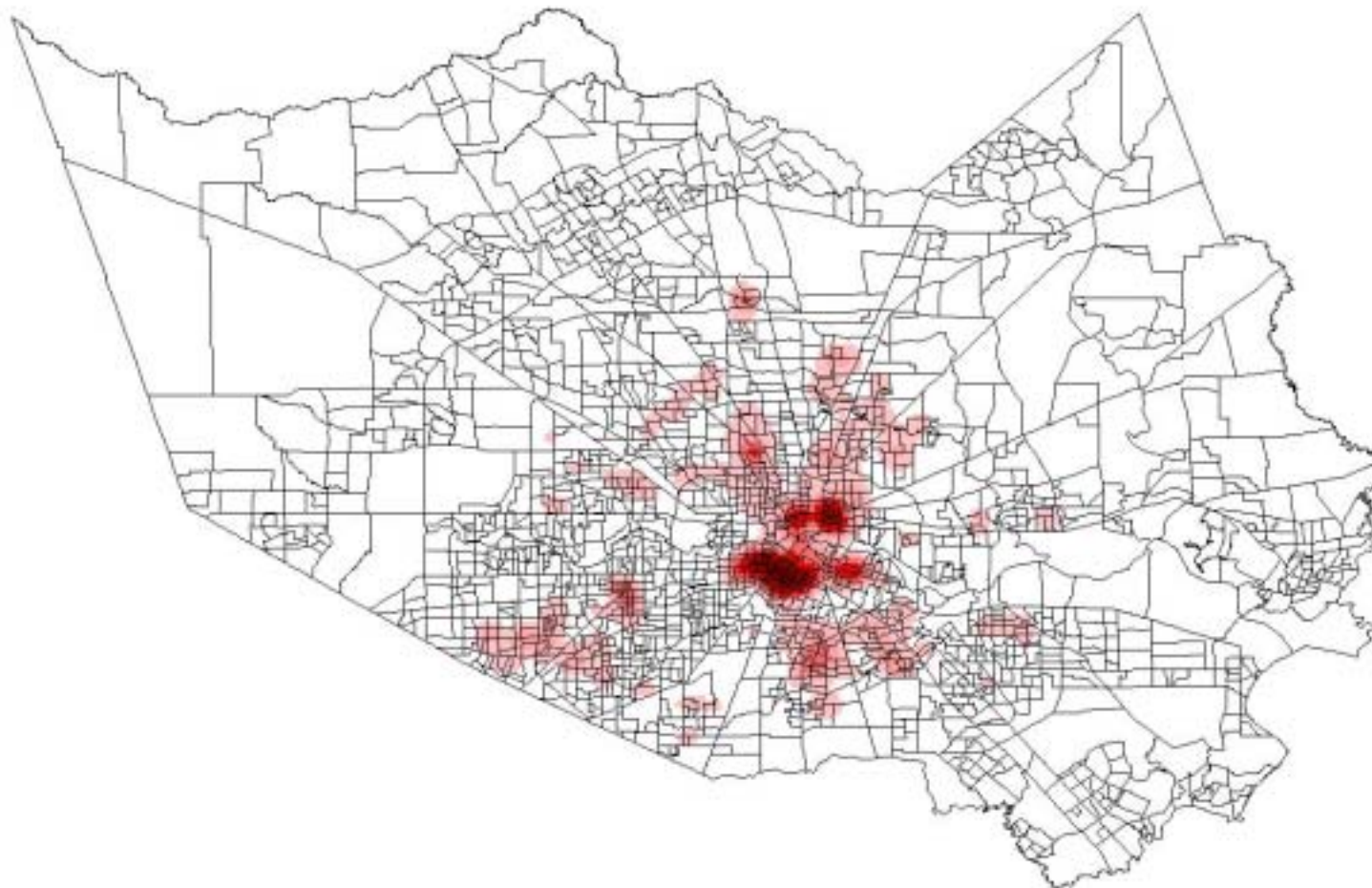
Distribution of TB Cases in Harris County, 1995-1998
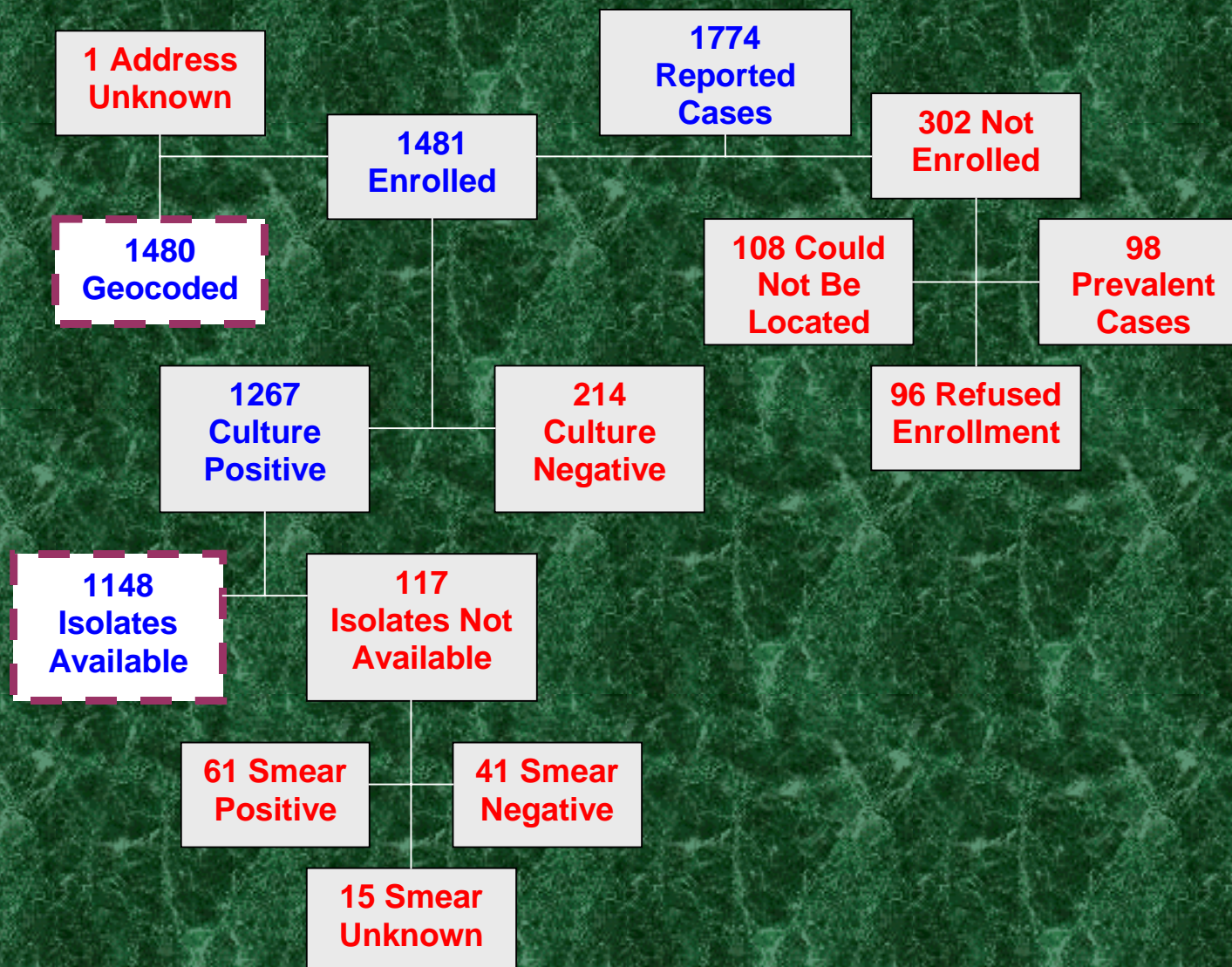
