



Overview of GIS

What is GIS?

- **GIS (Geographic Information System):** computer information system that can input, store, manipulate, *analyze*, and display geographically referenced (spatial) data to support decision making processes.

How Does GIS Work?



- Population Health Characteristics
- Vital Events/Critical Incidents
- Service Areas/Referral Regions
- Health & Human Service Workers
- Health Facilities and Services
- Streets/Rivers/Land Features

think of data in layers - with every type of data a layer . . .

Tools for a GIS

- **Hardware**

- Computer
- Printer / Plotter
- Digitizer
- Scanner

- **GIS Desktop Software (ESRI, Inc. – ArcView)**

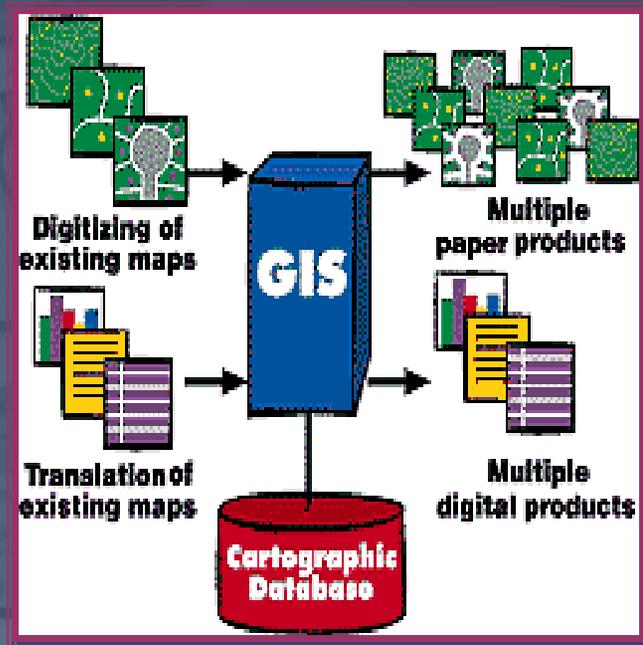
- **CAD Software (AutoDesk - AutoCAD)**

- **Multimedia (Photos, Video, 3D Models)**

- **World Wide Web (ESRI, Inc. – ARCIMS)**

- **Personnel**

GIS Data Sources



Digitized and Scanned Maps

- purchased, donated, free (Internet)
- created by user

Data Bases – Tables of data

GPS – Global Positioning System

- accurate locations

Field Sampling of Attributes

Remote Sensing & Aerial Photography

Conventional Information Systems

– Answer the following questions:

- Who ?
- What ?
- When ?
- Why ?
- How ?

GIS answers the following

- **Location: What is at...?**
- **Condition: Where is it?**
- **Trends: What has changed since...?**
- **Patterns: What spatial patterns exist?**
- **Modeling: What if...?**

Exploring data using GIS turns data into information into knowledge

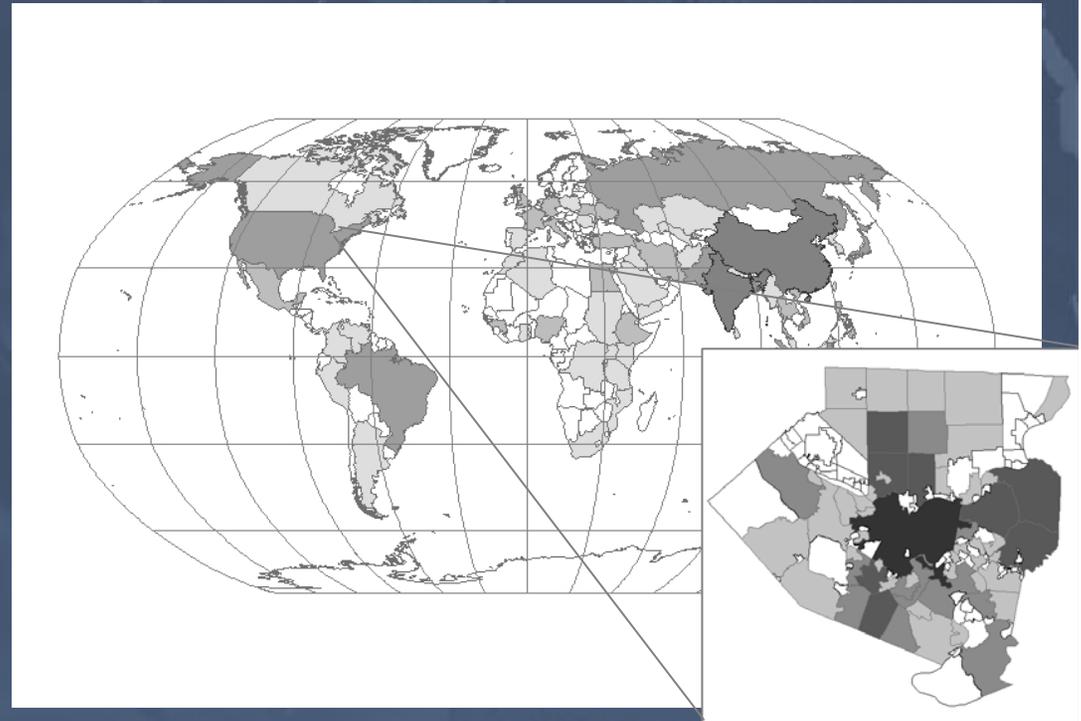
Data Data Data

- **Location Data**

How Many? – What Kind? – Where?

- **Scale of Data**

Global to Local



- **Data Presentation**

- Words, Charts, Graphs, Tables, Maps, Photos

Databases

- Not easy to interpret

Attributes of tgr27053trt00

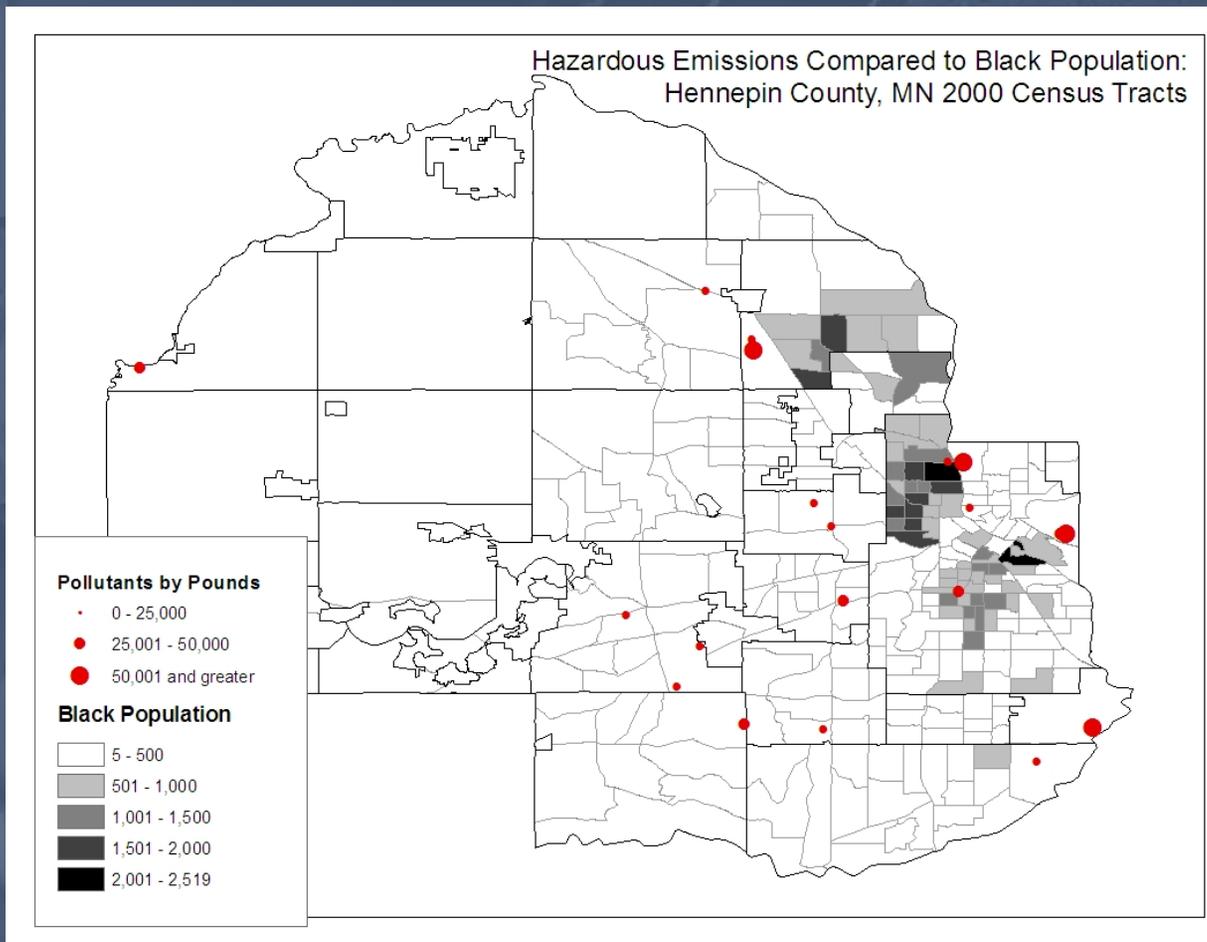
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1	Polygon	2	27053	000102	27053000102	27053000102	4448	2741	778	109	517	4
2	Polygon	3	27053	000300	27053000300	27053000300	3491	2572	543	31	164	1
3	Polygon	4	27053	000601	27053000601	27053000601	4837	3922	298	75	200	16
4	Polygon	5	27053	000603	27053000603	27053000603	2788	2563	52	21	85	0
5	Polygon	6	27053	01								
6	Polygon	7	27053	01								
7	Polygon	8	27053	01								
8	Polygon	9	27053	01								
9	Polygon	10	27053	01								
10	Polygon	11	27053	01								
11	Polygon	12	27053	01								
12	Polygon	13	27053	01								
13	Polygon	14	27053	01								
14	Polygon	15	27053	01								
15	Polygon	16	27053	01								
16	Polygon	17	27053	01								
17	Polygon	18	27053	01								
18	Polygon	19	27053	01								

Microsoft Excel - HennepinCountyPolluters.dbf

A	B	C	D	E	F	
1	P	CITY	SIC_CODE	LATITUDE	LONGITUDE	POUNDS
2	RITRAMA INC.	MINNEAPOLIS	26 Paper And Allied Products	44.98244	-93.21470	134100
3	PERAL BATHS	BROOKLYN PARK	30 Rubber And Misc. Plastics Products	45.08788	-93.39455	69380
4	RIVERSIDE GENERATING PLANT	MINNEAPOLIS	49 Electric Gas And Sanitary Services	45.02357	-93.27372	66074
5	NORTHWEST AIRLINES INC.	SAINT PAUL	45 Transportation By Air	44.87071	-93.19908	65000
6	DIVERSIFOAM PRODS.	ROCKFORD	30 Rubber And Misc. Plastics Products	45.07797	-93.74738	45304
7	DOUGLAS CORP.	EDEN PRAIRIE	30 Rubber And Misc. Plastics Products	44.87286	-93.39926	41600
8	NICO PRODS. INC.	MINNEAPOLIS	34 Fabricated Metal Products	44.94958	-93.27600	34364
9	NORTHLAND ALUMINUM PRODS. INC.	MINNEAPOLIS	34 Fabricated Metal Products	44.94389	-93.34222	32115
10	GREATBATCH - GLOBE TOOL INC.	MINNEAPOLIS	34 Fabricated Metal Products	44.98259	-93.21810	26140
11	TENNANT CO.	MINNEAPOLIS	35 Industrial Machinery And Equipment	44.98676	-93.34954	22572
12	GRACO MINNESOTA INC. MINNEAPOLIS	MINNEAPOLIS	35 Industrial Machinery And Equipment	44.99754	-93.27018	21009
13	POLARFAB L.L.C.	BLOOMINGTON	36 Electronic & Other Electric Equipment	44.85164	-93.23176	20111
14	MEDTRONIC INC. PERFUSION SYS.	BROOKLYN PARK	38 Instruments And Related Products	45.09460	-93.39541	19523
15	HONEYWELL INTL. INC. AUTOMATION & CONTROL	GOLDEN VALLEY	38 Instruments And Related Products	45.00000	-93.35999	18500
16	SIERRA CORP. / TK PRODS.	MINNETONKA	28 Chemicals And Allied Products	44.91809	-93.42575	15950
17	GE OSMONICS INC.	MINNETONKA	35 Industrial Machinery And Equipment	44.89456	-93.43876	15680
18	ILLBRUCK INC.	MINNEAPOLIS	30 Rubber And Misc. Plastics Products	45.02408	-93.28278	14995
19	FILMTEC CORP.	EDINA	30 Rubber And Misc. Plastics Products	44.87017	-93.35457	11241

