

“Some More Polluted
than Others: Unequal Cumulative
Industrial Hazard Burdens
in the Philadelphia MSA, USA.”
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Diane M. Sicotte
Associate Professor of Sociology
Drexel University, Philadelphia, PA USA

The Problem: Cumulative Hazards

- “Cumulative hazards” means the total of environmentally hazardous facilities and land uses sited in a community.
- Due to factors such as zoning, history of prior industrial use, and flawed state laws, hazardous land uses tend to accumulate in relatively few communities in urban areas.
- The impact of these hazards goes beyond possible health effects, lowering residents’ quality of life and property values, repelling “clean” businesses, and attracting still more hazardous land uses.

Research Questions:

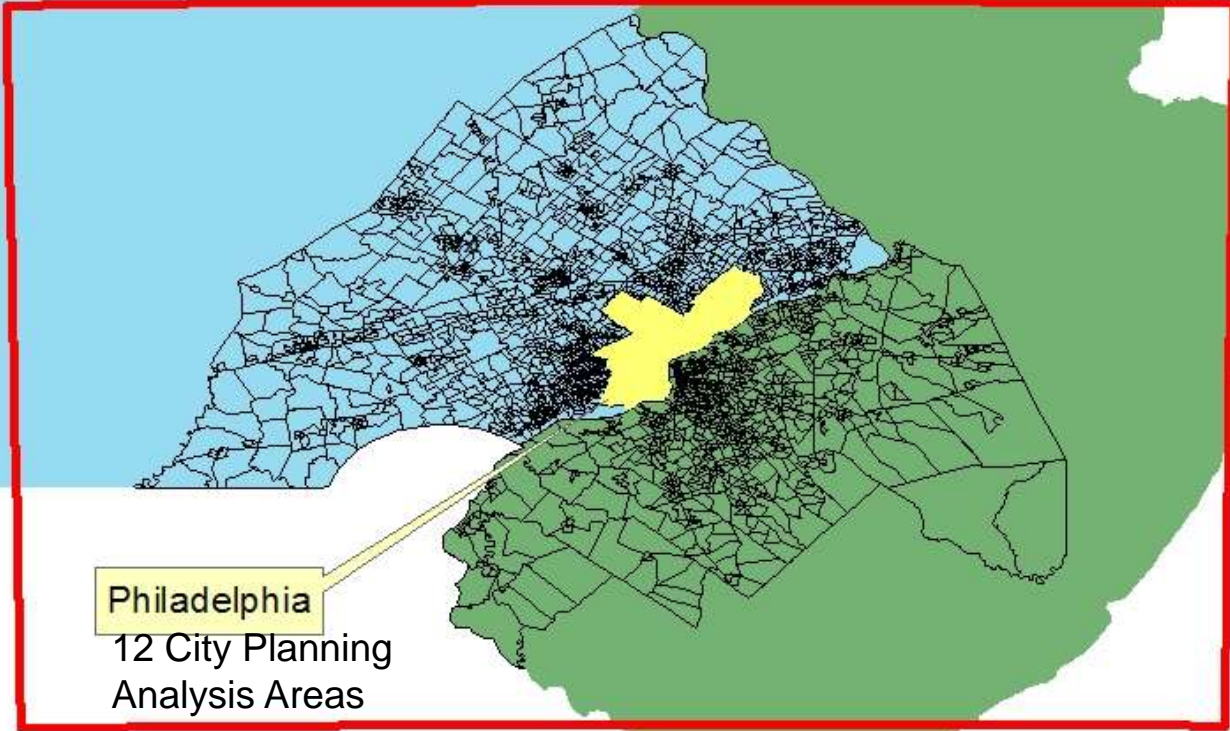
1. Taking into consideration all federally- and state-regulated environmental hazards, which communities in the Philadelphia Metropolitan Statistical Area (MSA) are the most burdened?
2. Are there environmental inequalities based on race/ethnicity and income?
3. If inequalities exist, how extensive are they?
4. Is there a spatial patterning among the most-burdened communities?

Map 1: Study Area

Pennsylvania

New Jersey

8 suburban counties containing
356 boroughs, cities and townships



Philadelphia
12 City Planning
Analysis Areas

0 5 10 20 Miles

Methods

- With ArcView, map all hazardous sites, assigning points value to each.
- Add together all points for each community.
- Define “extensively burdened communities” as those with more hazard points than 90% of communities in the Philadelphia MSA.
- Calculate risk of being extensively burdened by each community characteristic.

Sources of Data:

Federal-Level

- CERCLIS (Superfund) – USEPA
- TRI – USEPA
- Census of 2000 – US Dept. of the Census (places for suburban towns, Census Tract for Philadelphia Planning Analysis Areas).