All TB Cases in Harris County, Texas
1995-1998 (N=1480)
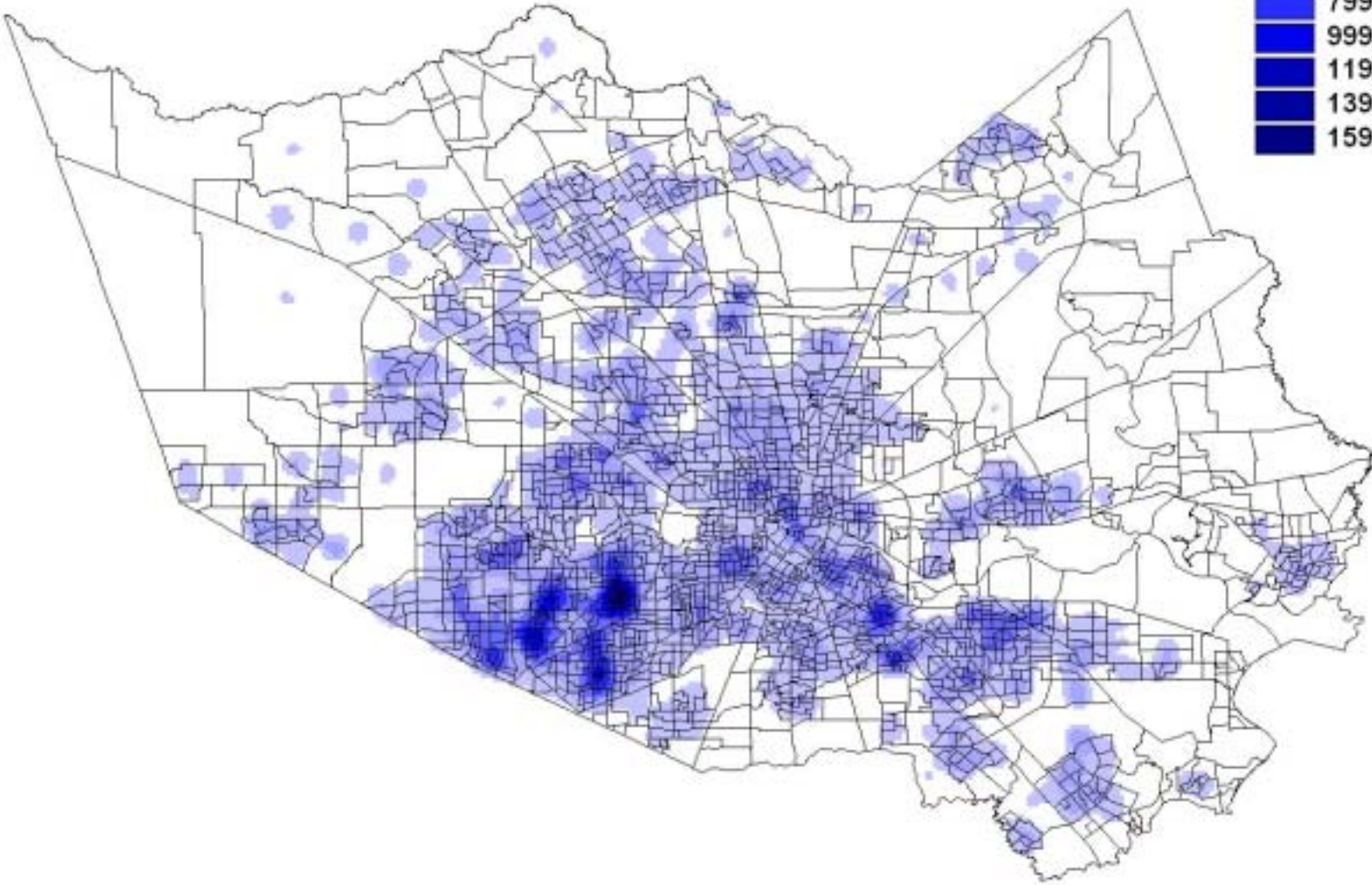
▲ TB Case