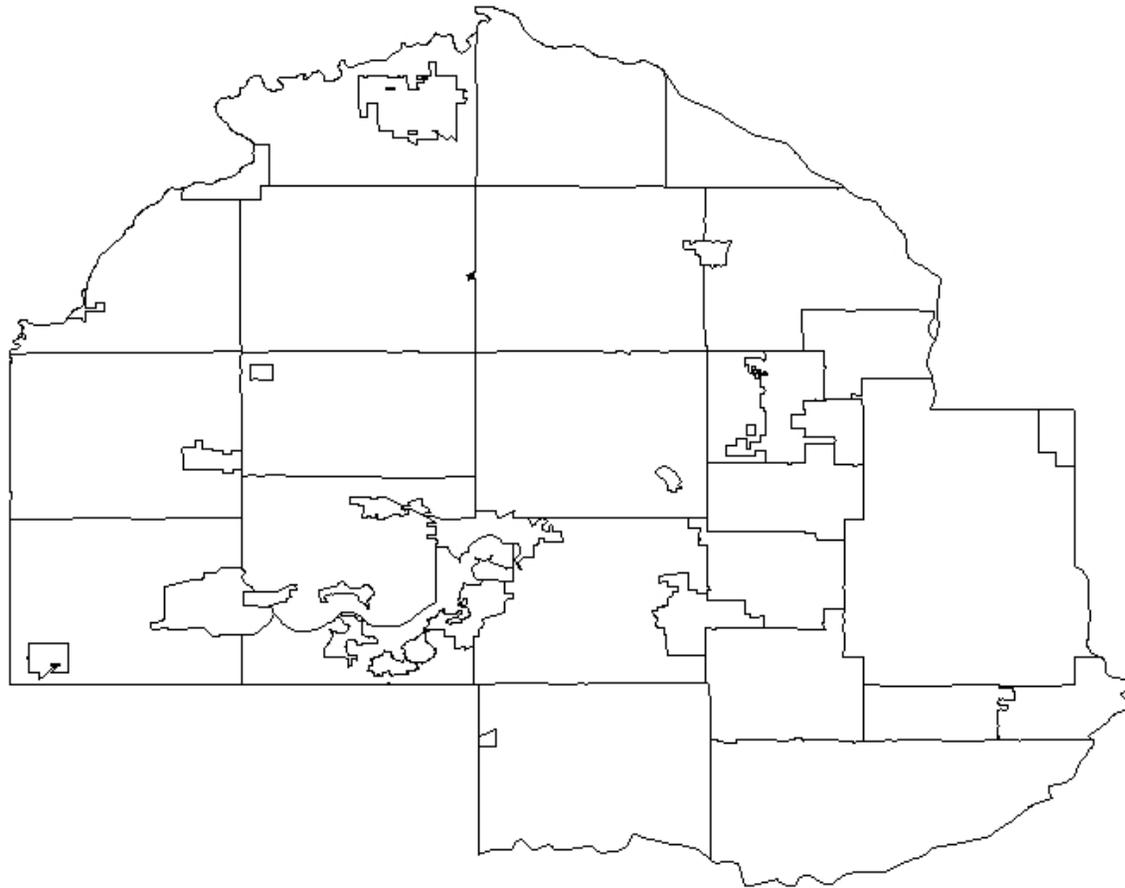
Visualization

A picture is worth a thousand words



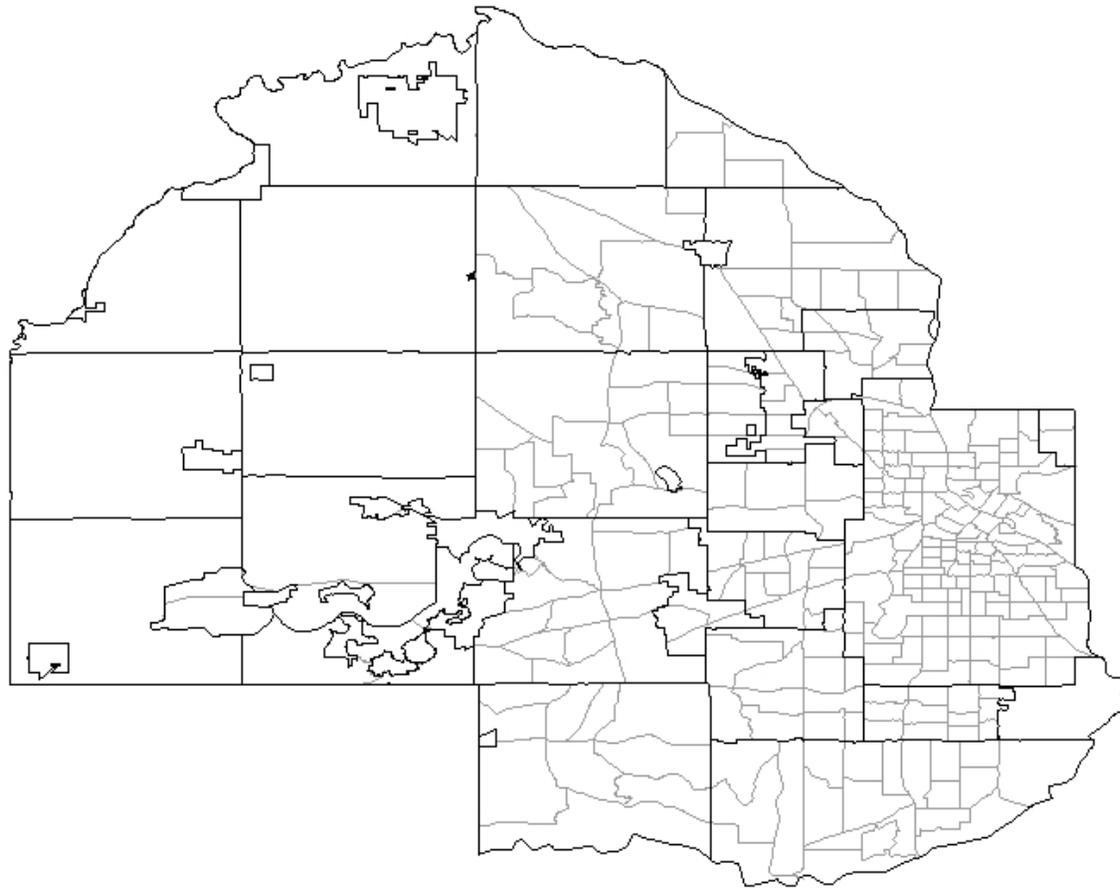
“Layers” of GIS Information

Municipalities



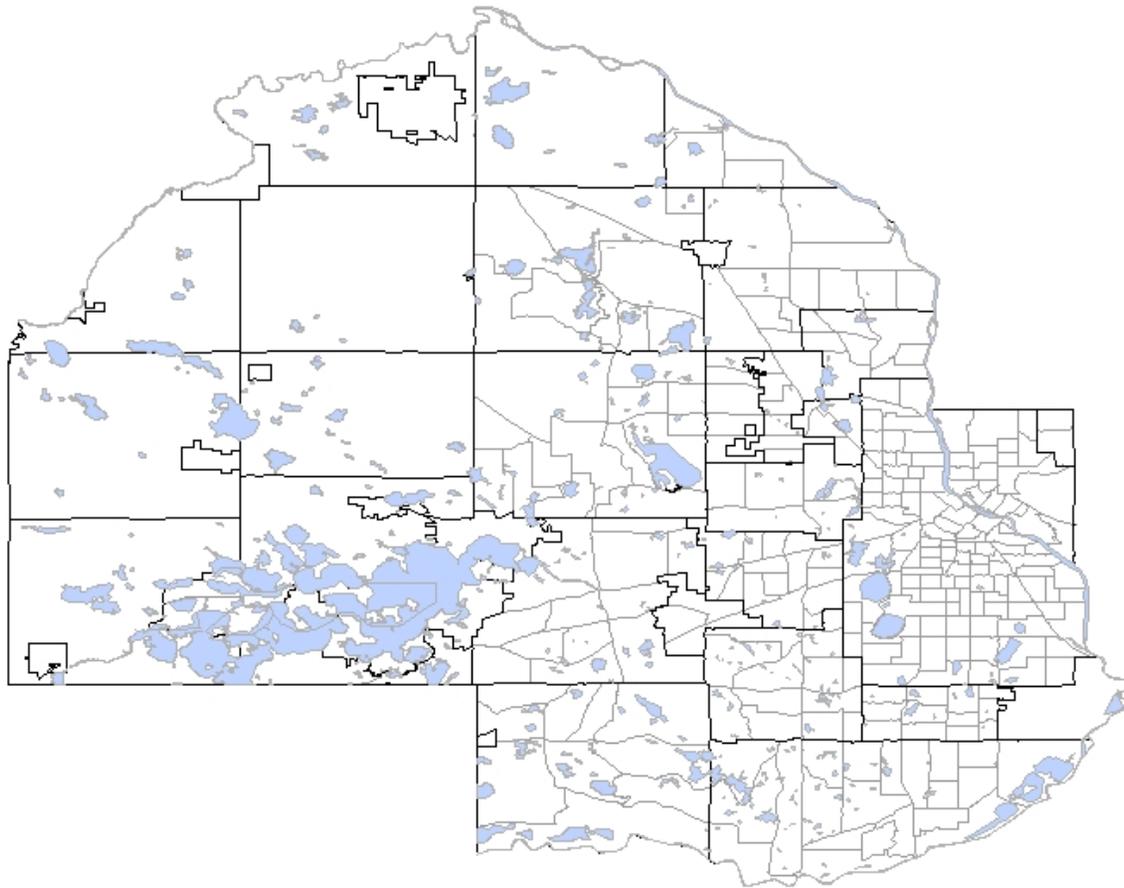
“Layers” of GIS Information

Census Tracts



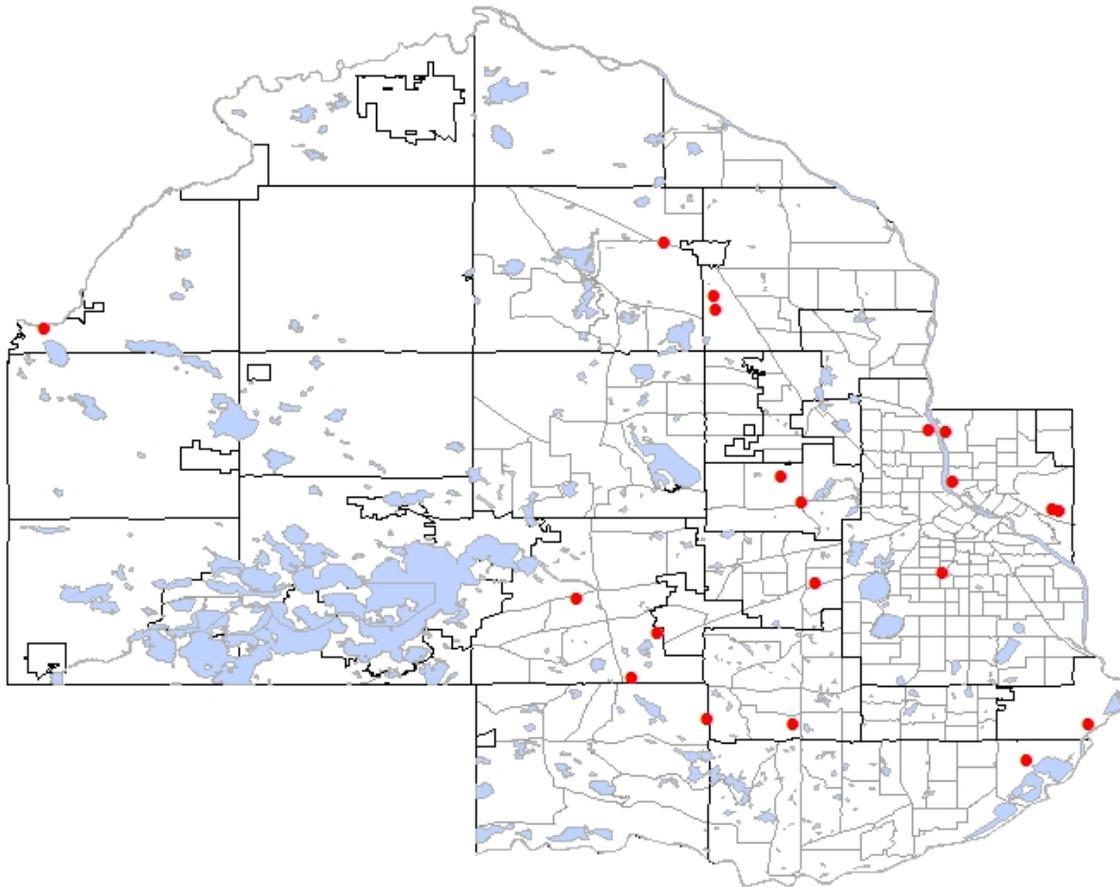
“Layers” of GIS Information

Lakes and Rivers



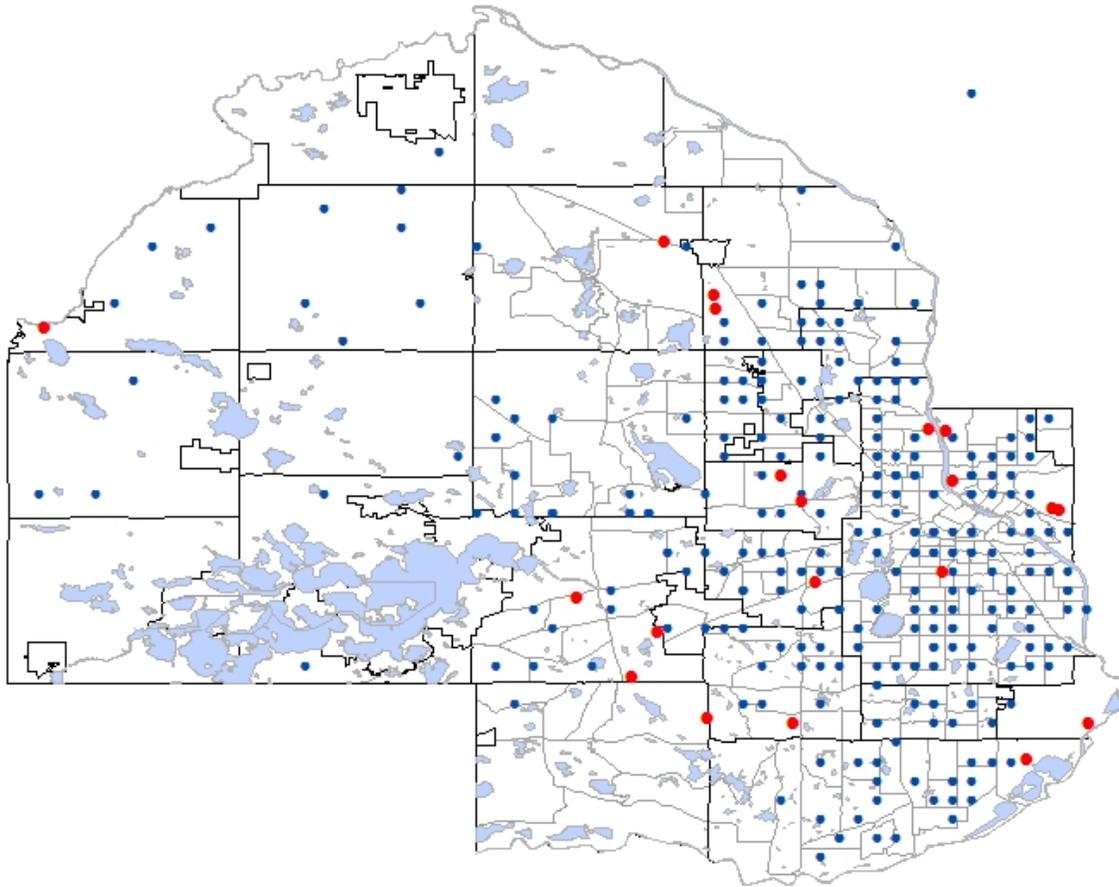
“Layers” of GIS Information

Polluting Companies



“Layers” of GIS Information

Schools

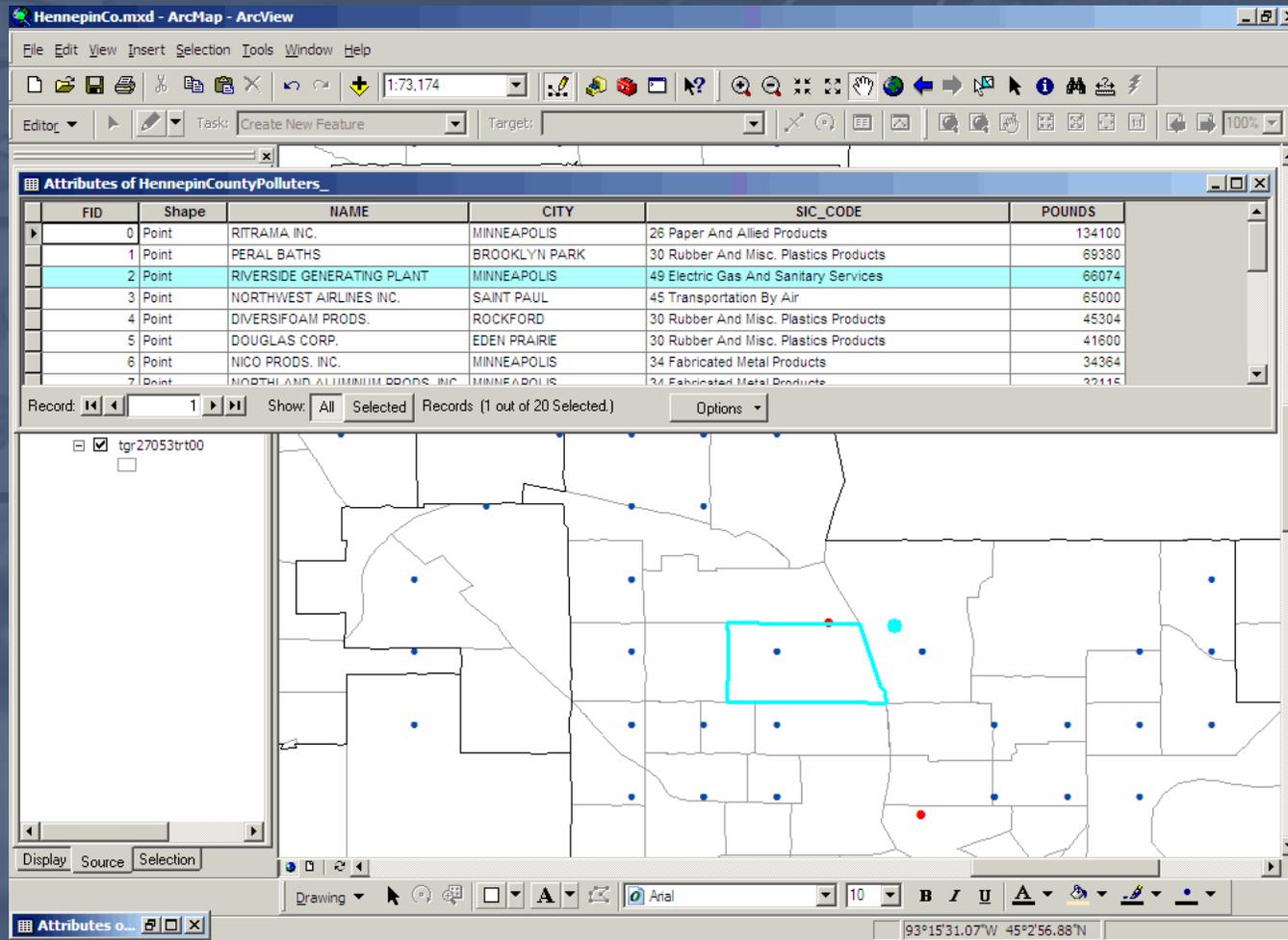


Maps and Databases are Interactive

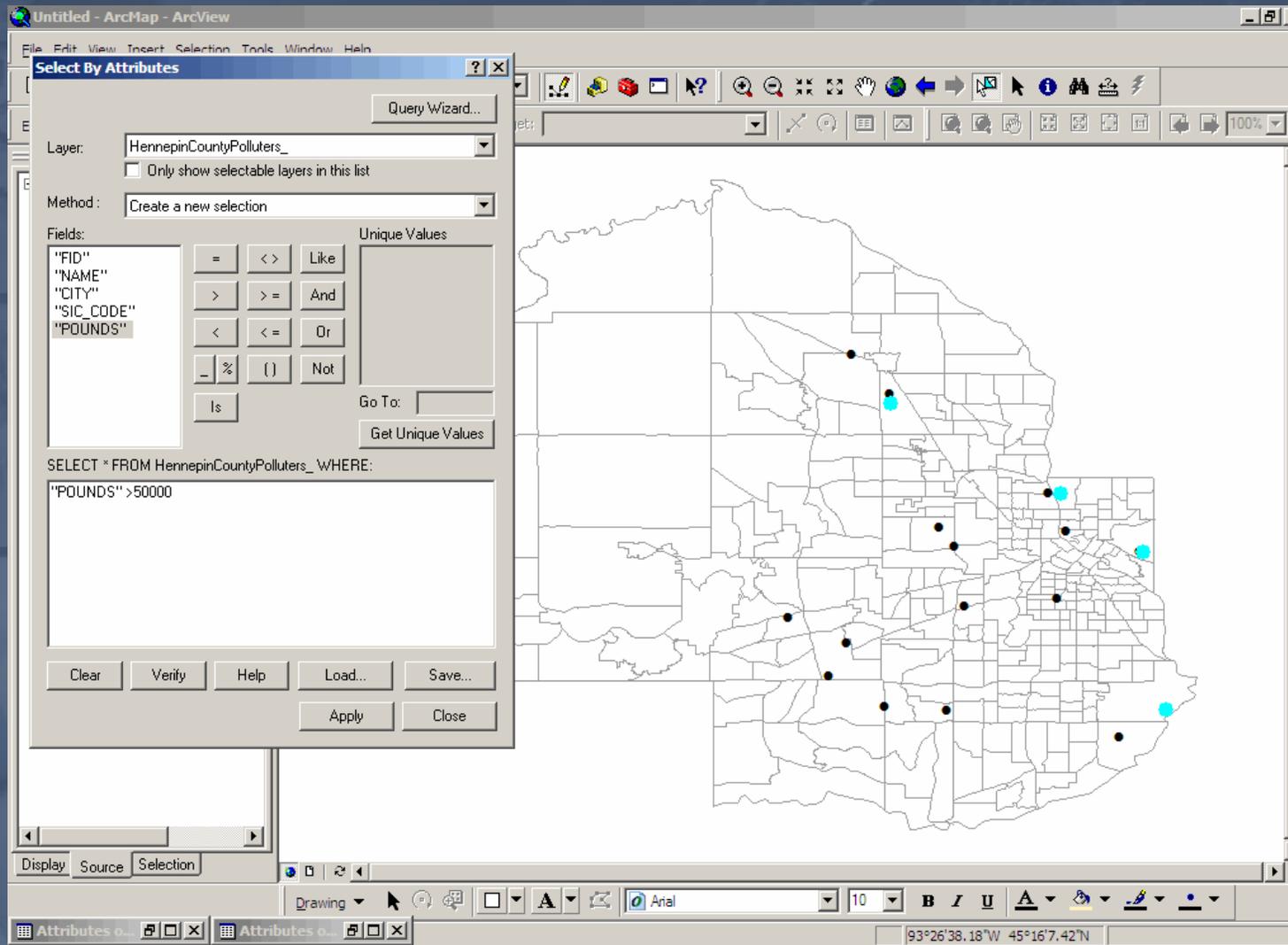
The screenshot displays the ArcMap interface. The main map area shows a geographic region with a grid overlay and numerous blue and red points. A 'Layers' window is open, showing a tree view with 'tgr27053trt00' selected. An 'Identify Results' window is also open, displaying a table of attributes for a specific location. The table includes fields such as FID, Shape, ID, FIPSSTCD, TRT2000, STFID, STFID_1, POP2000, and various demographic categories like WHITE, BLACK, AMERILES, ASIAN, HAWN_PI, OTHER, HISPANIC, AGE_UNDR5, AGE_5_17, and TRACTID.

Field	Value
FID	221
Shape	Polygon
ID	222
FIPSSTCD	27053
TRT2000	100900
STFID	27053100900
STFID_1	27053100900
POP2000	5603
WHITE	1781