State-Level

- Operating Hazardous Waste TSDFs (NJDEP, PADEP)
- Municipal Incinerators, Demolition and Municipal Landfills, Trash Transfer Stations, Waste Tire Piles (NJDEP, PADEP)
- Sewage and Sludge Facilities (NJDEP, PADEP)
- Operating Power Plants (NJDEP, PADEP, TRI)
- Proposed Power Plants (Power Plant Jobs, NJ & PA).

Census Data (2000):

“Minority Status:” Percent Black + Percent Hispanic. Median % Minority for all communities was only 5.3% (but 45% in Philadelphia). Four equal-sized groups:

- Low Minority: 0 – 2.59% Minority
- Moderately Low Minority: 2.6 – 5.29%
- Moderately High Minority: 5.3 – 14.99%
- High Minority: 15% and above

“Income Status:” Median Household Income for 1999. Median for entire Philadelphia MSA: \$55,086 (higher than national median because it’s a metro area, includes NJ, a high-income state). Four equal-sized groups:

- Low Income: \$0 - \$44,999
- Moderately Low Income: \$45,000 - \$54,999
- Moderately High Income: \$55,000 – 64,999
- High Income: \$65,000 and above

Sources of Methodology:

“Point Per Hazard” System (pioneered in Massachusetts)

Faber, D. R. and Krieg, E. J. 2002. “Unequal exposure to ecological hazards: environmental injustices in the Commonwealth of Massachusetts.” *Environmental Health Perspectives*, 110, (S2) 277-288.

Krieg, E. J. and Faber, D. R. 2004. “Not so Black and White: environmental justice and cumulative impact assessments.” *Environmental Impact Assessment Review*, 24, 667-694.

Calculating Risk of Being Environmentally Burdened

Apelberg, B.J., Buckley, T.J. and White, R.H. 2005. “Socioeconomic and Racial Disparities in Cancer Risk from Air Toxics in Maryland.” *Environmental Health Perspectives*, 113, 6:693-699.

Linder, S.H., Marko, D., and Sexton, K. 2008. “Cumulative Cancer Risk from Air Pollution in Houston: Disparities in Risk Burden and Social Disadvantage.” *Environmental Science and Technology*, 42, 12:4312-4322.

TYPE OF HAZARDOUS FACILITY OR SITE	POINTS
NPL Superfund Site	25
Non-NPL Superfund Site	5
State-Regulated Abandoned Hazardous Waste Site	5
Large Power Plant (Top 5 Polluter)	25
Small Power Plant	10
Proposed Power Plant	5
TRI Industrial Facility	5
Commercial Hazardous Waste TSDF	5
Municipal Incinerator	20
Municipal Solid Waste Landfill	5
Construction/Demolition Landfill	3
Large Sewage Treatment or Sludge Facility	5
Waste Tire Pile	5
Trash Transfer Station	5

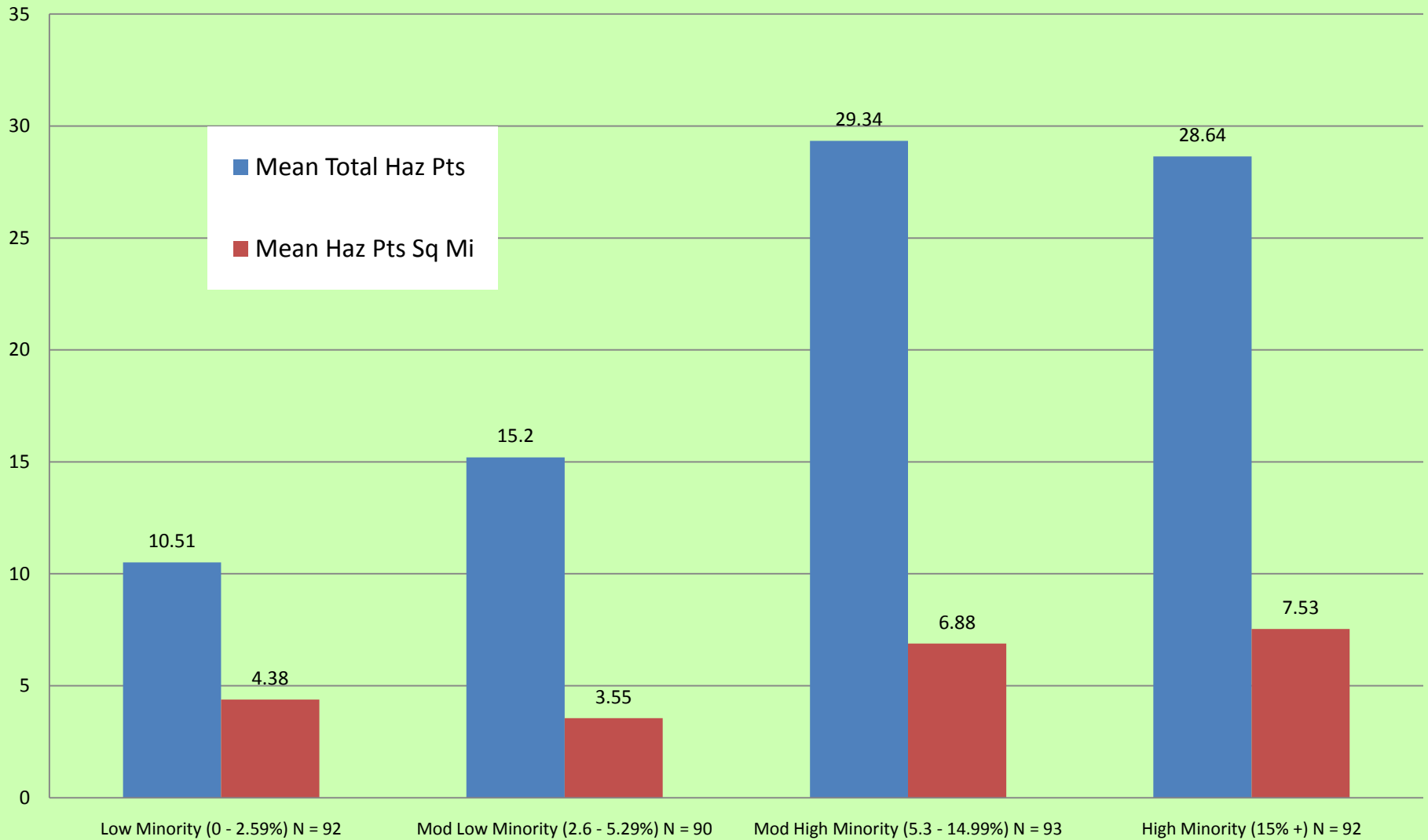
Limitations of Study Due to Data:

- *Very* imprecise characterization of hazardousness (of Superfund sites, state-regulated abandoned hazardous waste sites).
- Makes it untenable to draw conclusions about exposures—but this study is about *distributional inequality in proximity* (I make no claims about exposure or health effects).
- Some data had to be generalized due to incompatibility of NJ & PA classifications.
- NJ did much better job than PA of geocoding each site.
- PA did better job of mapping illegal garbage dumpsites than NJ.

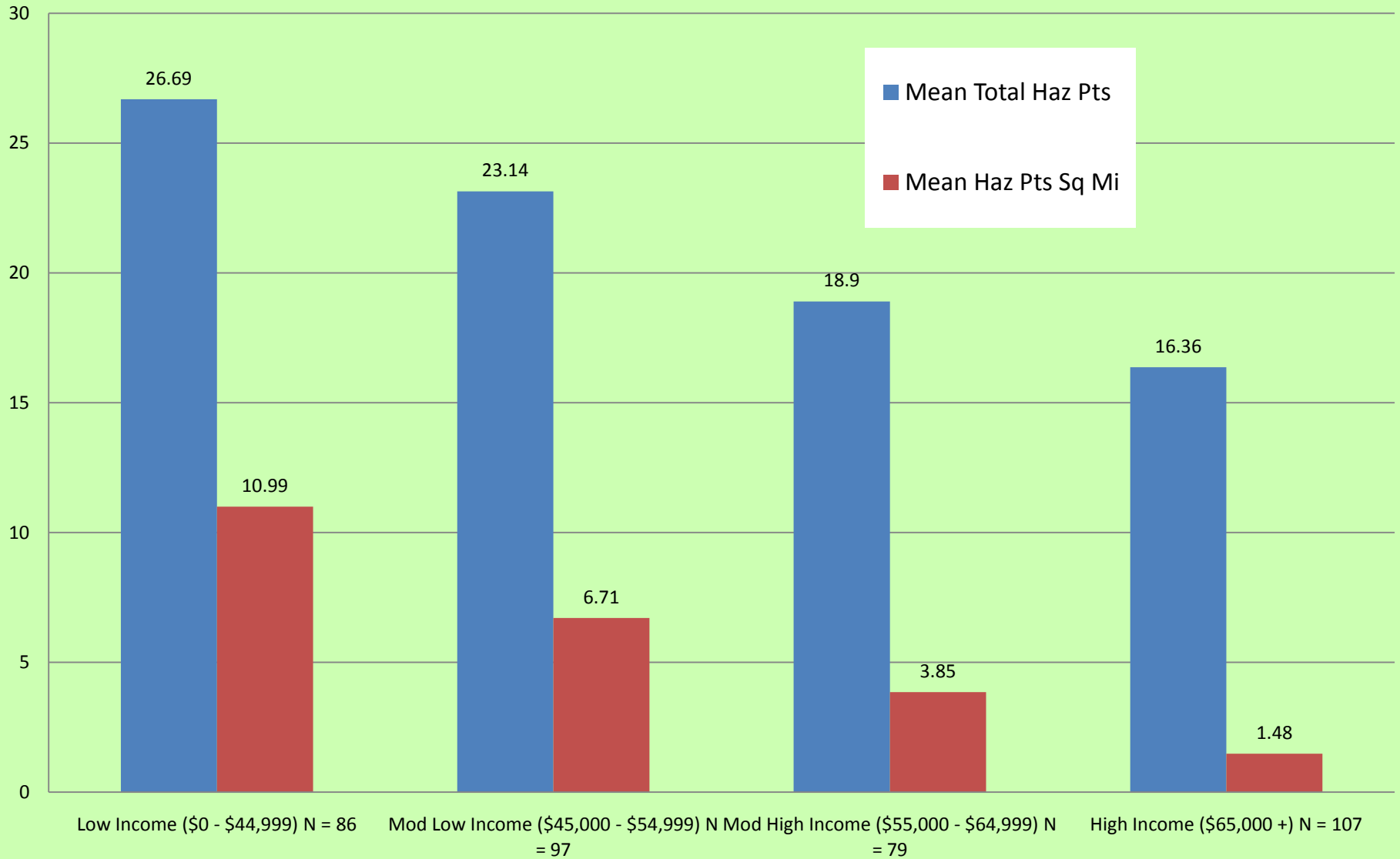
Top 10 Communities Extensively Burdened with Cumulative Hazards