☐ 2000 U.S. Census Block Groups

20   0   20   40 Miles

Density of All TB Cases, Harris County Texas, 1995-1998

Cases per Sq Mile

- 0 - 2.728
- 2.728 - 5.455
- 5.455 - 8.183
- 8.183 - 10.91
- 10.91 - 13.638
- 13.638 - 16.366
- 16.366 - 19.093
- 19.093 - 21.821
- 21.821 - 24.548

20   0   20   40   Miles

Density of 2000 U.S. Census Block Group Population

Persons per Sq Mile

- 0 - 1999.663
- 1999.663 - 3999.327
- 3999.327 - 5998.99
- 5998.99 - 7998.654
- 7998.654 - 9998.317
- 9998.317 - 11997.98
- 11997.98 - 13997.644
- 13997.644 - 15997.307
- 15997.307 - 17996.971

20   0   20   40   Miles

N
W   E
S

© Matthew Stone, 2001

Kernel Density Ratio of TB Cases to Underlying 2000 U.S. Census Population Harris County, Texas, 1995-1998

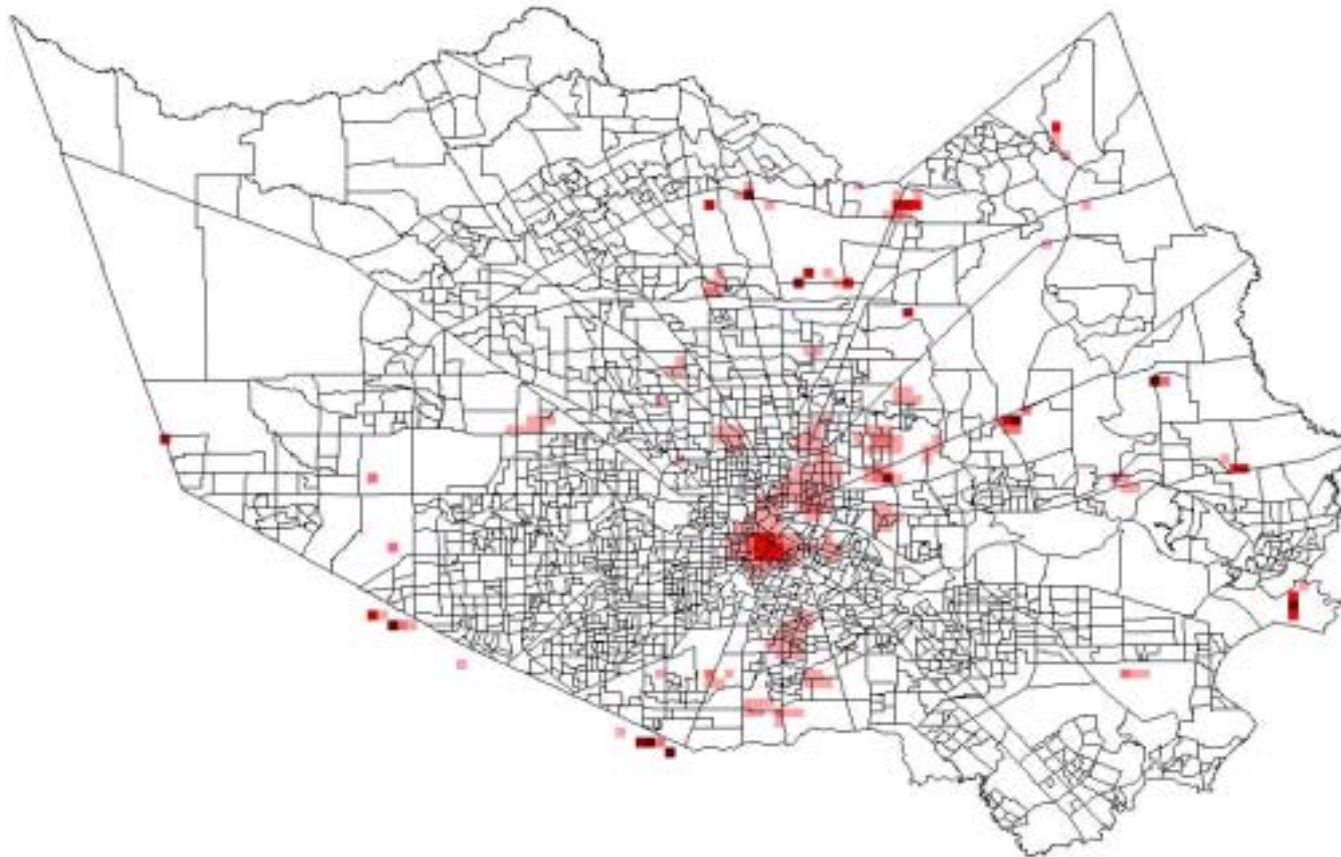**Estimated Incidence Rate (cases/100,000)**
- 0 - 50
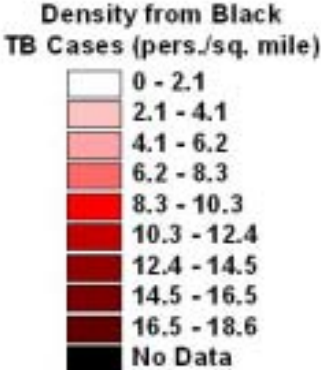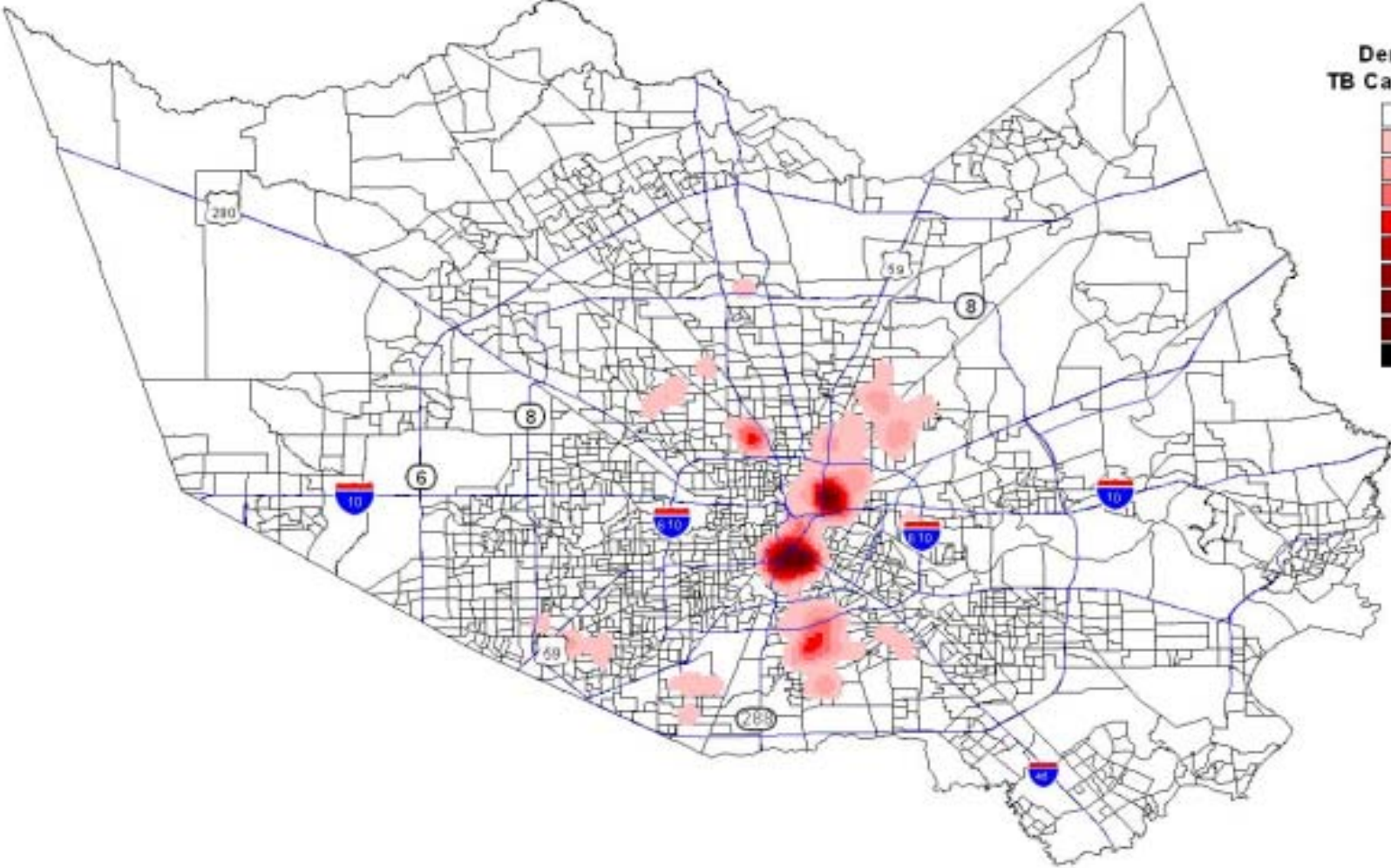- 51 - 100
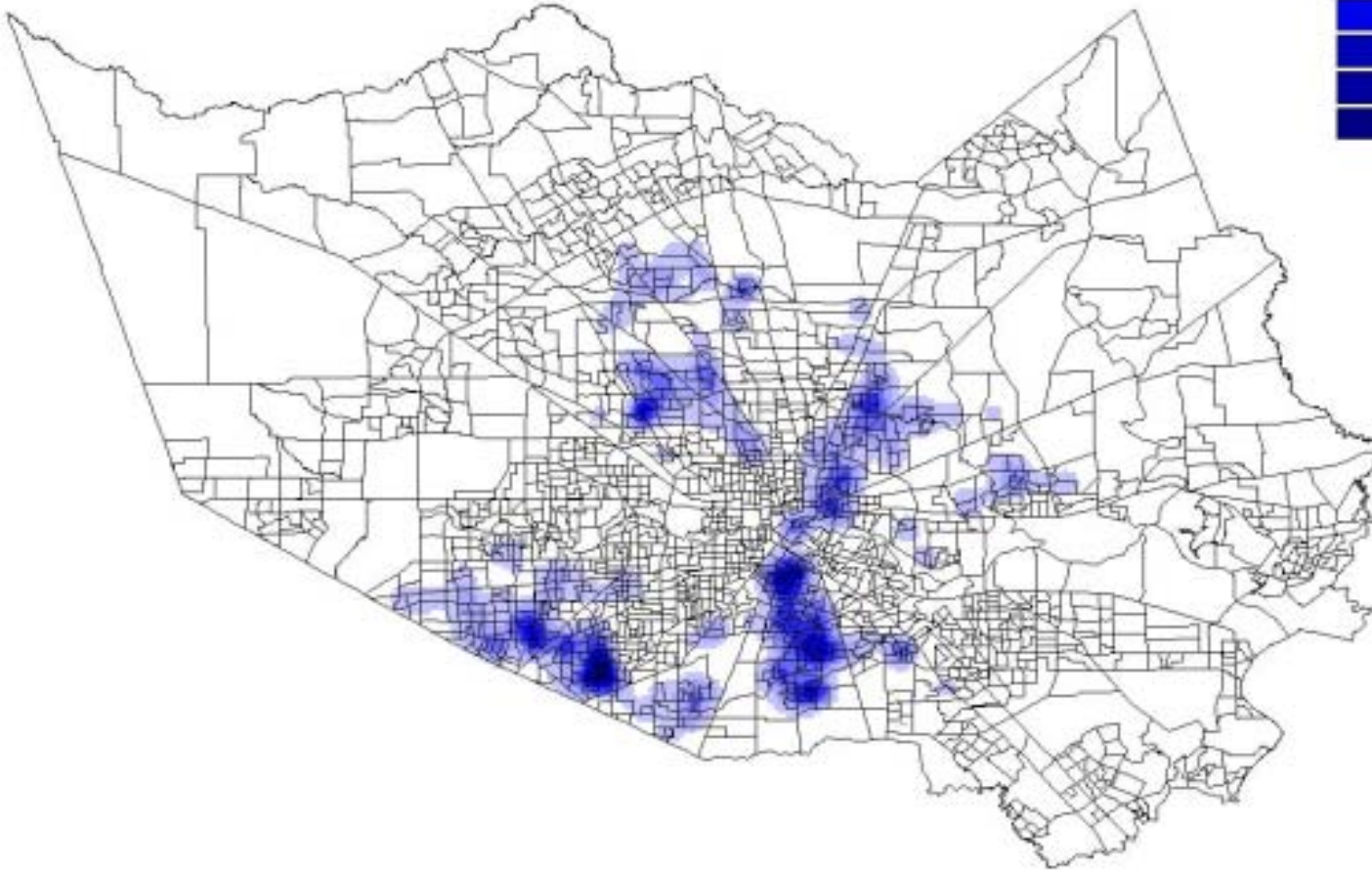- 101 - 150
- 150 - 200
- 201 - 250
- 251 - 300
- 301 - 400