BLACK	2519
AMERILES	123
ASIAN	748
HAWN_PI	1
OTHER	103
HISPANIC	182
AGE_UNDR5	502
AGE_5_17	1737
TRACTID	1009

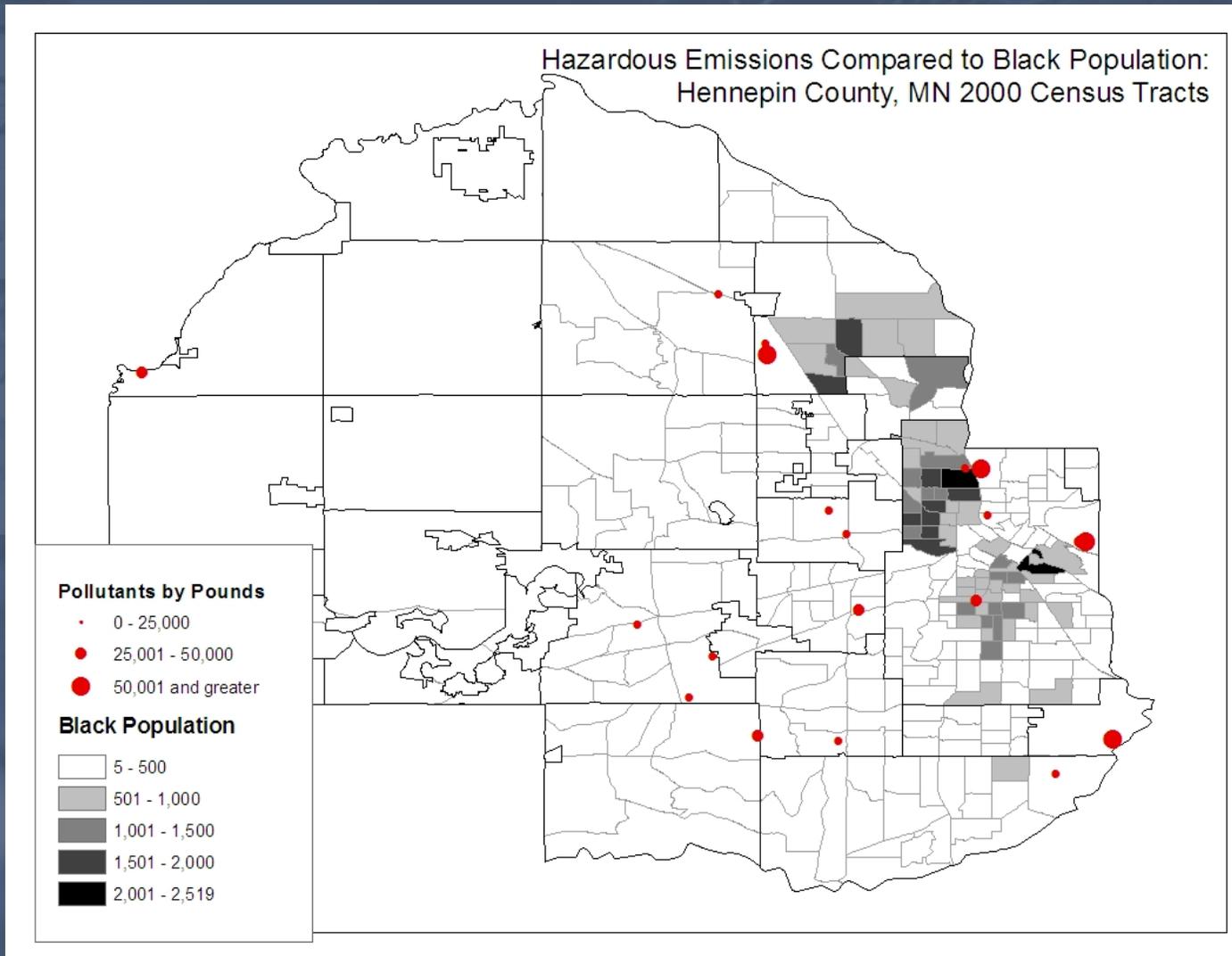
GIS Connects Graphics to Data



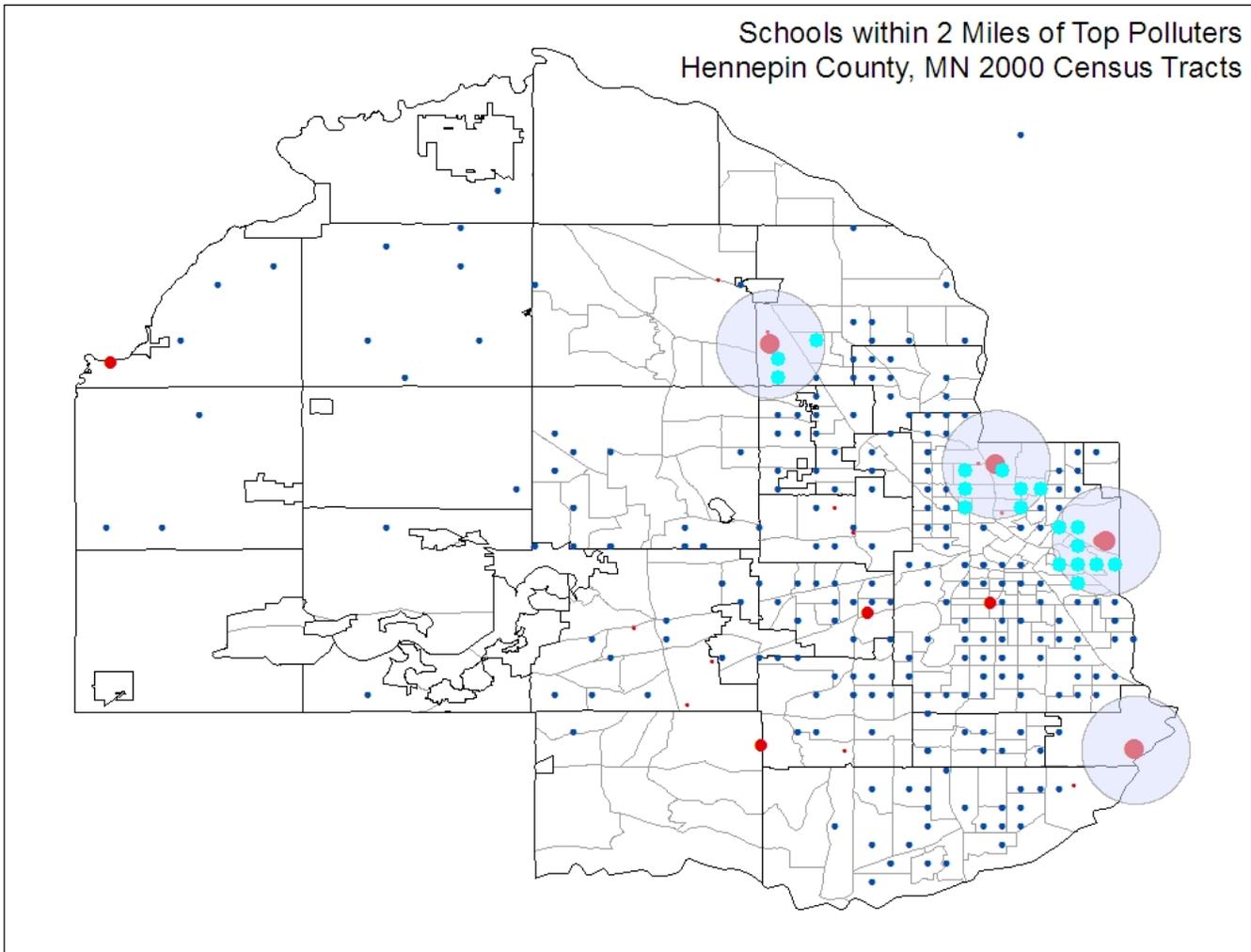
Queries and Restrictions



GIS Turns Data into Information



GIS Turns Data into Information



GIS Applications

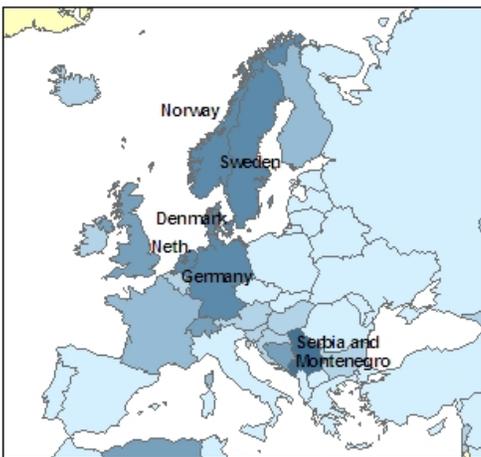
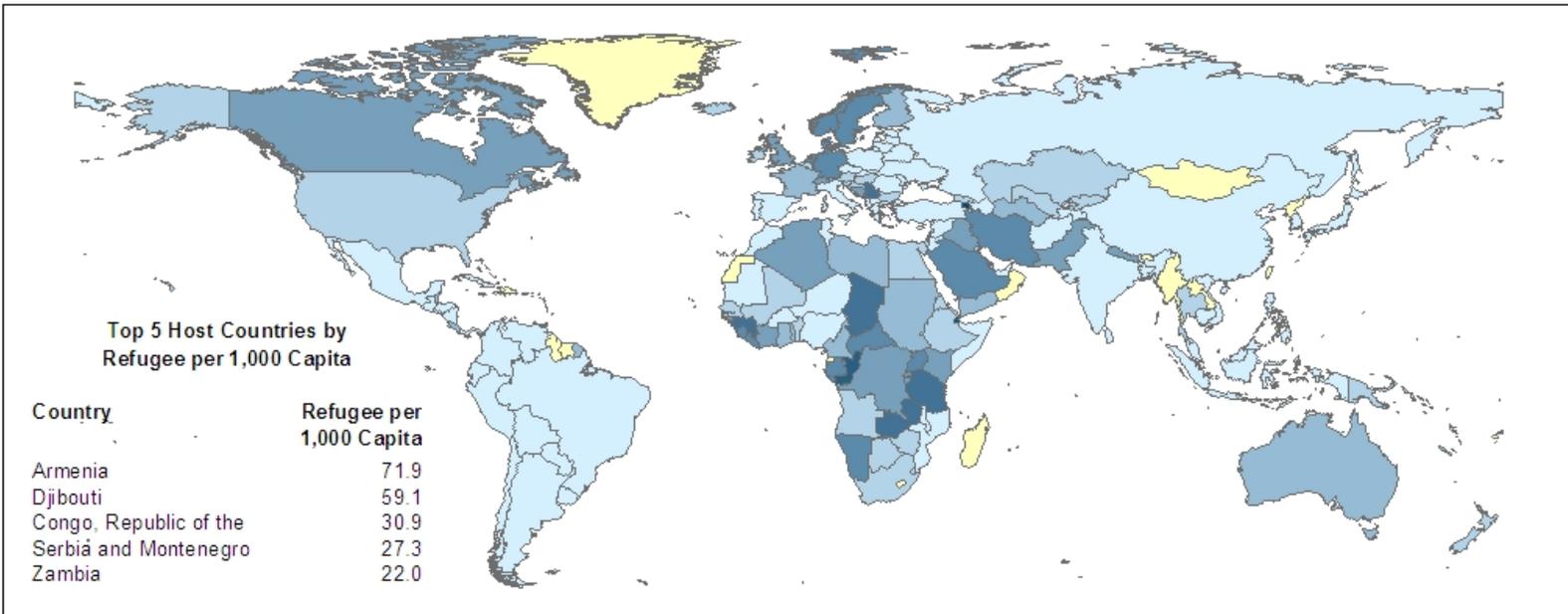
- **Business** *Systems, Marketing* **Site Location, Delivery**
- **Government** *Military* **Local, State, Federal,**
- **Economic Development** *Incomes, Census and Demographic Studies* **Population Studies,**
- **Emergency Services** **Fire & Police**
- **Environmental** **Monitoring & Modeling**
- **Industry** *Communication, Mining, Pipelines, Healthcare* **Transportation,**
- **Public Health** *Bioterrorism, Emergency Response, Planning* **Epidemiology,**
- **Urban Planning** *Environmental and Conservation* **Land Use, Historic studies,**
- **Politics** *Studies, Housing Studies, Crime Analysis* **Elections and Reappointment**
- **Education** *Tool, Administration* **Research, Teaching**

Wherever Spatial Data Analysis is Needed

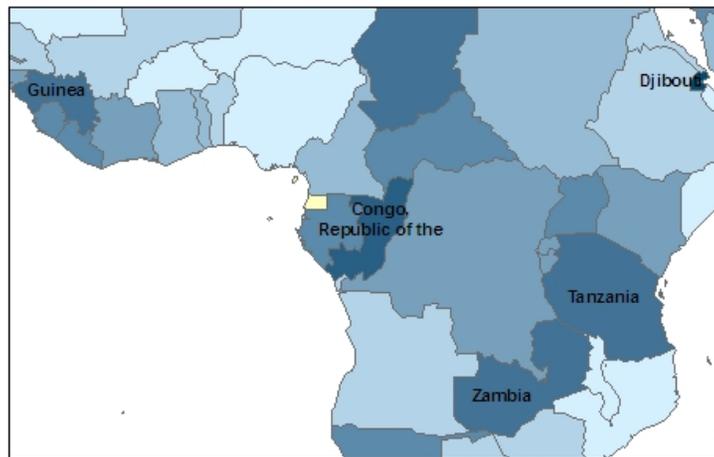


Examples

Cumulative Refugee Population by Host Country per Thousand Capita (2003)