Rank	Town or Planning Analysis Area (if Philadelphia)	Total Hazard Points (Mean = 21.2)	Income Status (1999 MHI)	Minority Status
1	Camden, NJ	270	Low Income (\$23,421)	High Minority (92.51%)
2	Falls Township, PA	210	Moderately Low Income (\$50,129)	Moderately High Minority (7.01%)
3	Pennsauken, NJ	208	Moderately Low Income (\$47,538)	High Minority (44.09%)
4	Bridesburg-Kensington-Richmond (Philadelphia), PA	200	Low Income (\$22,500)	High Minority (30.03%)
5*	Franklin Township, NJ	185	Moderately High Income (\$55,169)	Moderately High Minority (9.43%)
5*	West Deptford Township, NJ	185	Moderately Low Income (\$50,583)	Moderately High Minority (6.54%)
6*	Near Northeast (Philadelphia), PA	135	Low Income (\$34,310)	High Minority (18.55%)
6*	South Philadelphia (Philadelphia), PA	135	Low Income (\$24,500)	High Minority (37.14%)
6*	Upper Merion Township, PA	135	High Income (\$65,636)	Moderately High Minority (7.41%)
7*	Bristol Township, PA	110	Moderately Low Income (\$48,090)	Moderately High Minority (80.07%)

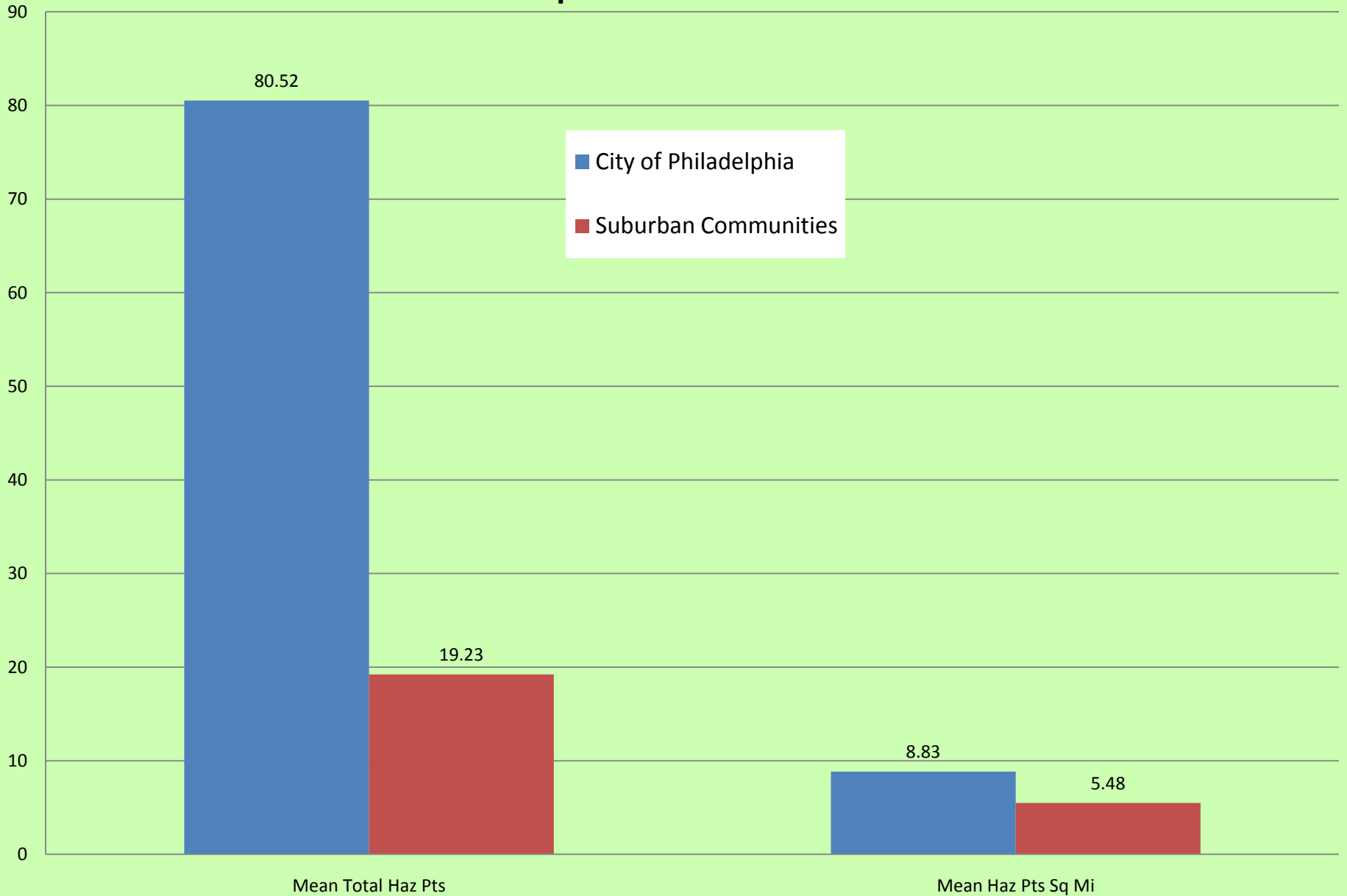
Environmental Hazard Burdening by Minority Status, Philadelphia MSA Communities