20   0   20   40 Miles

N
W   E
S

© Matthew Stone, 2001

Density of Black TB Cases, Harris County, Texas, 1995-1998

Density from Black TB Cases (pers./sq. mile)

- 0 - 2.1
- 2.1 - 4.1
- 4.1 - 6.2
- 6.2 - 8.3
- 8.3 - 10.3
- 10.3 - 12.4
- 12.4 - 14.5
- 14.5 - 16.5
- 16.5 - 18.6
- No Data

20   0   20   40 Miles

© Matthew Stone, 2001

Density of 2000 U.S. Census
Block Group Population (Black)

Persons per Sq Mile
- 0 - 806.292
- 806.292 - 1612.583
- 1612.583 - 2418.875
- 2418.875 - 3225.167
- 3225.167 - 4031.458
- 4031.458 - 4837.75
- 4837.75 - 5644.042
- 5644.042 - 6450.333
- 6450.333 - 7256.625

20   0   20   40 Miles

© Matthew Stone, 2001

Kernel Density Ratio of TB Cases (Black) to Underlying 2000 U.S. Census Population (Black) Harris County, Texas, 1995-1998

Cases
Estimated Incidence Rate
(cases/100,000)
0 - 50
51 - 100
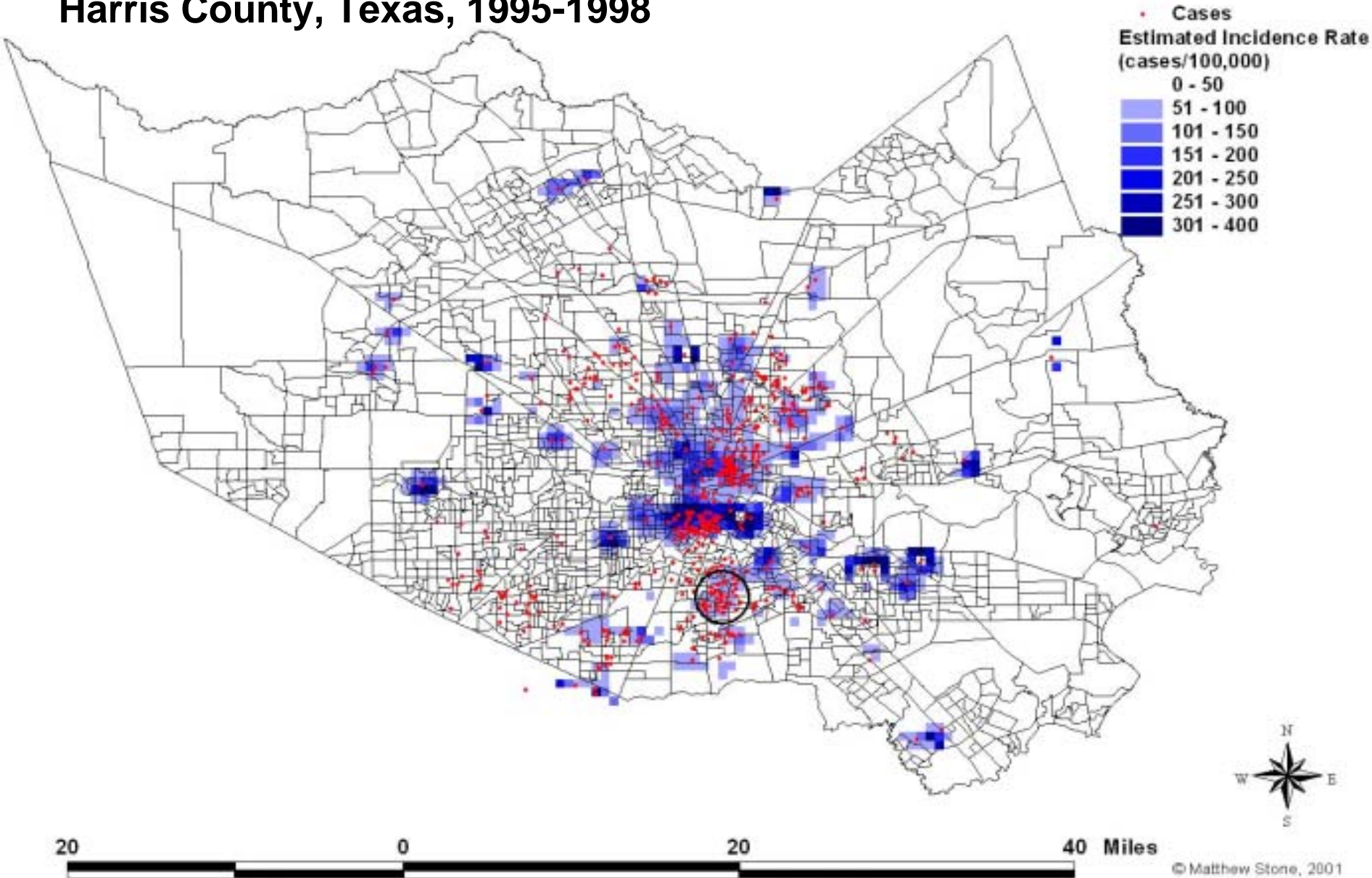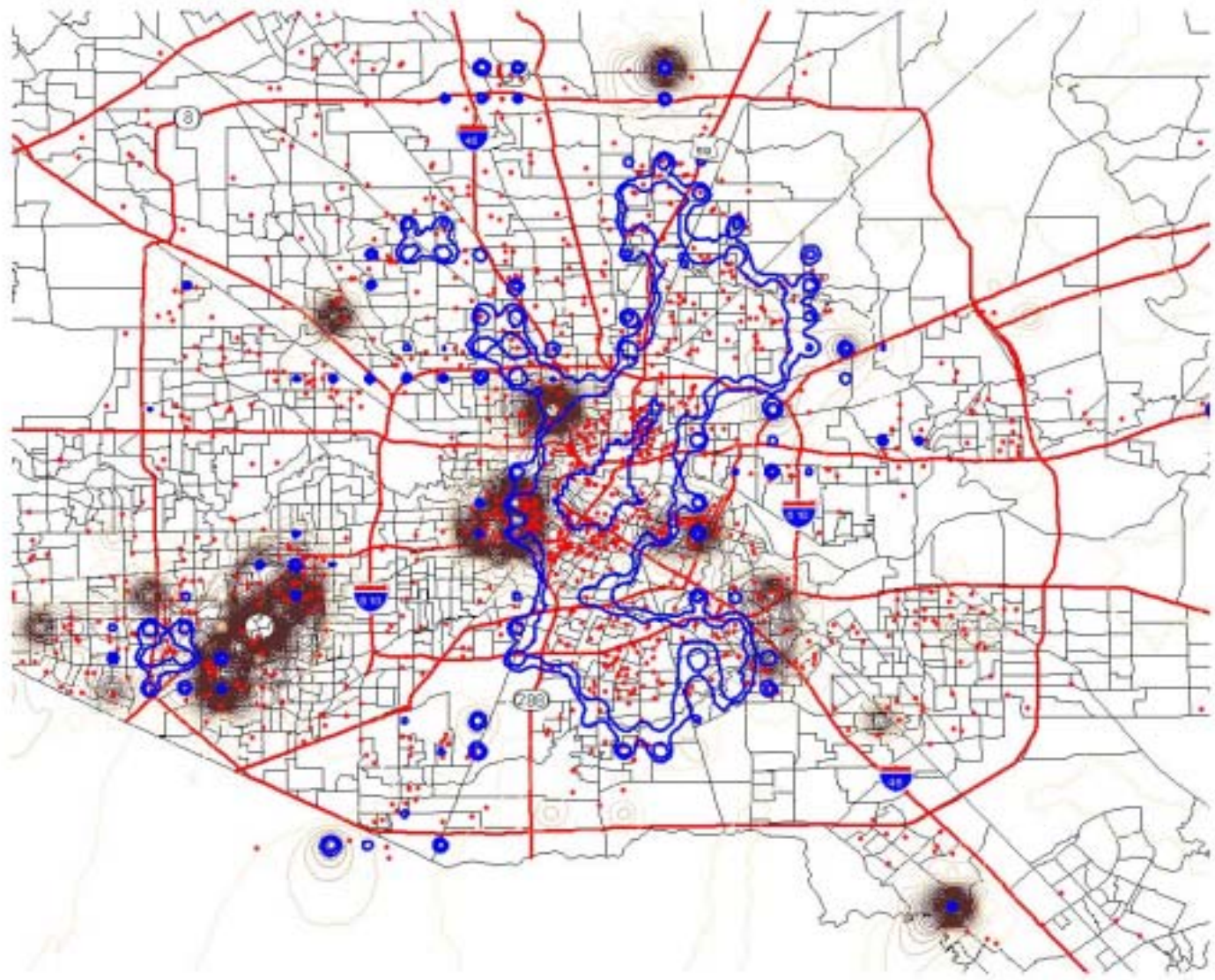101 - 150
151 - 200
201 - 250
251 - 300
301 - 400