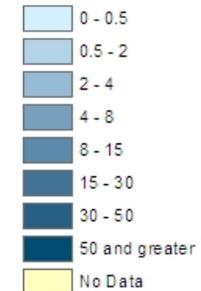
Focus on Europe



Focus on Sub-Saharan Africa

Legend

Refugee Per 1,000 Capita



Refugee Data obtained from the United Nations High Commissioner for Refugees (UNHCR), 2005

Population Data obtained from the CIA World Factbook (2003 Data), 2005

Map Designed by Josselin Phan

Potential Housing Development Sites Crawford/Roberts Area

Hill Community Development Corp. PGH 2005

Dinwiddie Property Owners

Tax Delinquent and Substandard Condition



Legend



Legend



Tax Delinquent Parcels-Sold to City or County, 2000-2005

Potential Redevelopment Candidates for Phase II Dinwiddie Street: Land Use and Site Condition Hill Community Development Corp. 2004



Legend

- | | |
|---|---|
|  CTAC_Neigh_Parcel |  CTAC_Inventory_Parcel |
|  Geocoded_DevelopmentSites |  Owner_2 |
| |  Parcel-N/A |
| |  City of Pittsburgh |
| |  URA |

Source: CTAC Elm Street Baseline Inventory, 2004
City of Pittsburgh- Department of City Planning, 2002



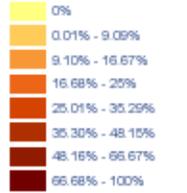
Pittsburgh - East End - Rental Households

FALL 2004

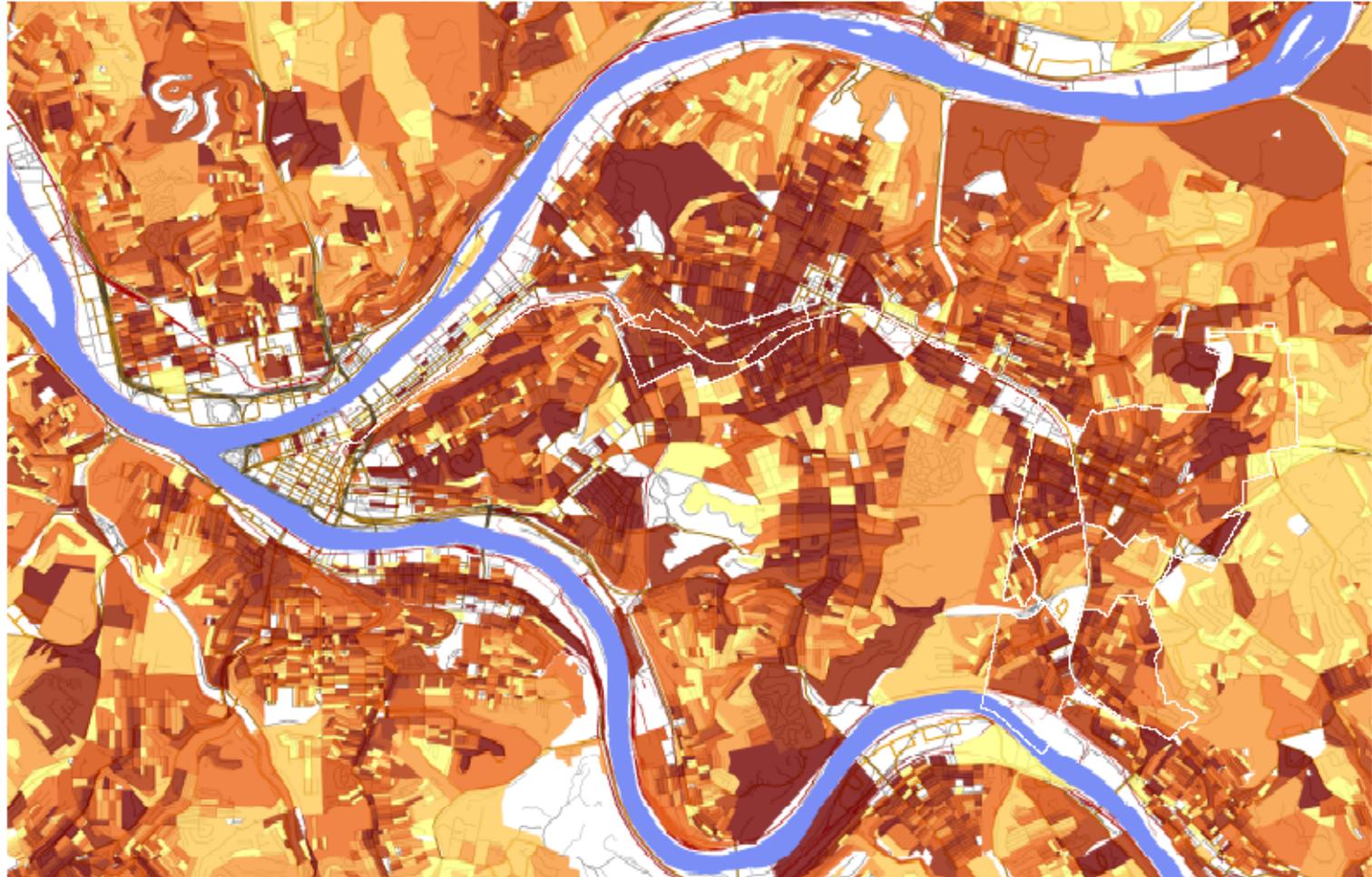
East Busway | Baum Centre Corridor | Wilkinsburg | Edgewood - Swissvale

Legend

Population - 2000 Census
Percentage Rental



- Streets
- Railroads
- East Bus Way
- Busway Stops
- Urban Lab Study Area





Pittsburgh - East End - Vacant Households

FALL 2004

East Busway | Baum Centre Corridor | Wilkinsburg | Edgewood - Swissvale

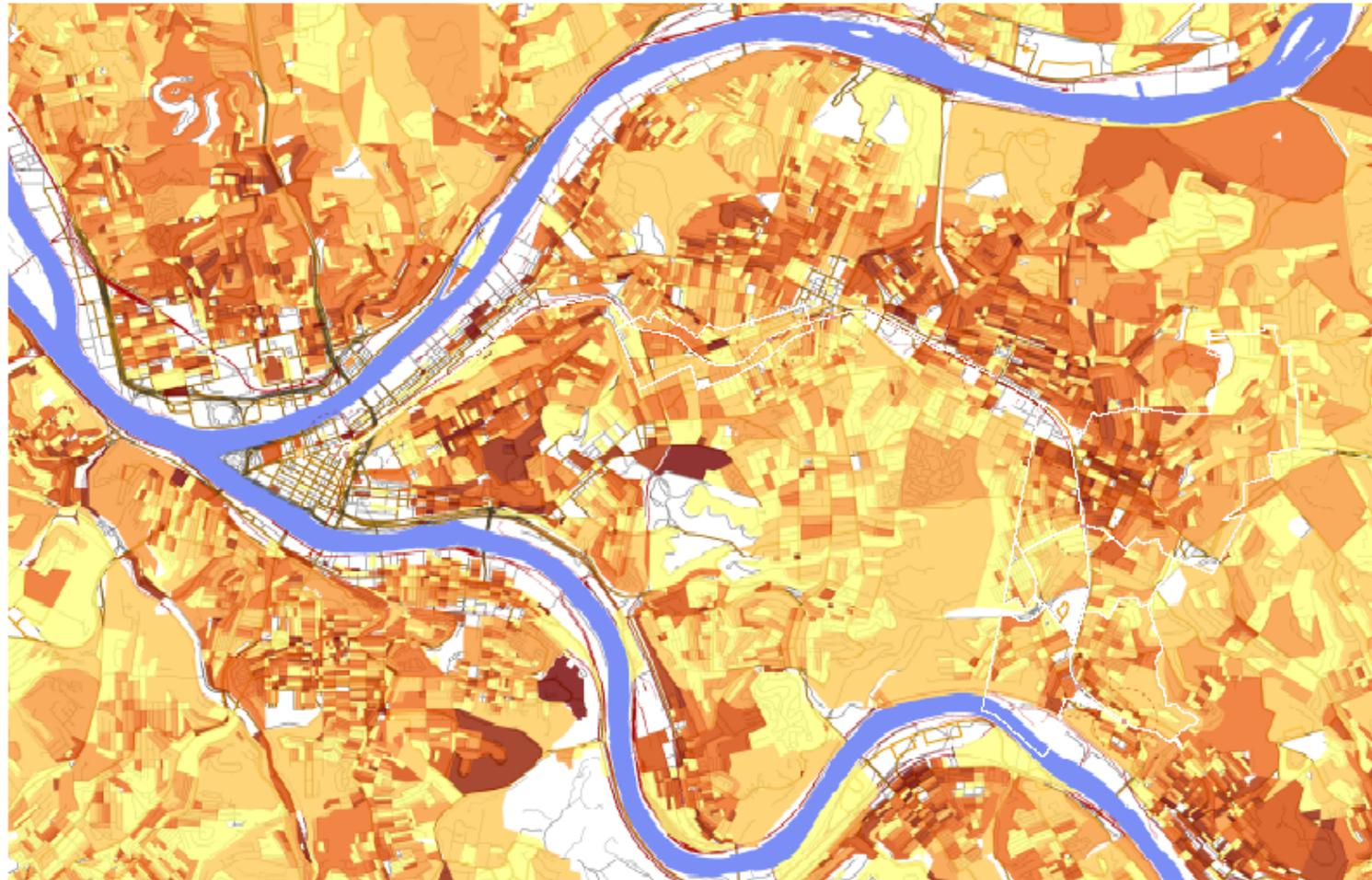
Legend

2000 Census Households
Percent Vacant

- 0% - 2.44%
- 2.45% - 7.02%
- 7.03% - 12.25%
- 12.26% - 19.23%
- 19.24% - 29.17%
- 29.18% - 40%
- 40.01% - 71.43%
- 71.44% - 100%

- Streets
- Railroads
- East Bus Way
- Busway Stops
- Urban Lab Study Area

This map reflects the percentage of housing units in a census block which were vacant at the 2000 census. It does NOT represent vacant lots or parcels.





Pittsburgh - East End - Young Adult Population

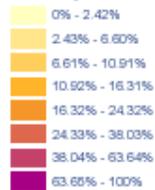
FALL 2004

East Busway | Baum Centre Corridor | Wilkinsburg | Edgewood - Swissvale

Legend

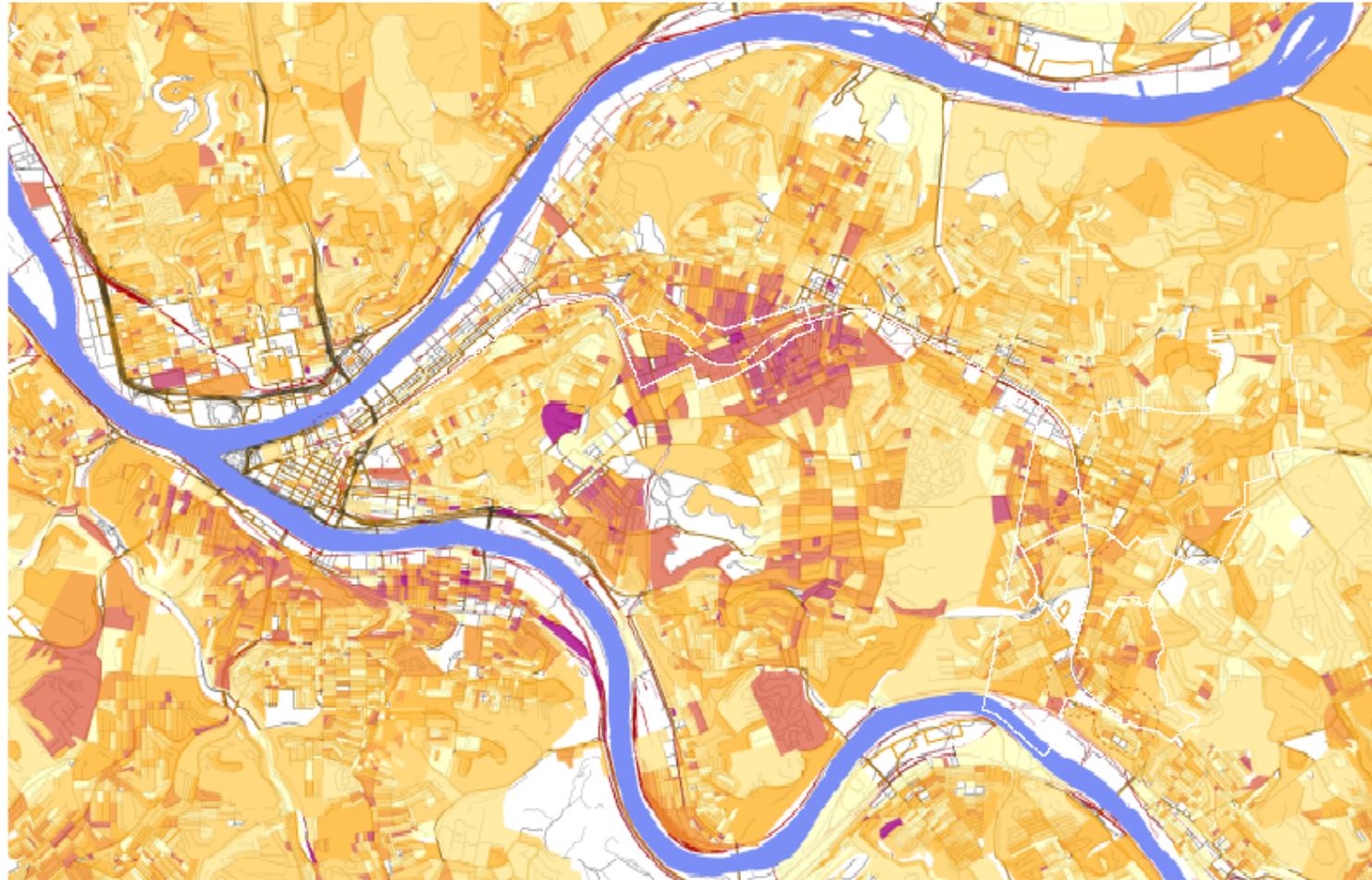
2000 Census Population

Percent Ages 22 - 29



- Streets
- Railroads
- East Bus Way
- Busway Stops
- Urban Lab Study Area

This map reflects the percentage of the total population living in a block which are between ages 22 and 29.