Environmental Burdening by Income Status, Philadelphia MSA Communities



Environmental Hazard Burden by City/Suburb Location, Philadelphia MSA Communities



Communities Extensively Burdened in More than One Category (14 of the 16 Extensively Burdened):

Community (# of Categories)	Categories			
*Planning Analysis Area, Philadelphia	HAZ WASTE (NPL Superfund, Other Superfund, State-Regulated Abandoned)	POWER PLANTS (Large, Small & Proposed Electric Power Plants)	INDUSTRY (TRI and Hazardous Waste TSD Facilities)	WASTE (Incinerators, Landfills, Sewage and Sludge Facilities, Waste Transfer Stations, Waste Tire Piles)
*Bridesburg-Kensington-Richmond , PA (4)	X	X	X	X
West Deptford Township, NJ (4)	X	X	X	X
Camden City, NJ (3)	X		X	X
Chester City, PA (3)		X	X	X
Falls Township, PA (3)		X	X	X
*Near Northeast, PA (3)	X		X	X
*South Philadelphia, PA (3)		X	X	X
Bristol Township, PA (2)		X	X	
Franklin Township, NJ (2)	X			X
Greenwich Township, NJ (2)		X	X	
Logan Township, NJ (2)	X	X		
Pennsauken, NJ (2)	X		X	
Upper Merion Township, PA (2)	X		X	
Warminster Township, PA (2)	X		X	