20   0   20   40 Miles

© Matthew Stone, 2001

Spatial Filtering Method, All TB Cases Harris County, Texas, 1995-1998

Significance Contours
Simulated Rate<Observed Rate
95% - 100% of the time

· Cases

Contours of Rates(per 100,000)
0-20/100,000
21-40/100,000
41-60/100,000
61-80/100,000
81-100/100,000
101-120/100,000
GT 120/100,000

10   0   10   20 Miles

© Matthew Stone, 2001

Spatial Filtering Method, Black TB Cases
Harris County, Texas, 1995-1998

Significance Contours
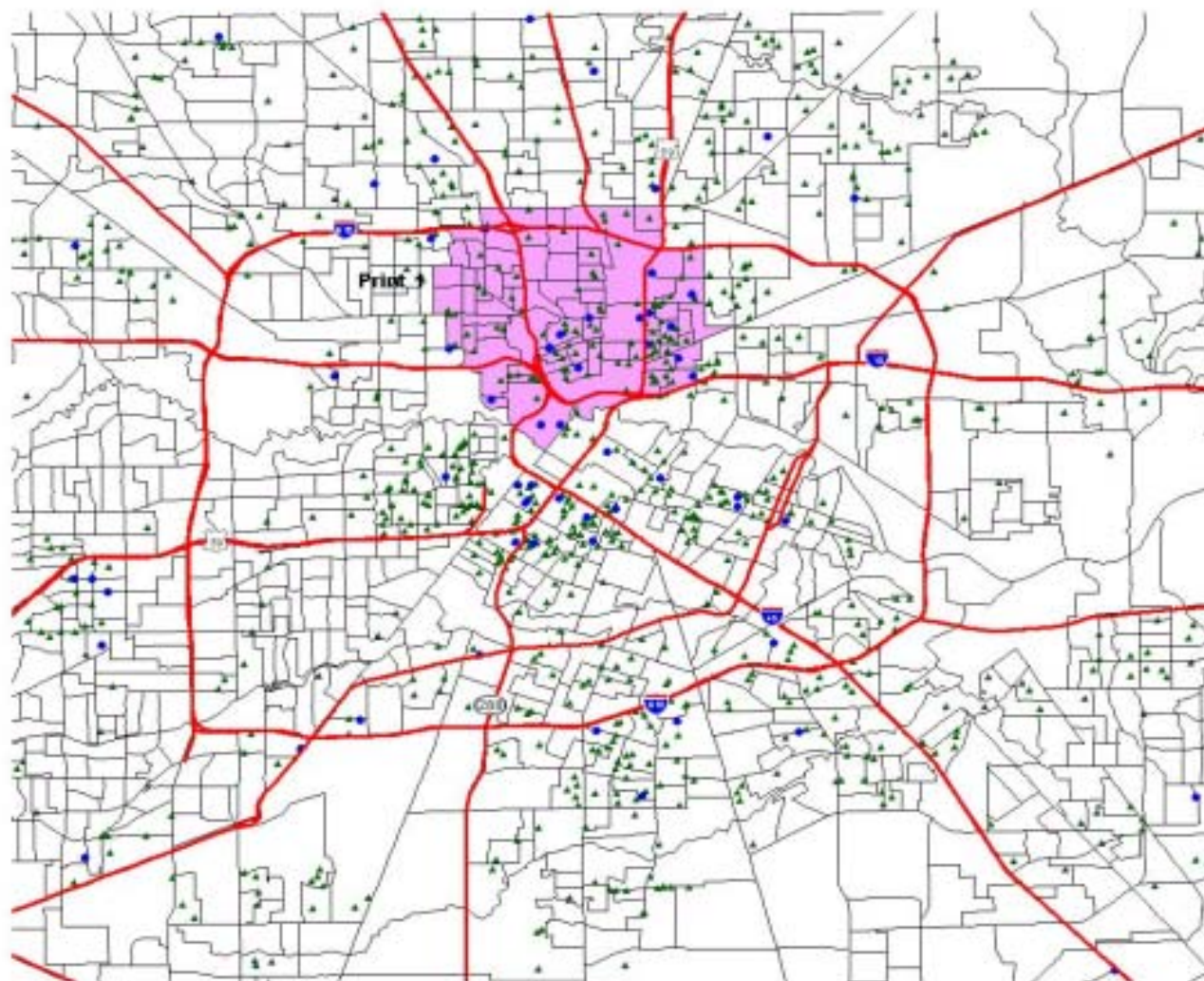Simulated Rate<Observed Rate
95% - 100% of the time

. Cases
Contours of Rates(per 100,000)
0-20/100,000
21-40/100,000
41-60/100,000
61-80/100,000
81-100/100,000
101-120/100,000
GT 120/100,000