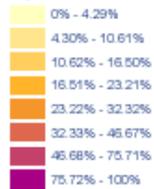
Pittsburgh - East End - Elderly Population

FALL
2004

East Busway | Baum Centre Corridor | Wilkinsburg | Edgewood - Swissvale

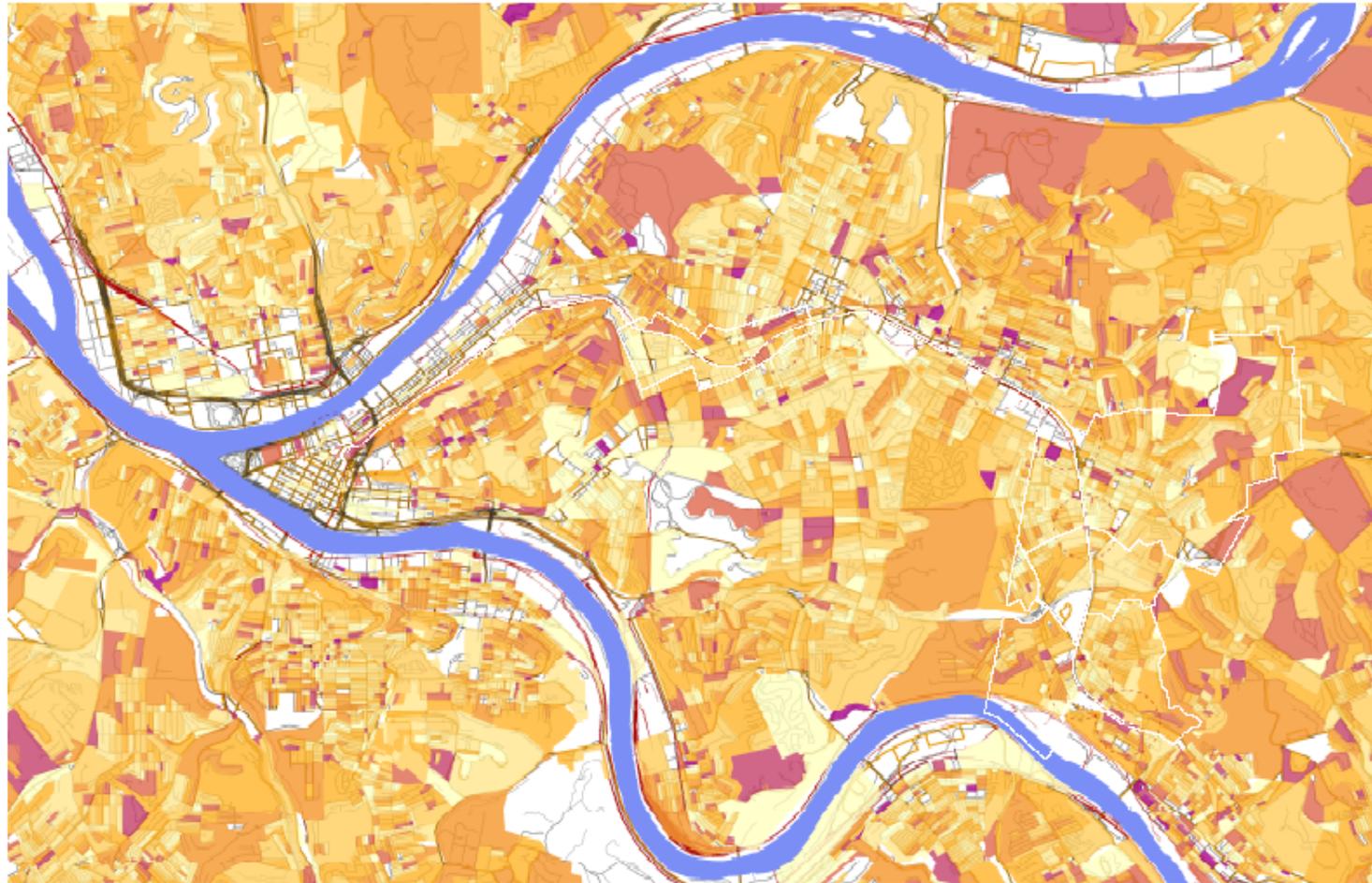
Legend

2000 Census Population
Population above 65

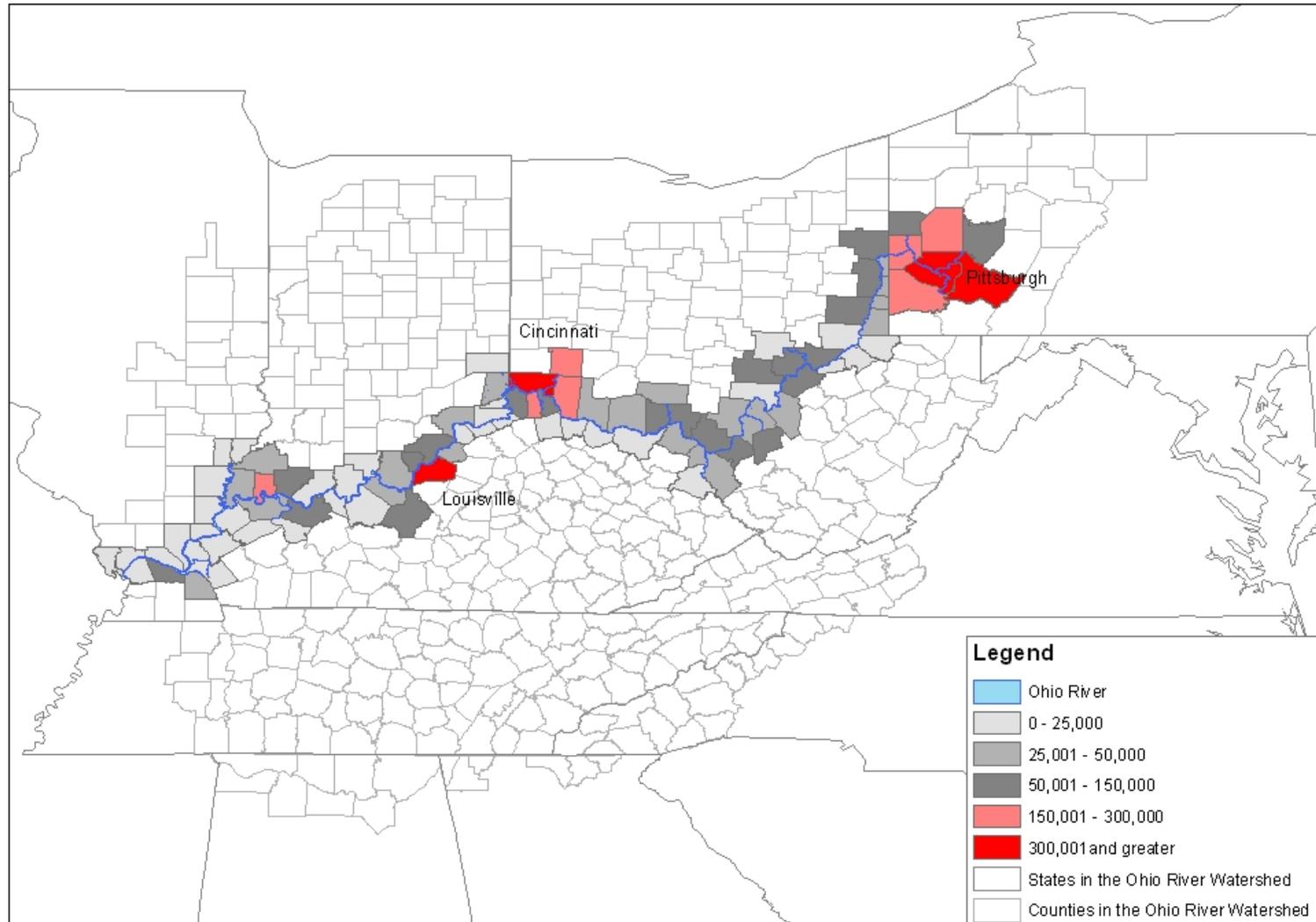


- Streets
- Railroads
- East Bus Way
- Busway Stops
- Urban Lab Study Area

This map reflects the percentage of households inhabited by unretired men or women.

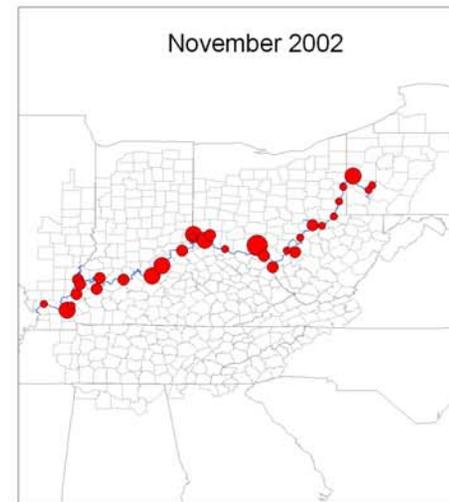
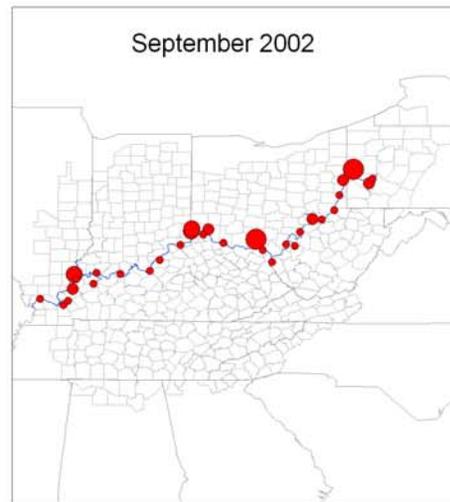
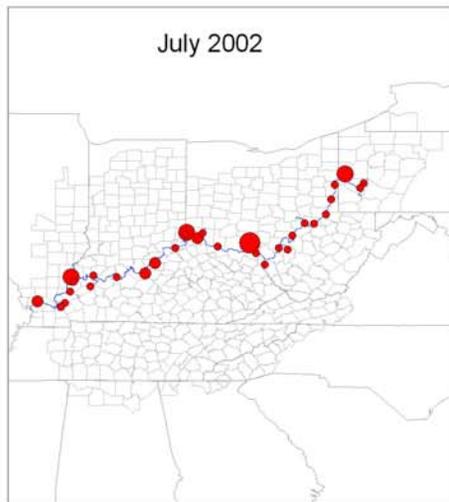
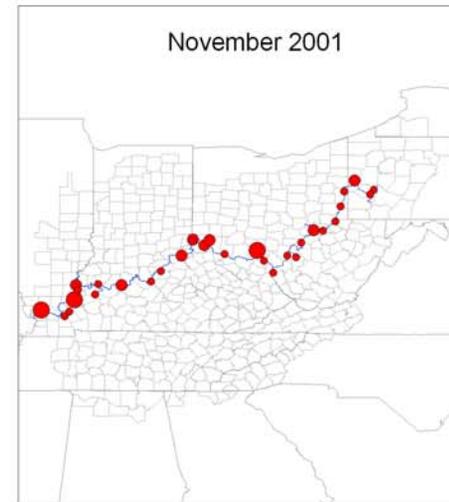
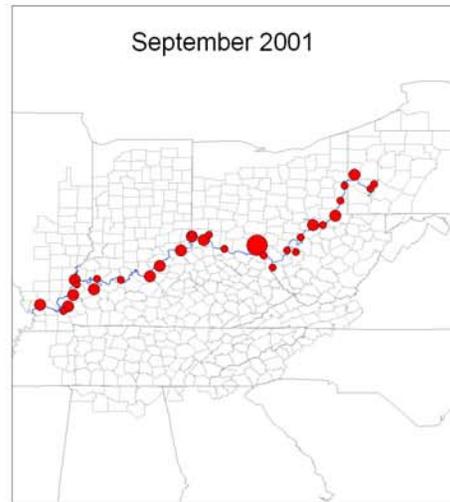
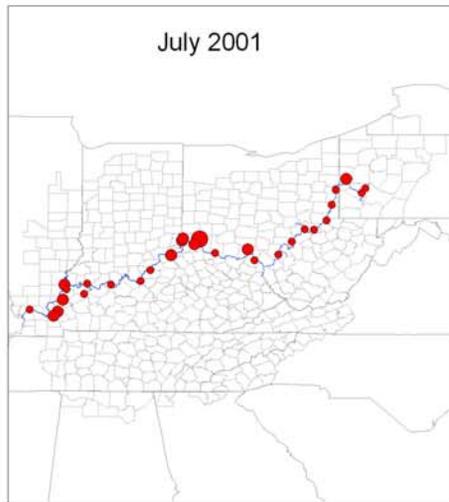


County Population (Census 2000) Along Ohio River



Map Designed by Damian Helbling

Ohio River Total Organic Carbon Concentration (mg/L) by Sample Collection Point

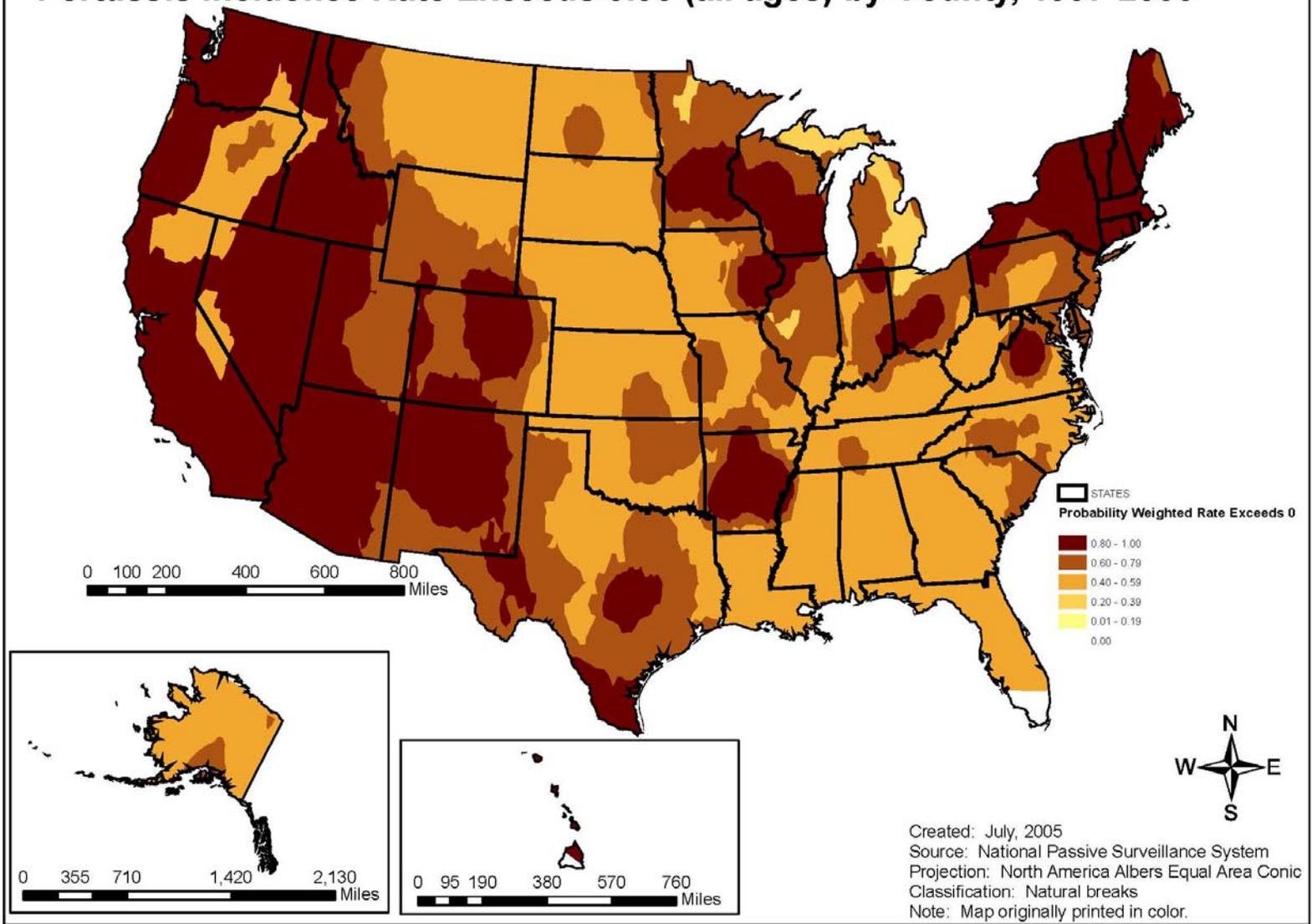


Legend

- 0.0 - 4.0
- 4.1 - 6.0
- 6.1 - 8.0
- 8.1 and greater

Map Designed by Damian Helbling

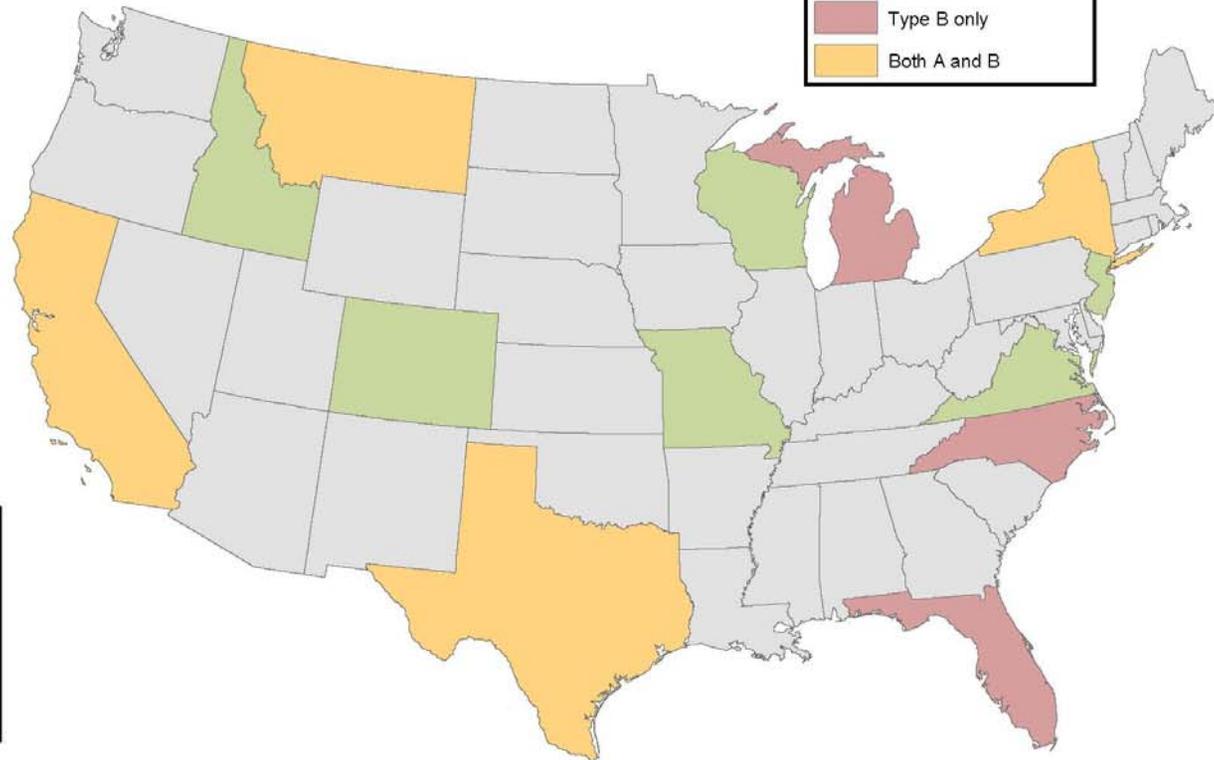
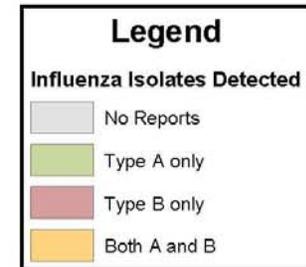
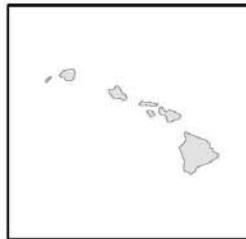
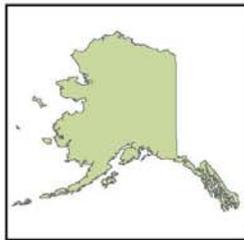
Probability Kriging: Surface of the Probability that the Weighted Pertussis Incidence Rate Exceeds 0.00 (all ages) by County, 1997-2003