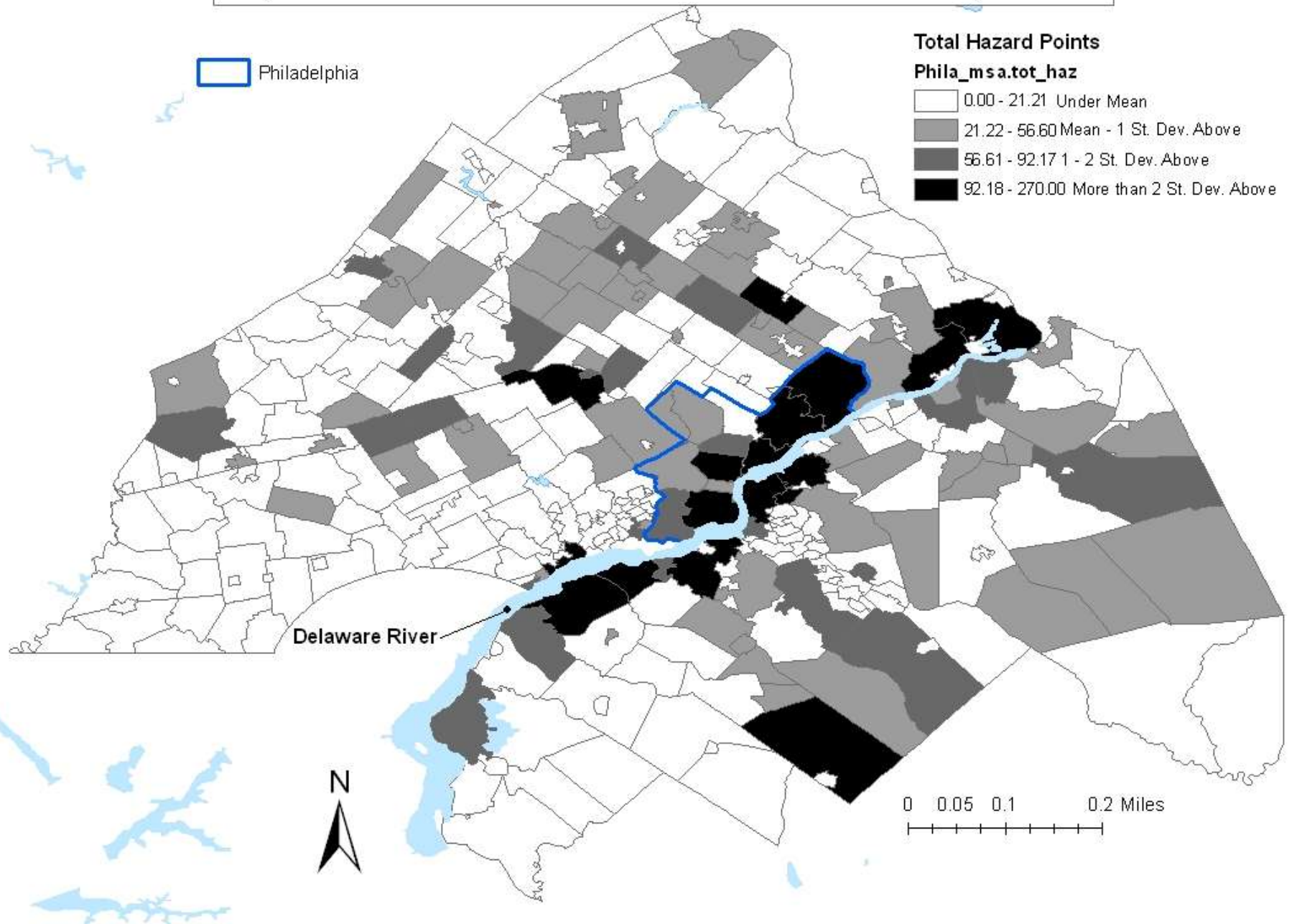
Characteristics that increase or decrease risk of being extensively burdened: **Bordering the Delaware**

RISK	Percent Extensively Burdened	Risk Ratio (95% CI)
Community Borders Delaware River	44.44	7.58 (4.39 – 13.07)

How to interpret a Risk Ratio: A Risk Ratio is only significant if the 95% Confidence Interval falls outside the range of 1.0; therefore, if the last number is less than 1.0 the risk is less than 1; if the first number is more than 1.0, the risk is more than 1.

The correct way to interpret the Risk Ratio above: the risk of being extensively burdened is 7.6 times greater for communities on the border of the Delaware River.