10   0   10   20 Miles

© Matthew Stone, 2001
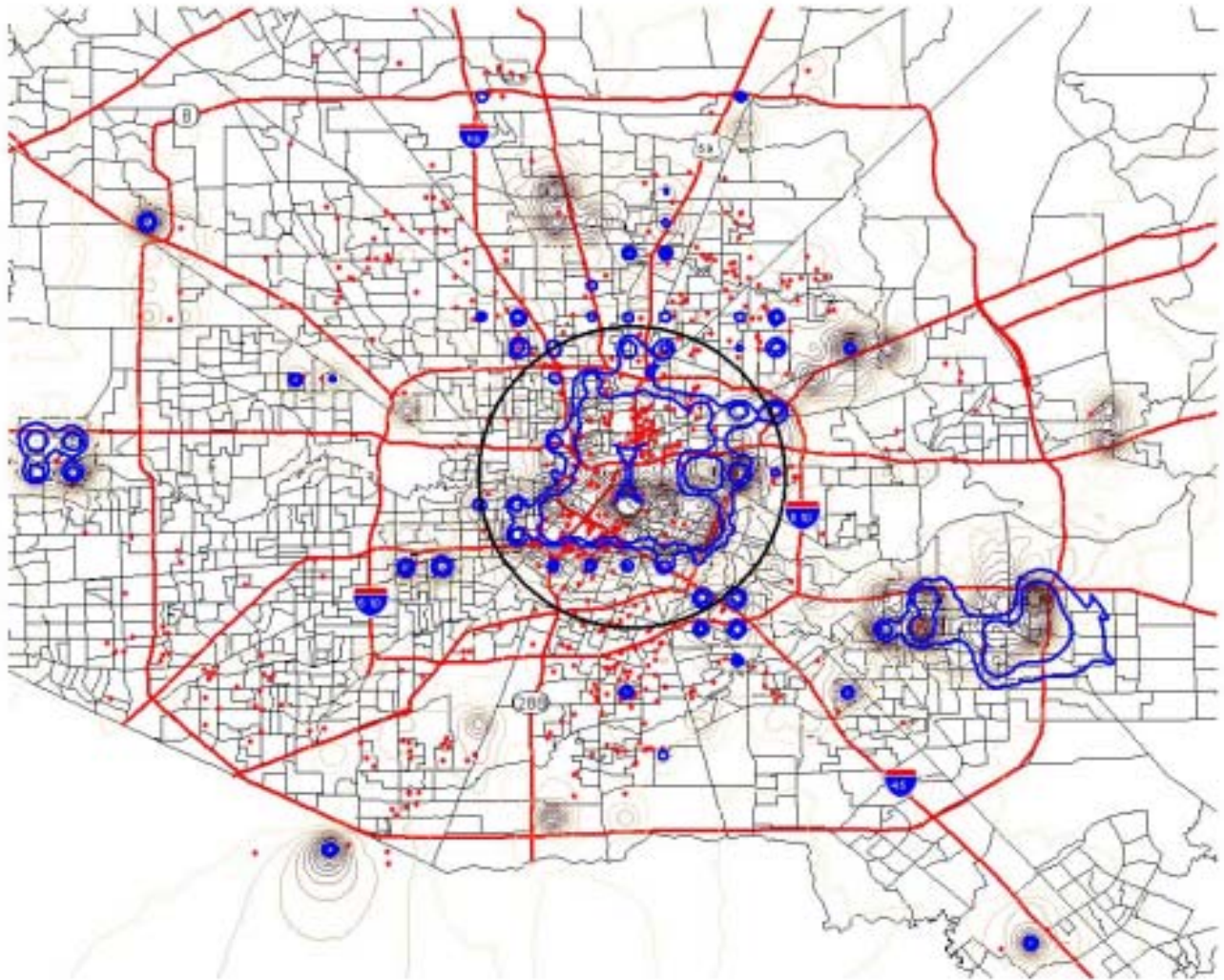
Print 1 Cluster
(Print 1 Cases compared to Non-Print 1 Cases)

Print 1 Cluster
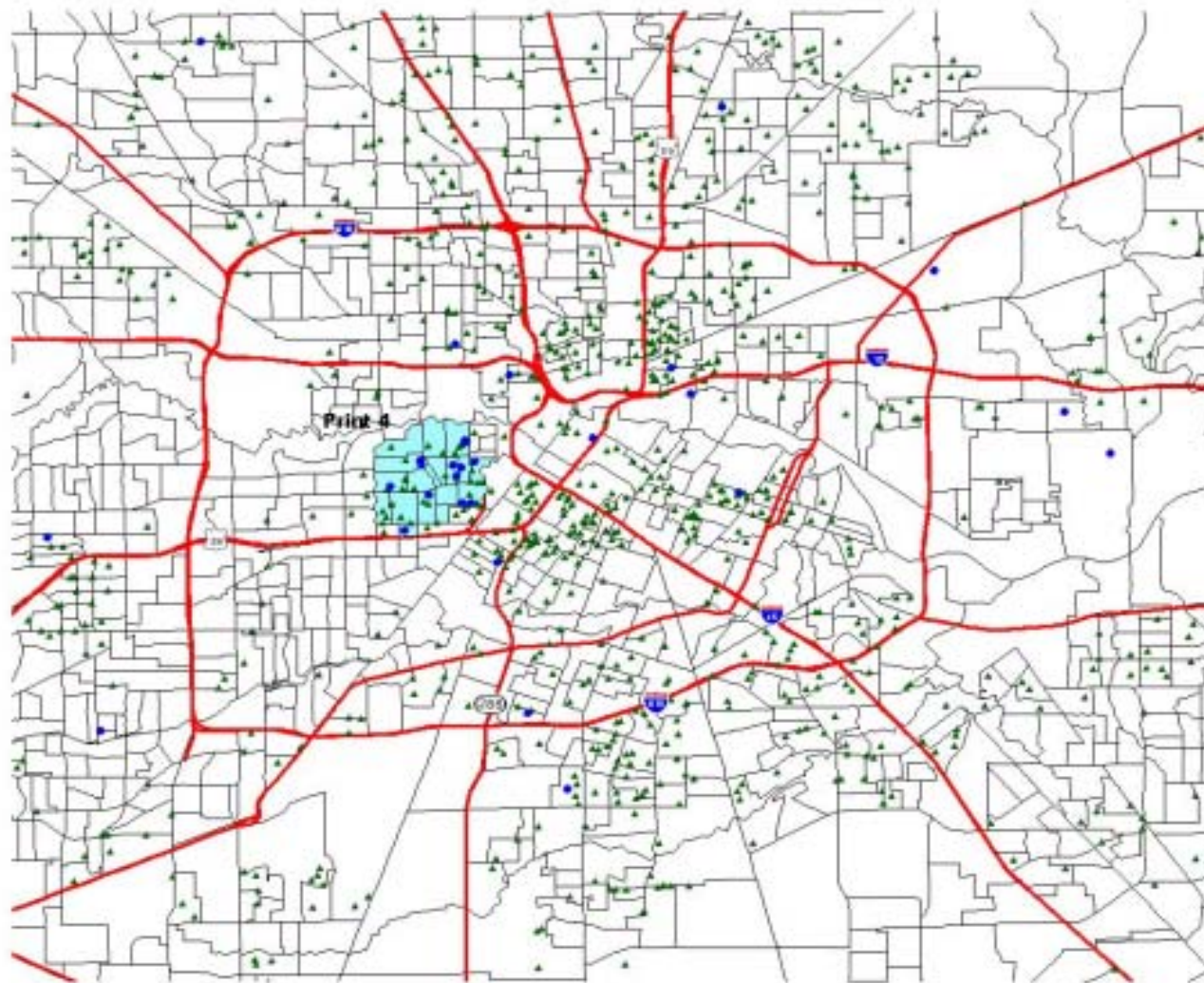RR=2.98 (p=.01)