Influenza Viruses Isolated since October 3, 2004

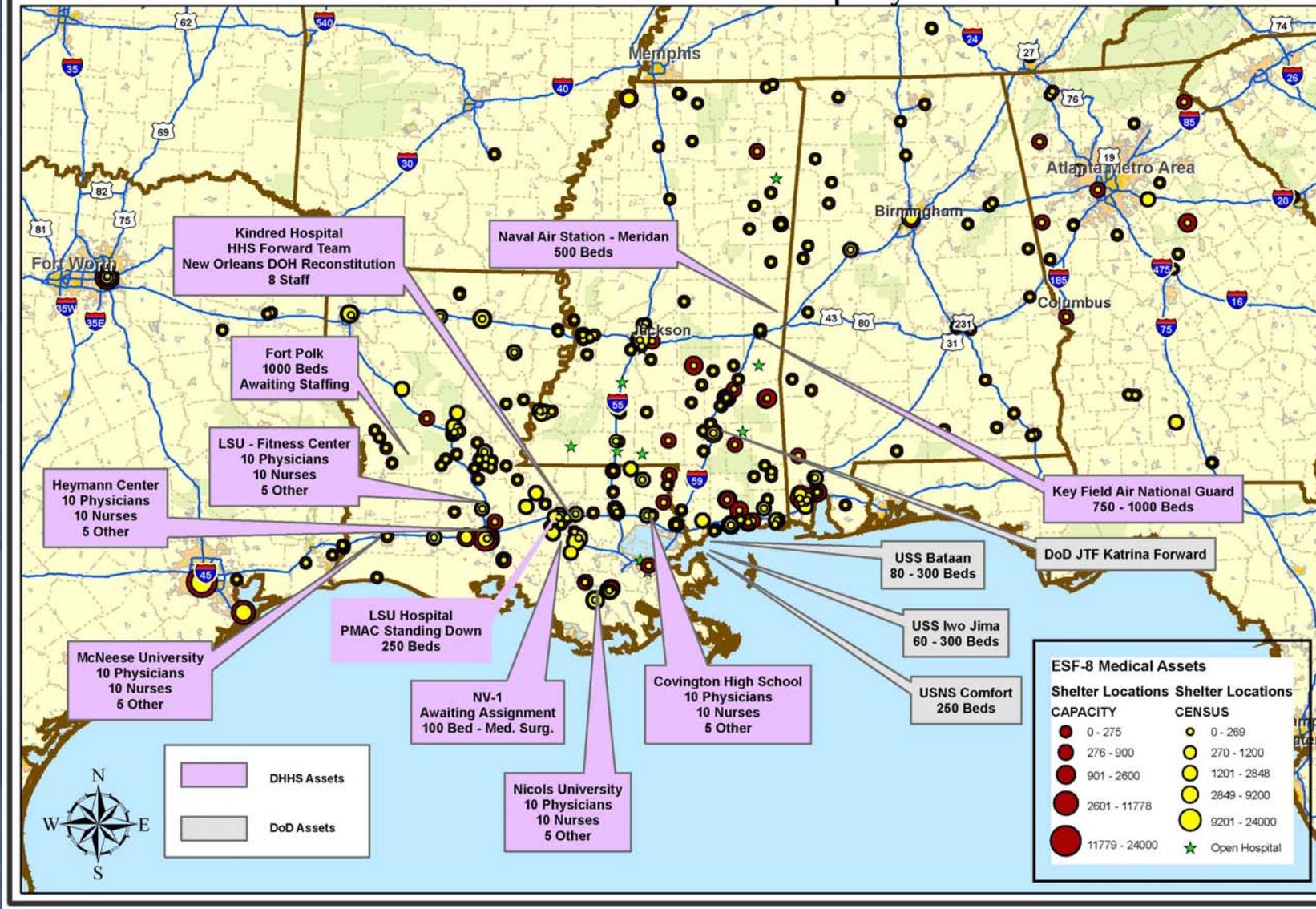
As Reported to CDC through the WHO Collaborating Laboratories and NREVSS

Updated November 5, 2004.



Hurricane Katrina ESF-8 Medical Assets Deployed

*September 7, 2005

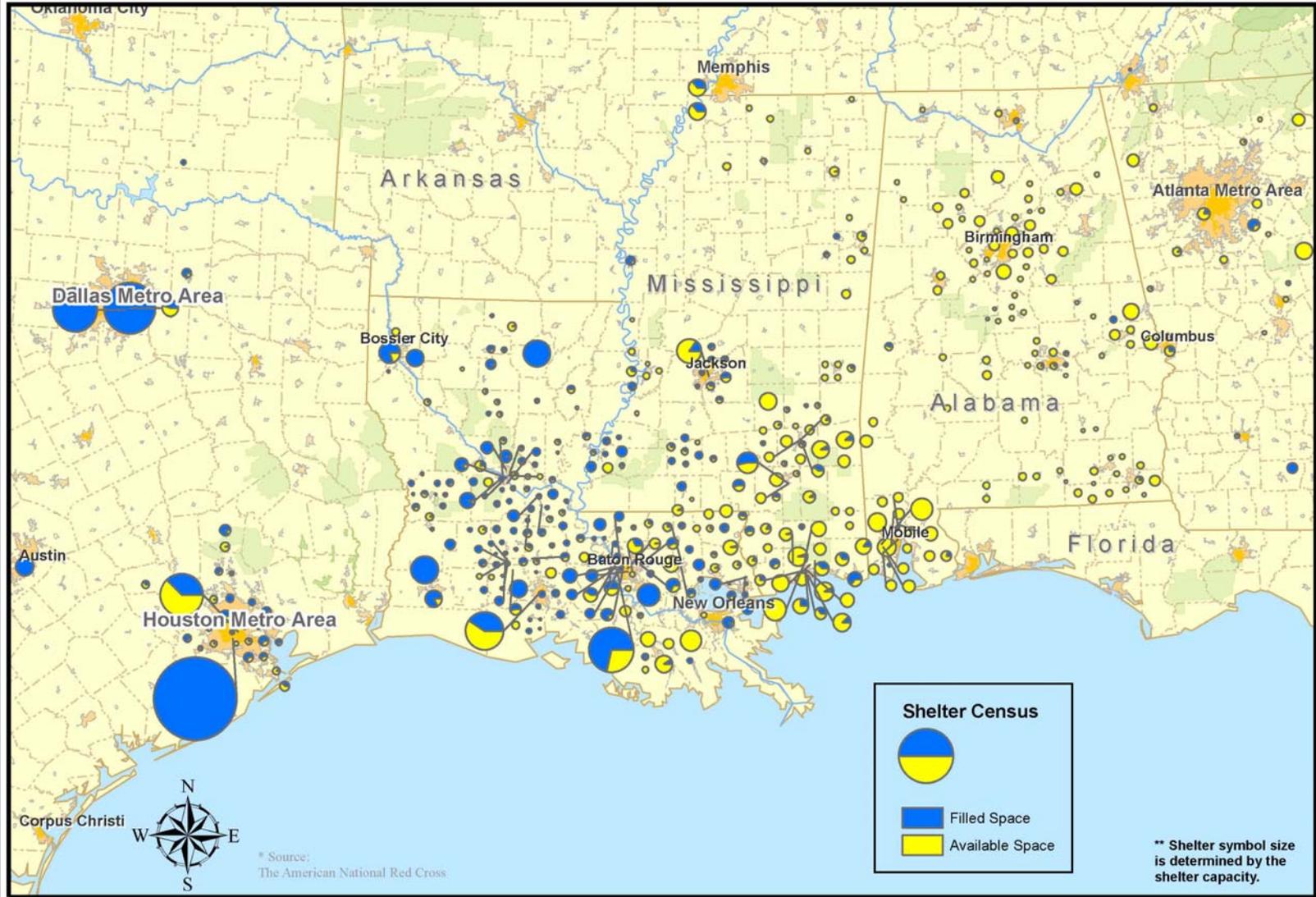




Secretary's
Operation
Center

Shelters by Capacity and Census *

September 9, 2005

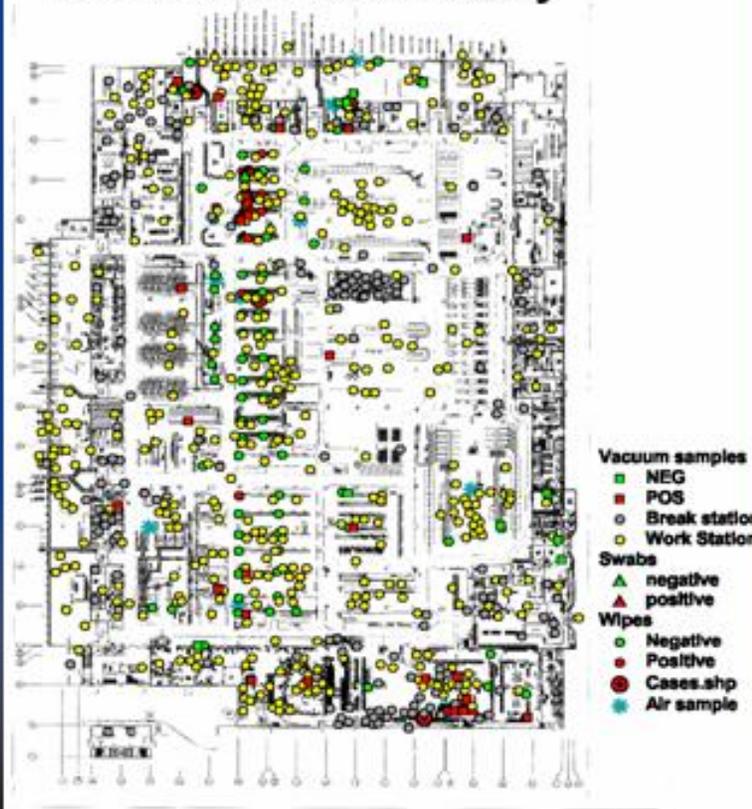




Post Office Washington DC, 2001



Washington DC Brentwood Postal Facility



SAFER • HEALTHIER • PEOPLE™



National Center for Infectious Diseases

RABIES

[Rabies Home](#) | [Professional Resources](#) | [References](#) | [Links](#) | [Contact Us](#)

Rabies Surveillance Mapping

Map by Animal

Raccoon

Map by Time Period

All Years

GO

Submit request

Using the Map

Zooming

(1) Click on either of the Magnifying Glass buttons to

Zoom-In  or

Zoom-Out .

(2) Draw a box on the Map Frame that encompasses your area of interest.

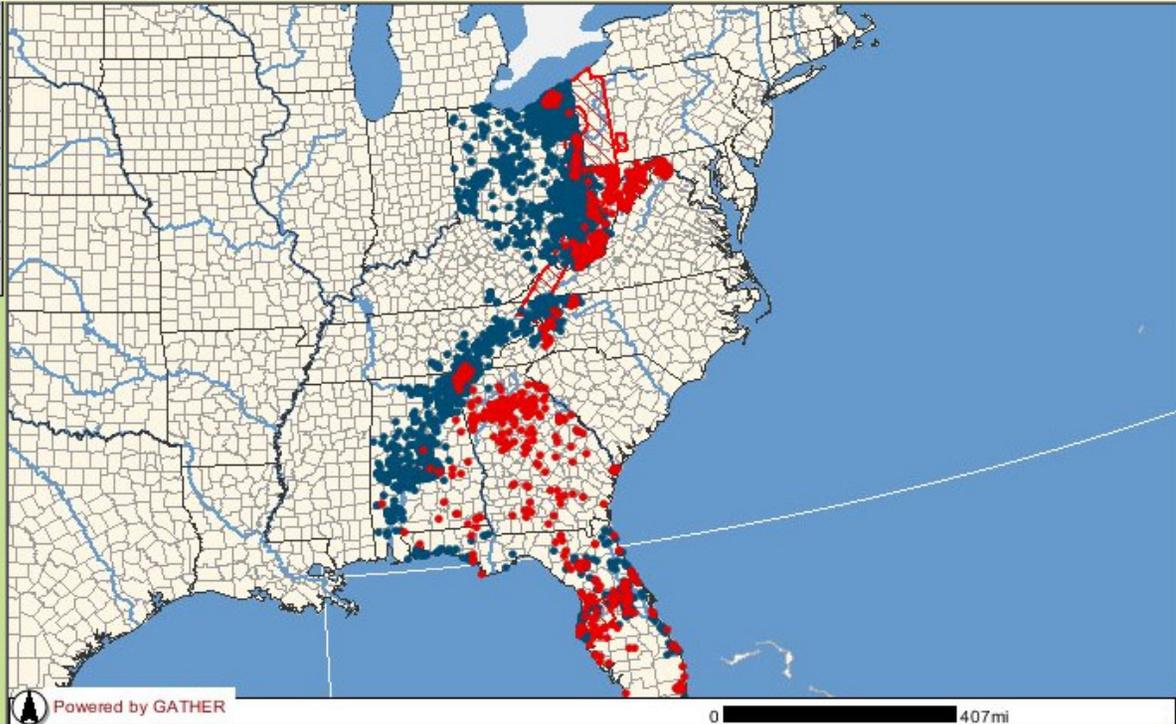
Panning the Map

Shift the area of the map by using the "Pan" tool

(1) Click , the Pan Tool.