Map 1: Total Hazard Points for Communities in Philadelphia MSA



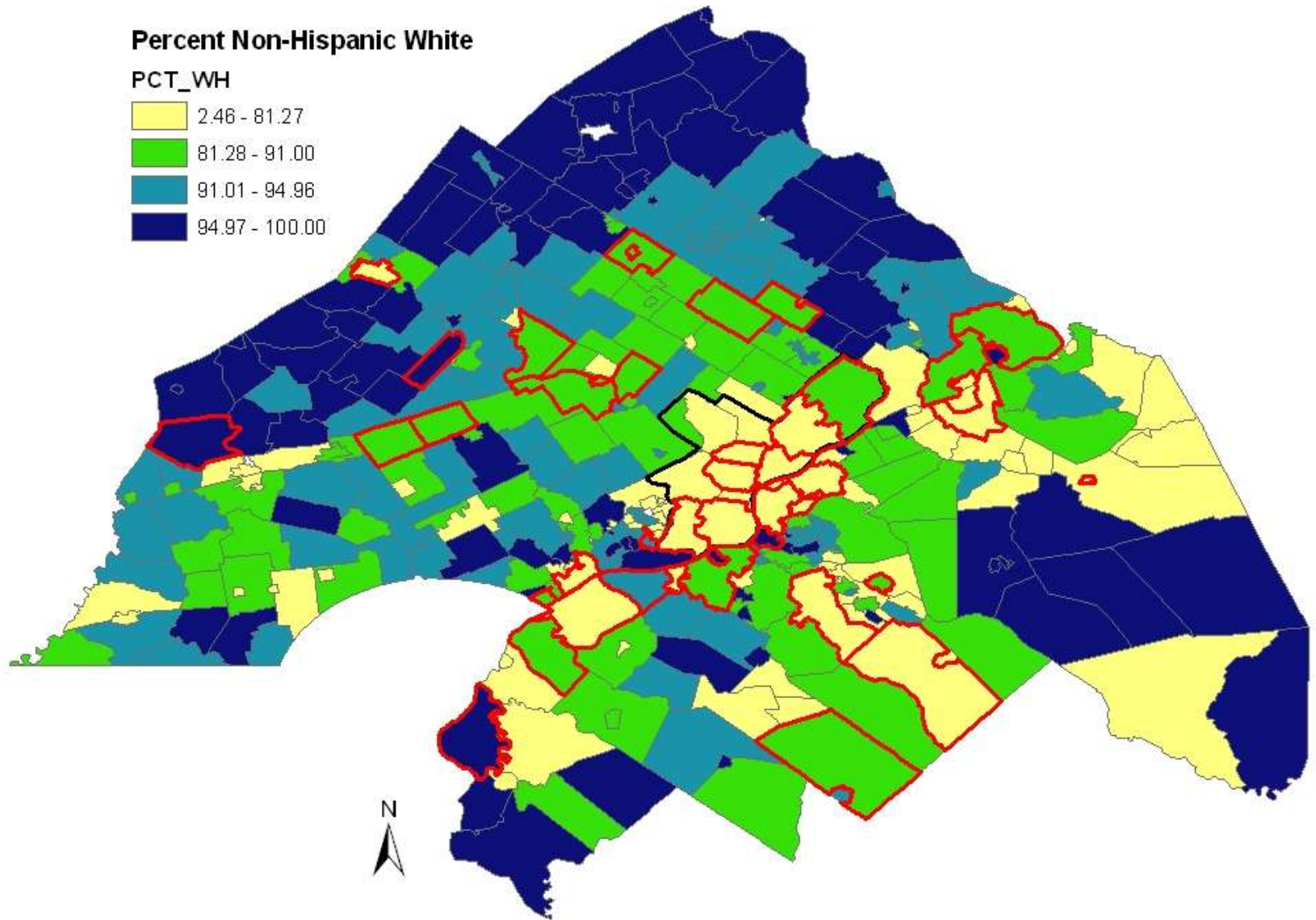
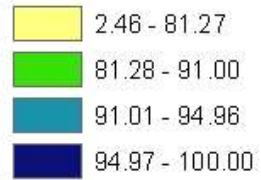
Characteristics that increase/decrease risk of extensive burdening: **Race/Ethnicity**

RISK	Percent Extensively Burdened	Risk Ratio (95% CI)
Percent Black		
0 – 1.08	7.89	0.26 (0.08 – 0.84)
1.09 – 3.03	13.16	0.45 (0.18 – 1.11)
3.04 – 9.81	39.47	1.93 (1.05 – 3.54)
9.82 – 89.98	39.47	1.95 (1.07 – 3.59)
Percent Hispanic		
0 – .9582	2.56	0.79 (0.01 – 0.57)
.9583 – 1.75	25.64	1.03 (0.52 – 2.04)
1.76 – 3.53	28.21	1.18 (0.61 – 2.27)
3.54 – 38.70	43.59	2.31 (1.29 – 4.17)
Percent White		
2.46 – 81.27	41.03	2.08 (1.15 – 3.76)
81.28 – 91.00	43.59	2.34 (1.30 – 4.21)
91.01 – 94.96	5.13	0.16 (0.04 – 0.66)
94.97 – 100.00	10.26	0.34 (0.12 – 0.94)

Extensively Burdened Communities, by Percent White

Percent Non-Hispanic White

PCT_WH



Characteristics that increase/decrease risk of extensive burdening: **Social Class**

RISK	Percent Extensively Burdened	Risk Ratio (95% CI)
<p>Median Household Income</p> <p>\$19,361 - \$45,368</p> <p>\$45,369 - \$55,085</p> <p>\$55,086 - \$66,891</p> <p>\$66,892 - \$130,096</p>	<p>35.90</p> <p>28.21</p> <p>25.64</p> <p>10.26</p>	<p>1.69 (0.92 – 3.10)</p> <p>1.18 (0.61 – 2.28)</p> <p>1.02 (0.52 – 2.02)</p> <p>0.34 (0.13 – 0.94)</p>
<p>Percent Age 25 with no H.S. Diploma</p> <p>1.34 – 8.87</p> <p>8.88 – 13.80</p> <p>13.81 – 19.10</p> <p>19.11 – 48.96</p>	<p>4.35</p> <p>7.69</p> <p>12.77</p> <p>17.39</p>	<p>0.34 (0.13 – 0.94)</p> <p>0.67 (0.31 – 1.46)</p> <p>1.30 (0.69 – 2.46)</p> <p>2.09 (1.16 – 3.79)</p>
<p>Percent of Housing Units Vacant</p> <p>0 – 2.67</p> <p>2.68 – 3.89</p> <p>3.90 – 5.60</p> <p>5.61 – 20.64</p>	<p>6.59</p> <p>10.87</p> <p>7.45</p> <p>17.39</p>	<p>0.56 (0.24 – 1.28)</p> <p>1.04 (0.53 – 2.05)</p> <p>0.64 (0.29 – 1.40)</p> <p>2.09 (1.16 – 3.79)</p>