● Print 1 Cases

▲ Non-Print 1 Cases

Print 1

7   0   7   14 **Miles**

N
W ✦ E
S

© Matthew Stone, 2004

Print 4 Cluster
(Print 4 Cases compared to Non-Print 4 Cases)

Print 4 Cluster
RR=9.03 (p<.01)

• Print 4 Cases

▲ Non-Print 4 Cases

Print 4

7 0 7 14 Miles

© Matthew Stone, 2001
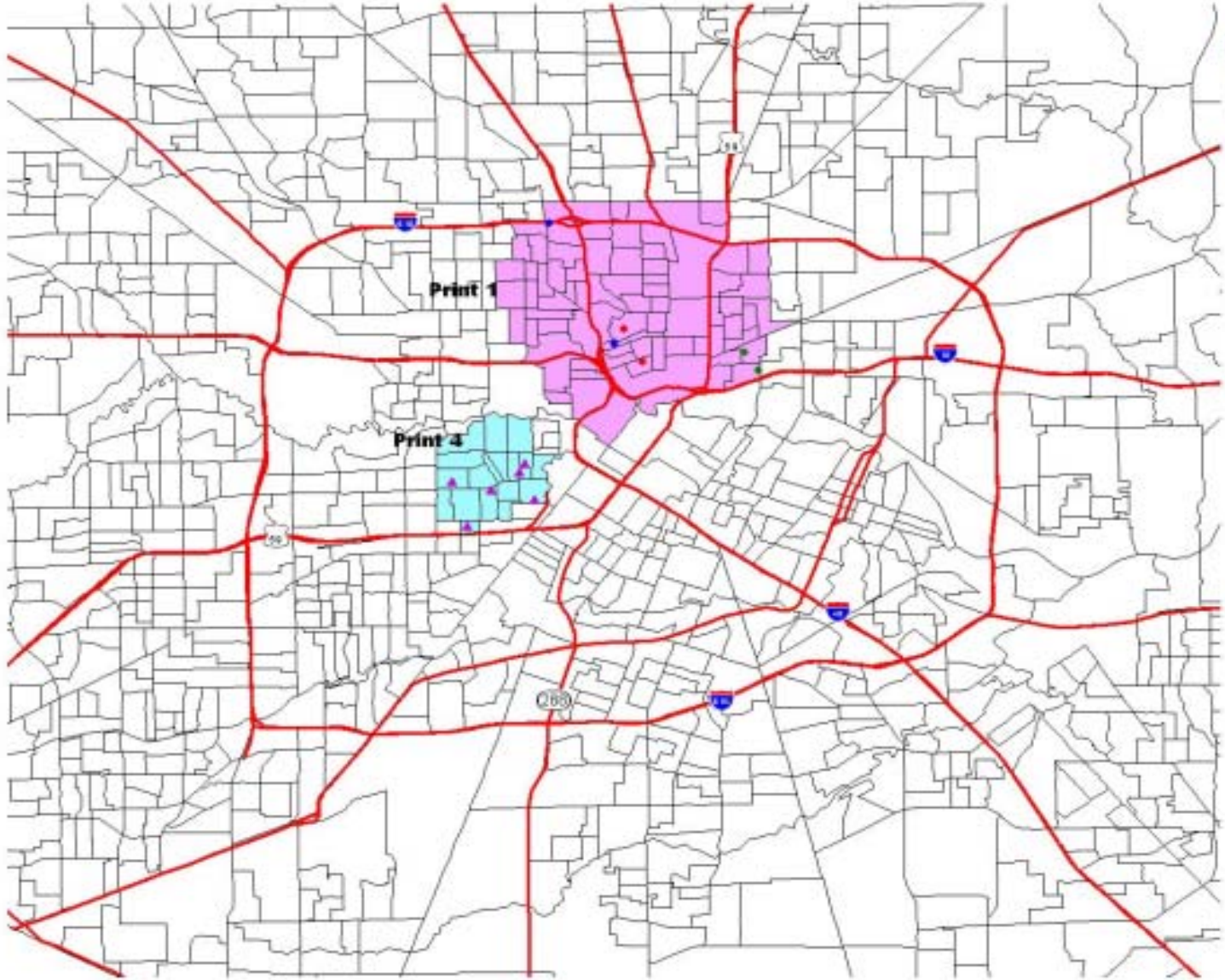
Print 1 and Print 4 Significant Clusters Showing Shared Bus Routes within Cluster

Print 4 Cluster
RR=9.03 (p<.01)

▲ Shared Bus Route 82

Print1 Cluster
RR=2.98 (p=.01)

Print1 Shared Bus Routes
- 15
- 25
- 80

Print 1

Print 4

7   0   7   14 Miles

© Matthew Stone, 2001

Conclusions

- There were specific neighborhood areas where the intensity of Black TB cases during the three-year period was high, even in reference to the underlying Black population.

- There appear to be definite areas where specific genetic print types tend to cluster.

- Within the print type clusters, there is evidence that shared public transportation occurs that may warrant further inspection

Acknowledgements

- **Houston Tuberculosis Initiative and Edward Graviss, Ph.D, M.P.H.**

- **The designers of the software utilized in this project**

  - **Ned Levine, Ph.D (CrimeStat®)**
  - **Martin Kulldoorf, Ph.D (SatScan™)**
  - **Gerard Rushton, Ph.D (Dmap™)**