(2) Click and drag

- Legend
- Positive Rabies Cases
 - Negative Rabies Cases
 - ORV Barrier
 - World Lakes
 - U.S. States
 - U.S. Rivers
 - U.S. Counties
 - Country
 - Earth Grid



Pan

Investigation of a Possible Birth Defects Cluster in Metropolitan Atlanta, Georgia 2000–2003

Figure 1. Urinary birth defects rate
(not adjusted for cofactors)

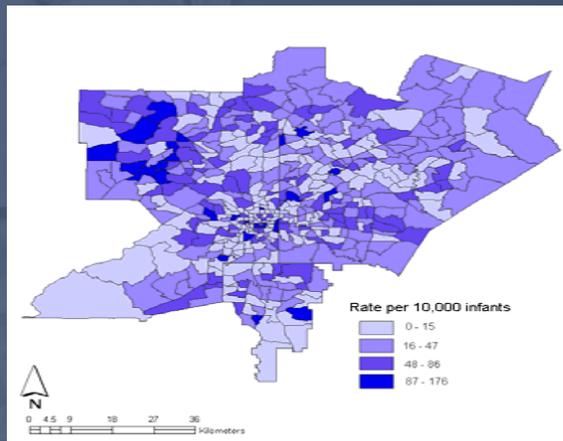


Figure 4. How SatScan Works

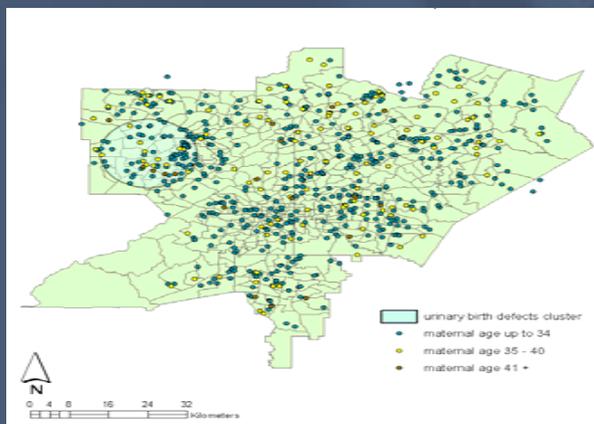


Figure 2. Urinary birth defects residuals
(adjusted for cofactors)

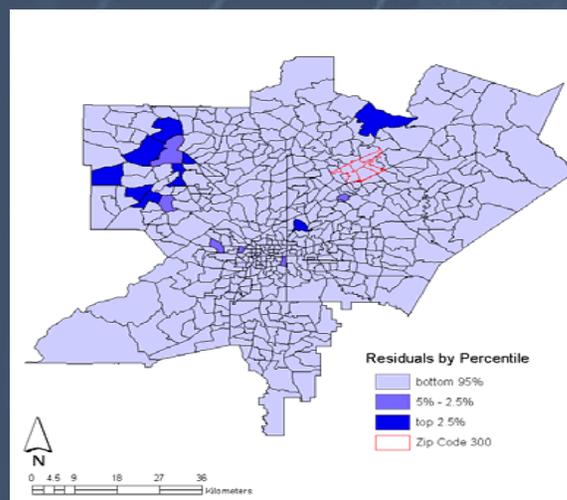


Figure 3. Residuals of all birth defects
(adjusted for cofactors)

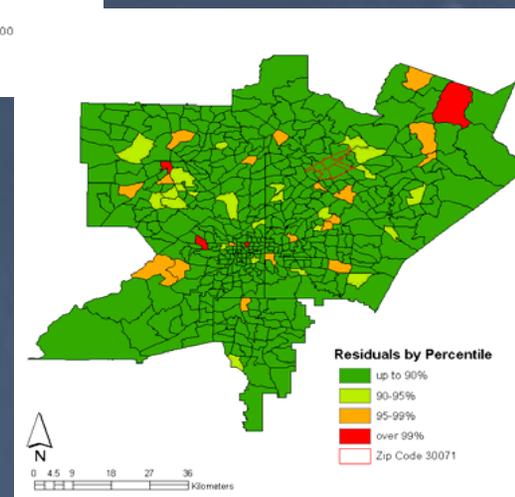
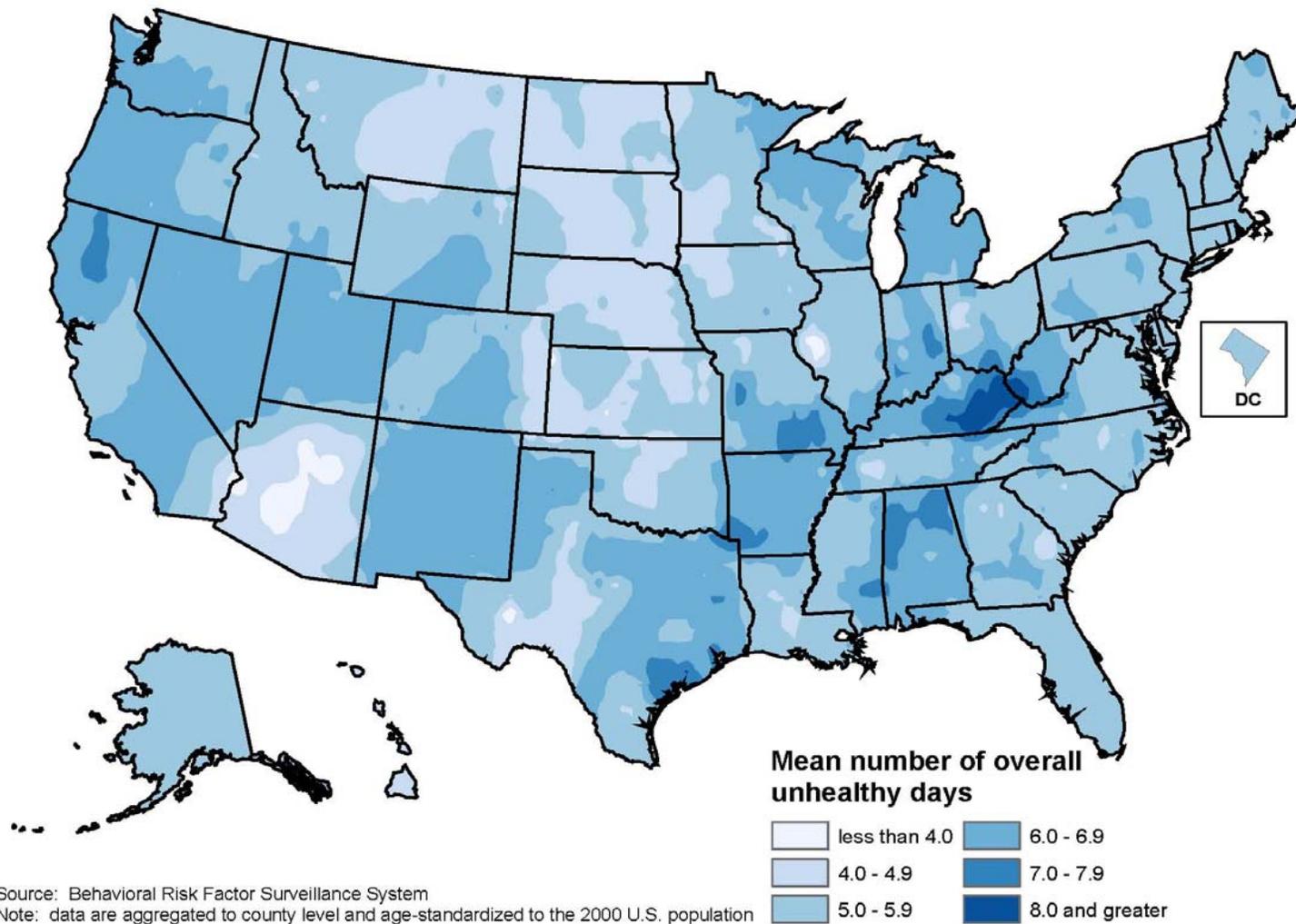
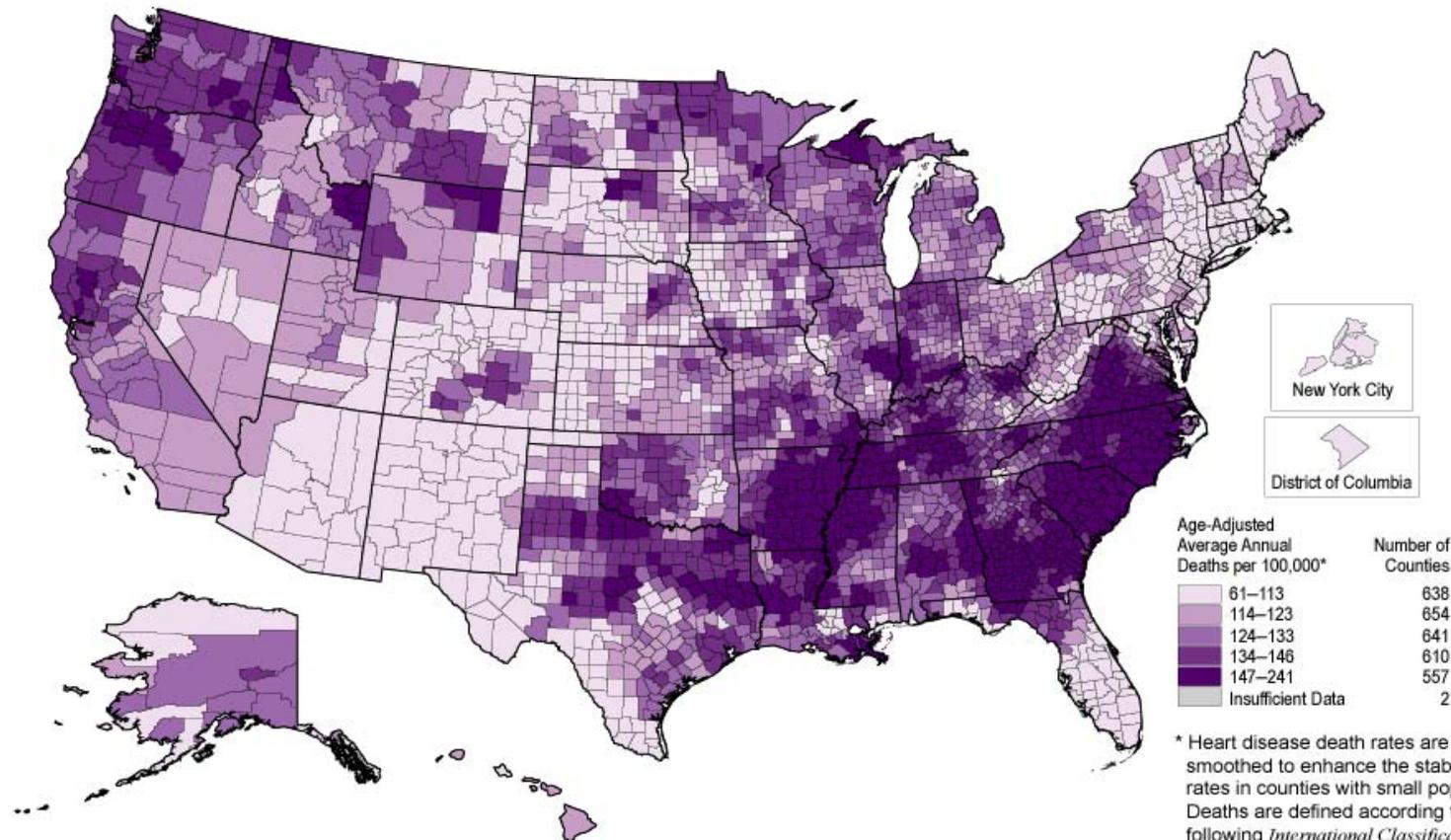


FIGURE 9. Mean number of overall unhealthy days among adults by geographic area -- United States, Behavioral Risk Factor Surveillance System, 1998 -- 2001 (age-standardized)



Stroke Death Rates, 1991–1998 Adults Ages 35 Years and Older, by County



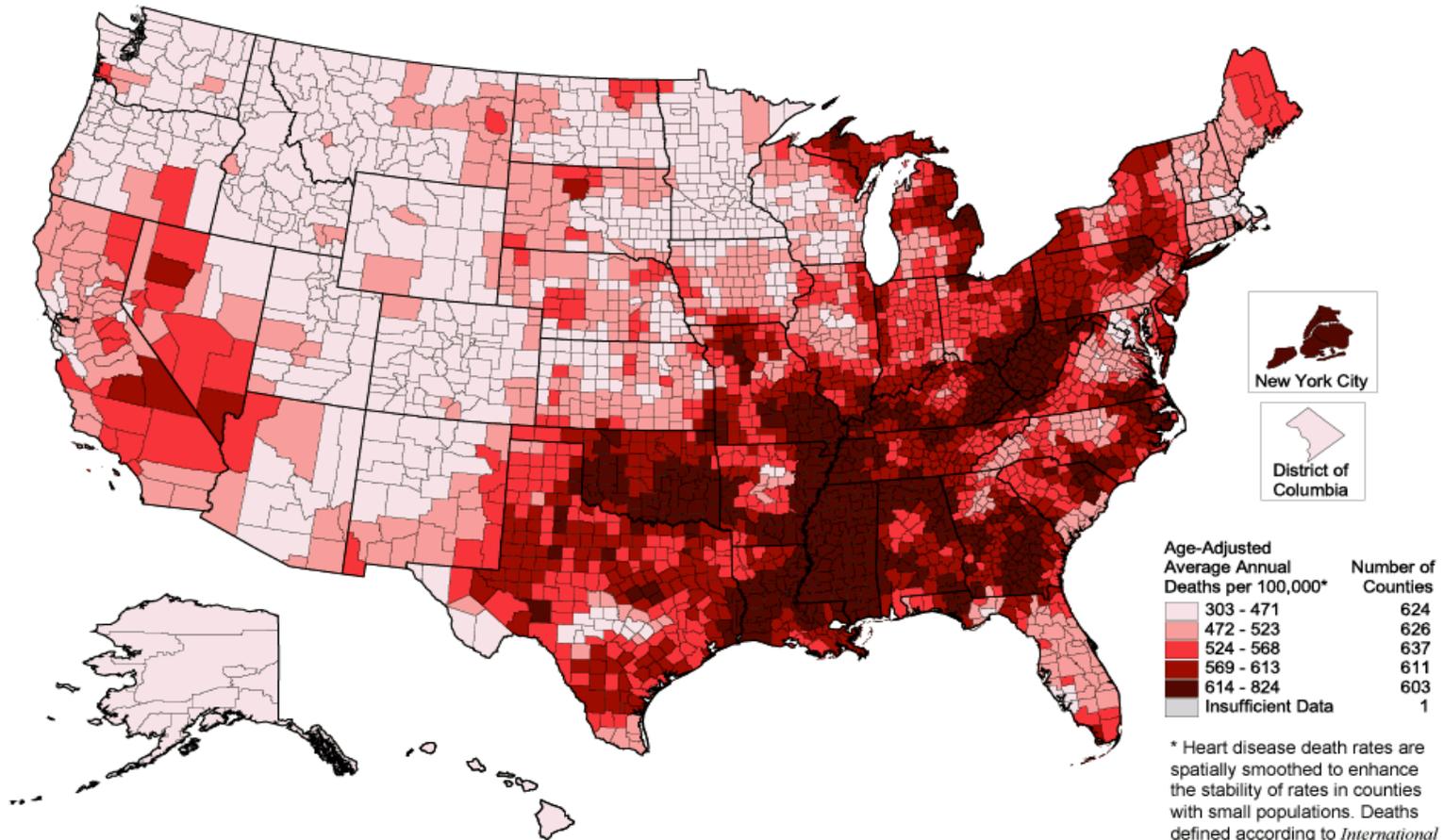
* Heart disease death rates are spatially smoothed to enhance the stability of rates in counties with small populations. Deaths are defined according to the following *International Classification of Diseases (ICD)* codes:
 ICD-9: 390-398, 402, 404-429
 ICD-10: I00-I09, I11, I13, I20-I51.

Data Sources: National Vital Statistics System, U.S. Census Bureau.



Department of Health and Human Services
 Centers for Disease Control and Prevention
 National Center for Chronic Disease Prevention and Health Promotion
 May 2004

Heart Disease Death Rates, 1996-2000 Adults Ages 35 Years and Older, by County



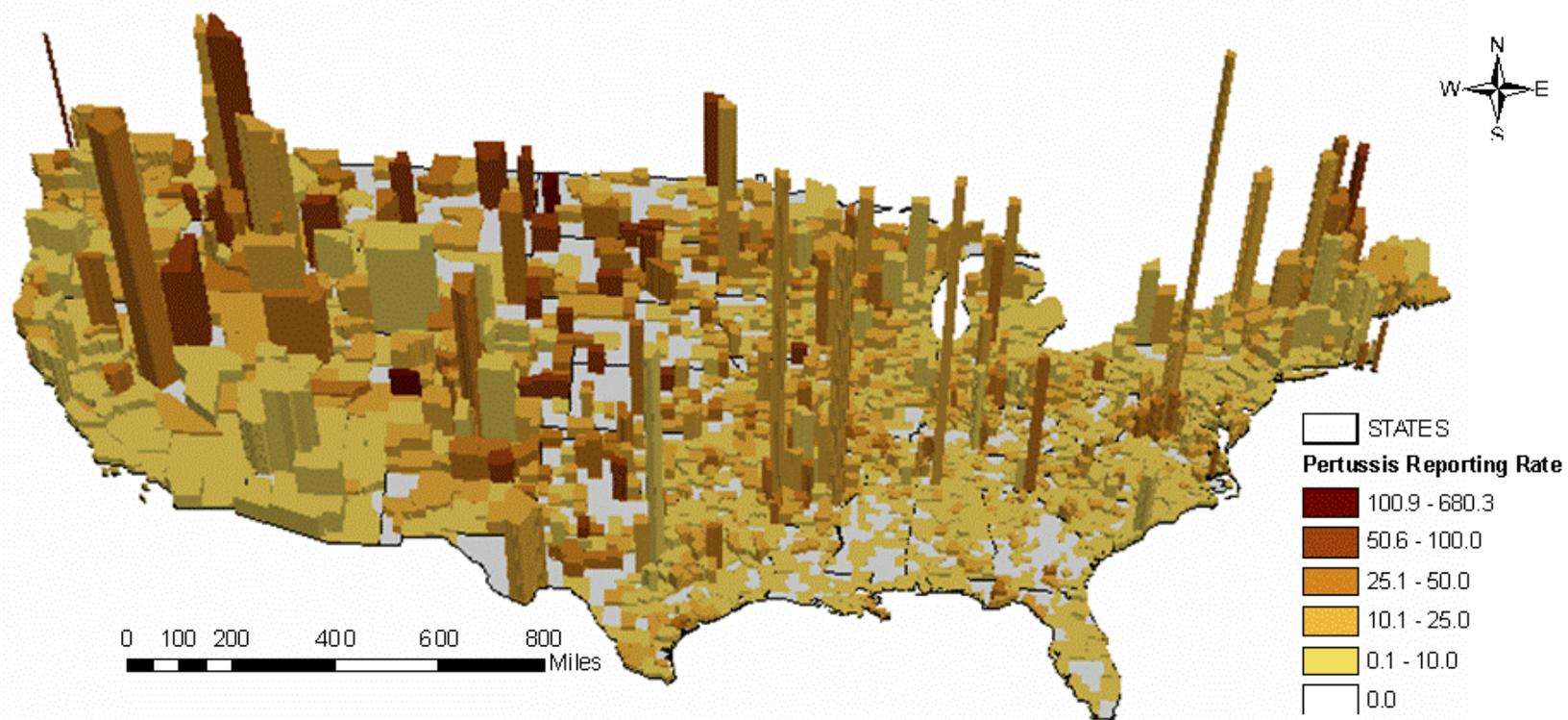
* Heart disease death rates are spatially smoothed to enhance the stability of rates in counties with small populations. Deaths defined according to *International Classification of Diseases (ICD) codes*: ICD-9: 390-398, 402, 404-429
ICD-10: I00-I09, I11, I13, I20-I51.

Data Source: National Vital Statistics System, U.S. Census Bureau.



Department of Health and Human Services
Centers for Disease Control and Prevention
National Center for Chronic Disease Prevention and Health Promotion
January 2004

Pertussis Reporting Rate Extruded by Pertussis Incidence Rate By County, 1990-2003



Created: November 2005
Source: National Passive Surveillance System
Projection: Geographic
Classification: Manual Breaks (0, 10, 25, 50, 100)
Note: Map originally printed in color.

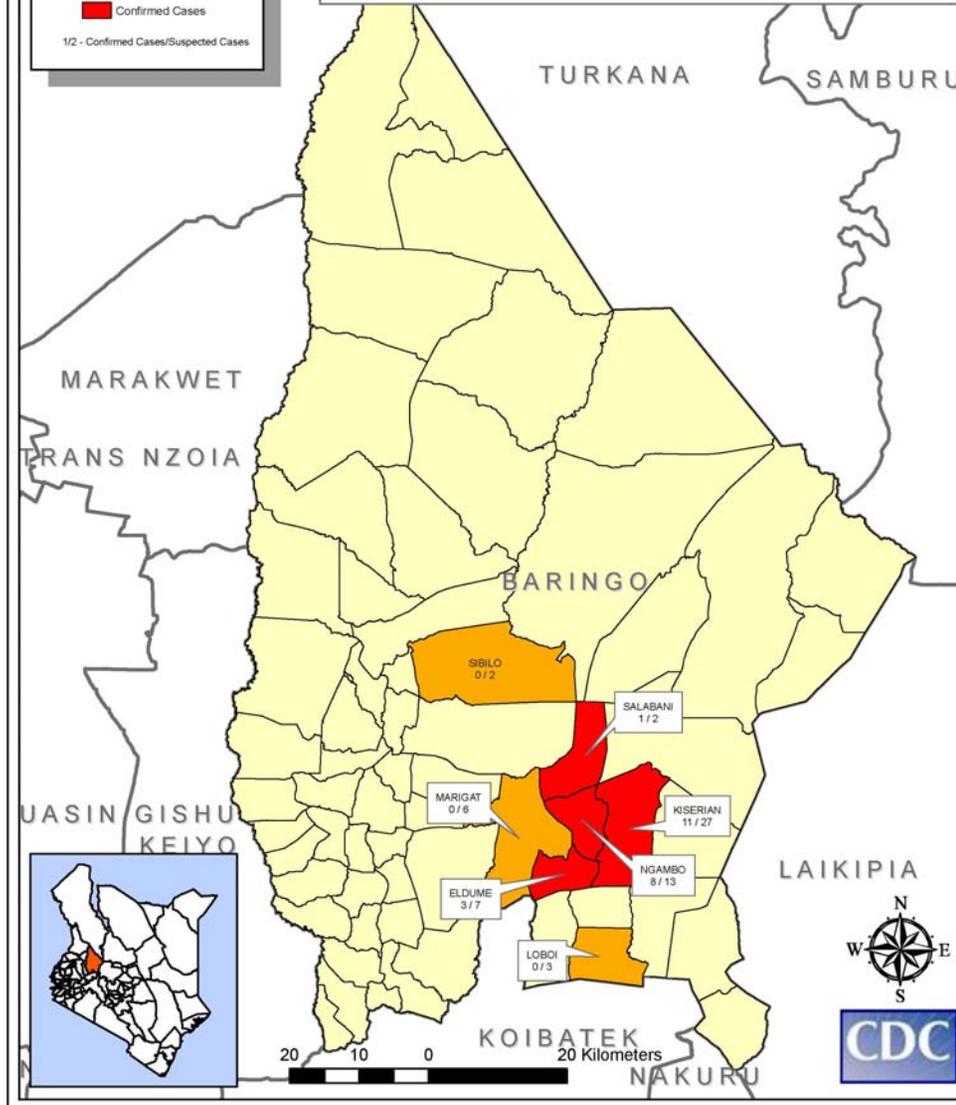
Rift Valley Fever Cases by Location Baringo District February 13, 2007

Legend

Baringo Locations

- No Cases
- Suspected Cases
- Confirmed Cases

1/2 - Confirmed Cases/Suspected Cases





CDC China Earthquake Response: A Mobile Data Collection System Implementation and Training



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Introduction

A strong earthquake (7.9 Richter scale) struck central China on May 12, 2008. The US Centers for Disease Control (CDC) expressed their condolences and offered technical assistance. A request from the China CDC for assistance with mobile data collection system(s) was received and the US CDC started working on a response. Multiple companies donated hardware and software for earthquake response and a prototype mobile data collection system was assembled, tested, and deployed in Atlanta, GA.

This prototype was demonstrated in Beijing and soon afterward the US CDC received an invitation for a field team of 6 personnel to deliver the donated hardware and software as well as to provide training to the China CDC.

Mobile Data Collection Components:



Mind Map of System in English and Chinese:



Background

Mobile Data Collection System

In the initial hours following the earthquake, the focus was to provide a technical solution for mobile data collection that would be feasible for deployment in China. The first steps involved a high-level mind map of the process of mobile data collection followed by the construction of a prototype system.



Method

Training methods included:

- Manuals
- Instructor-based, step-by-step training
- Screen-shots and emulations of the Installation, form creation, data collection, and data Analysis process.
- End-to-end system installation, implementation, and use.

Field Team Deployed to Beijing:



The official handover meeting of technology (upper left) started the collaborative effort and lead to a comprehensive set of technical and survey design for field epidemiology staff.



Workflows were developed to show how the mobile data collection system could be deployed in the field. Two options included a workgroup deployment as well as an enterprise deployment.



The CDC Global AIDS Program (GAP) office was a home base (upper left). Mobile units were charged and a plan was contracted to train China CDC IT staff (upper right) and then provide training to field epidemiologists.

Results

Preparation for Mobile Data Collection System Training...

The preparation for training involved 2 days of intensive training with the China CDC IT staff to prepare for training field epidemiologists at China CDC.

SOTI emulation was utilized to provide What-You-See-Is-What-You-Get (WYSIWYG) screenshots of how the mobile surveys operate on the smart phones.



Mobile Data Collection System Training...

The mobile data collection system implementation and training involved all levels of the China CDC.

The China CDC Director (center below) engaged with our team to discuss the system.



Epidemiological training as well as technology...

Training presentations were provided on epidemiological methods for form creation, survey design, and proper collection to allow for data analyses and data reporting. Special focus was given to the types of survey questions needed for disaster response.



Conclusion

Next Steps ...

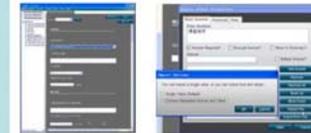
Expand the informatics exchange effort with China

Provide technical and Epi support

Evaluate the use of the system in China

Further open additional doors to cooperation between US and China CDC's

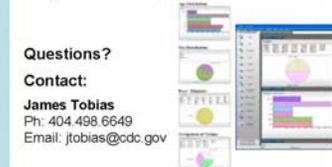
Data Collection Forms created in Chinese:



Text File Import of standard vocabularies integrated:



Analytics and Data Reporting in Chinese:



Questions?

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Public Health Impact

Collaborative efforts between the US CDC and China CDC have an opportunity to expand. There are potential opportunities to provide GIS training and to work together on issues such as pandemic flu preparation, planning, and preparedness.





The Public Health Distributed Geospatial Intelligence Network (PH-DGInet) Pilot

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1) BearingPoint 2) South Carolina Department of Health and Environmental Control (DHEC) 3) Centers for Disease Control and Prevention (CDC)

Introduction

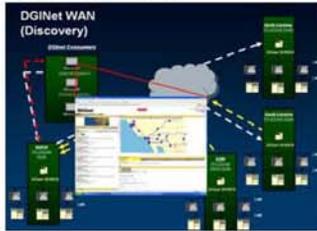
The Office of Management and Budget (OMB) is moving the federal government to a Service-Oriented Architecture (SOA) and released the Geospatial Line of Business to mandate consolidation of geospatial services across the federal government.

The CDC is currently pilot testing several shared services frameworks including a framework called the Public Health Distributed Geospatial Intelligence Network (PH-DGInet).

The pilot test of the PH-DGInet will include installation of 3 nodes:

- 1) National Center for Public Health Informatics
- 2) South Carolina Department of Health & Environmental Control
- 3) Environmental Systems Research Institute (ESRI)

PILOT TEST NODES:



Background

DGINet History:

The Distributed Geospatial Intelligence Network (DGInet) was built by ESRI for the intelligence community (CIA, FBI, NSA, DIA) and has been operational since 1999.

Components of a DGInet Portal:



Method

A Shared Services Framework

The PH-DGInet has an SOA architecture that allows public health clients to author services and describe those services with Web Service Description Language (WSDL) metadata. The WSDL are published to a Universal Description Discovery and Integration (UDDI) registry. This allows partner nodes to discover and leverage services authored by other nodes and to reduce duplication of effort.



Figure 3 DGInet Architecture Detail



The DGInet portal viewer allows clients to search and discover shared geospatial data and services and fuse those data sources within a map portal. The portals are customizable and can be tailored to meet specific client requirements.



Fusion of data and services operate across multiple partner nodes to leverage data from an enterprise or between entire agencies or organizations.



National disasters such as hurricane Katrina (2005) demonstrate the need for shared geospatial services and data fusion to provide situational awareness to all agencies responding to the crisis.

Results

Pilot Project Accomplishments

- Installation of 3 nodes of the PH-DGInet
- Communication between the 3 nodes
- Federated queries between the nodes
- Data fusion and overlay of nodal data
- Collaboration between node partners
- Basic epidemiological curve / histogram tool
- Foundational framework for new public health services

The Distributed Aggregation Function allows clients to select federated data sources and to specify parameters for federated queries.



The customized PH-DGInet portal viewer allows clients to execute federated queries across the partner nodes and to produce choropleth maps of cases per county with a histogram of cases within the last 7 days.

Future Expansion of the Pilot

The future of the pilot project will involve the addition of several new nodes (both state and federal nodes). These additional nodes will allow for regional collaboration between nodes and will expand the utility of the basic pilot.

Agencies that have expressed interest in the expanded pilot:

- VA
- USDA
- FDA
- North Carolina Department of Health
- Georgia Division of Public Health
- California Department of Health
- New York City Department of Health
- Florida Department of Health

Conclusion

PH-DGInet

The pilot of the PH-DGInet demonstrates the utility of a shared services framework for public health. Geospatial services, data, tools, models, and more can be shared and leveraged across multiple partner nodes. The ability to perform federated queries on distributed data stores is vital to the future of public health and biosurveillance. This framework will allow shared geospatial services across government agencies as outlined in the Geospatial Line of Business. The framework is mostly open-source (Apache, JBOSS, Python, etc) and works with non-ESRI clients such as Google Earth.

Geospatial Line of Business:



In 2005 the FEA sponsors recognized the special value of systematic approaches to geospatial location, search data and services across the government.

Support for Google Earth:

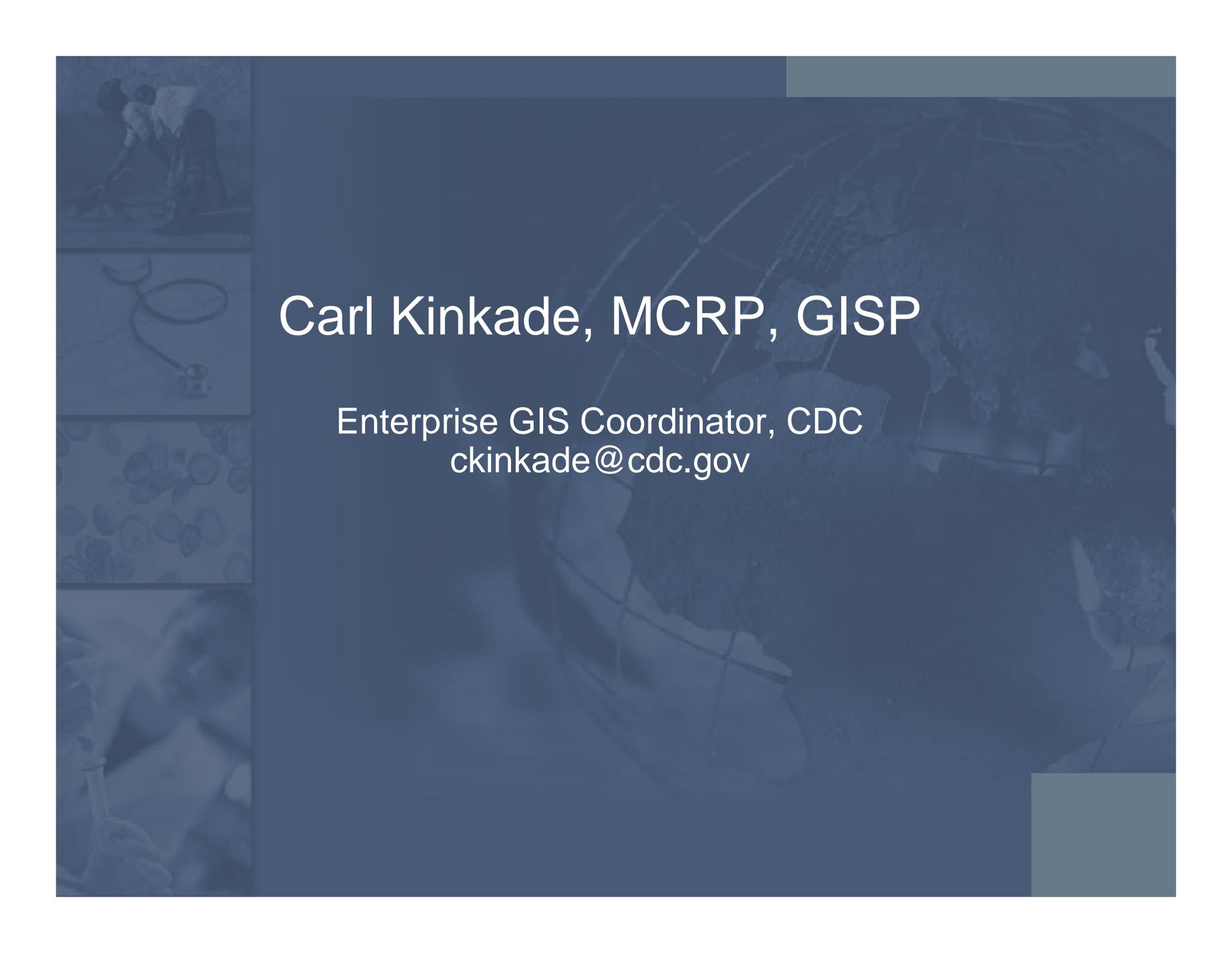


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Public Health Impact

The sharing of geospatial services across public health agencies will reduce duplication of effort, standardize services, provide rapid application development at lower cost, and increase situational awareness and capability to respond during times of regional or national disasters.

The background features a dark blue color scheme with a faint, large-scale globe centered on the right side. On the left, there is a vertical strip containing four small, semi-transparent images: the top one shows two people examining a map; the second shows a stethoscope; the third shows a cluster of cells or microorganisms; and the bottom one shows a person's face. The text is overlaid on the right side of the slide.

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