Extensively Burdened Communities, by Median Household Income

Median Household Income

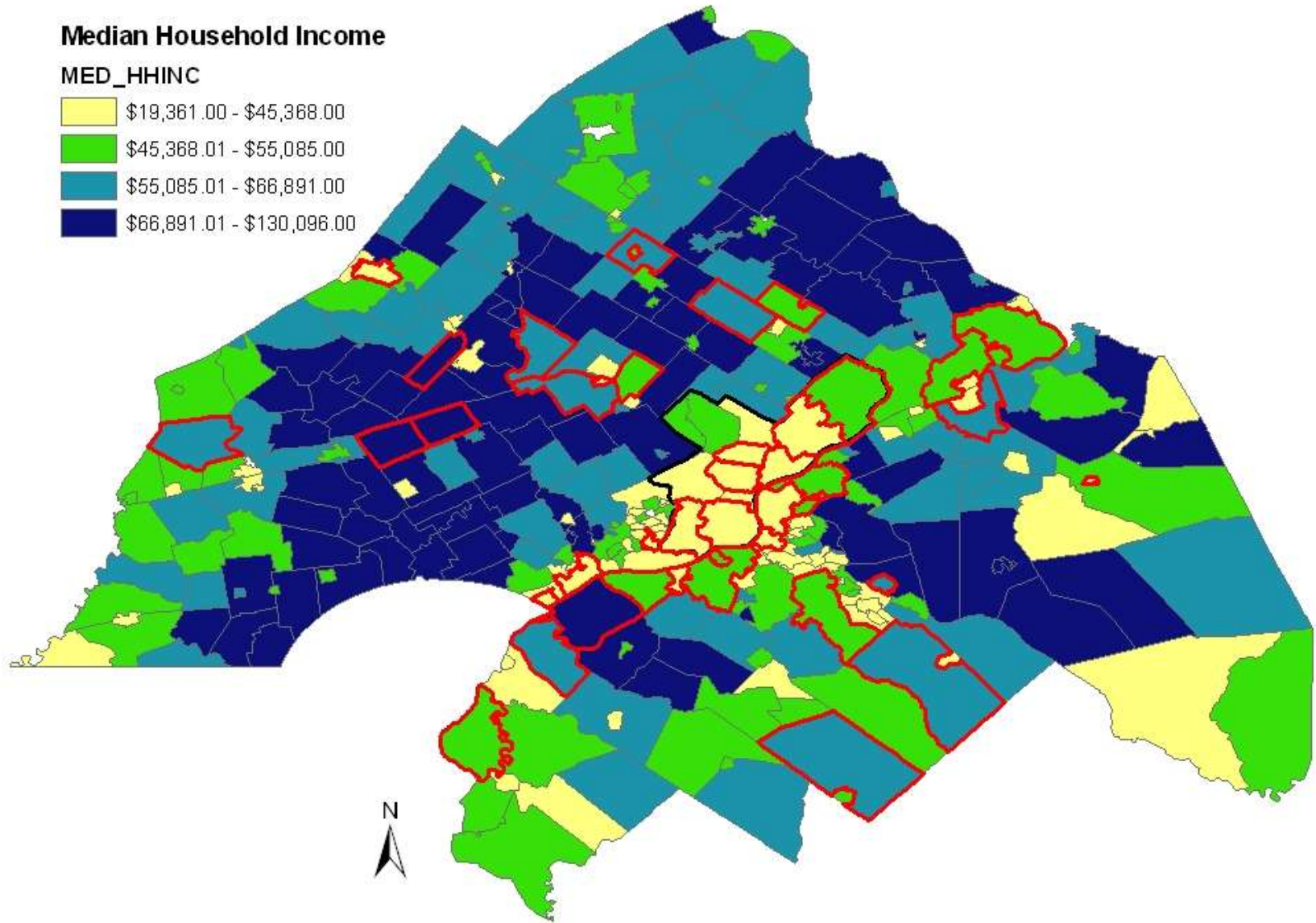
MED_HHINC

\$19,361.00 - \$45,368.00

\$45,368.01 - \$55,085.00

\$55,085.01 - \$66,891.00

\$66,891.01 - \$130,096.00



...But one characteristic did not make a difference in risk of extensive burdening: **Percent Employed in Manufacturing**

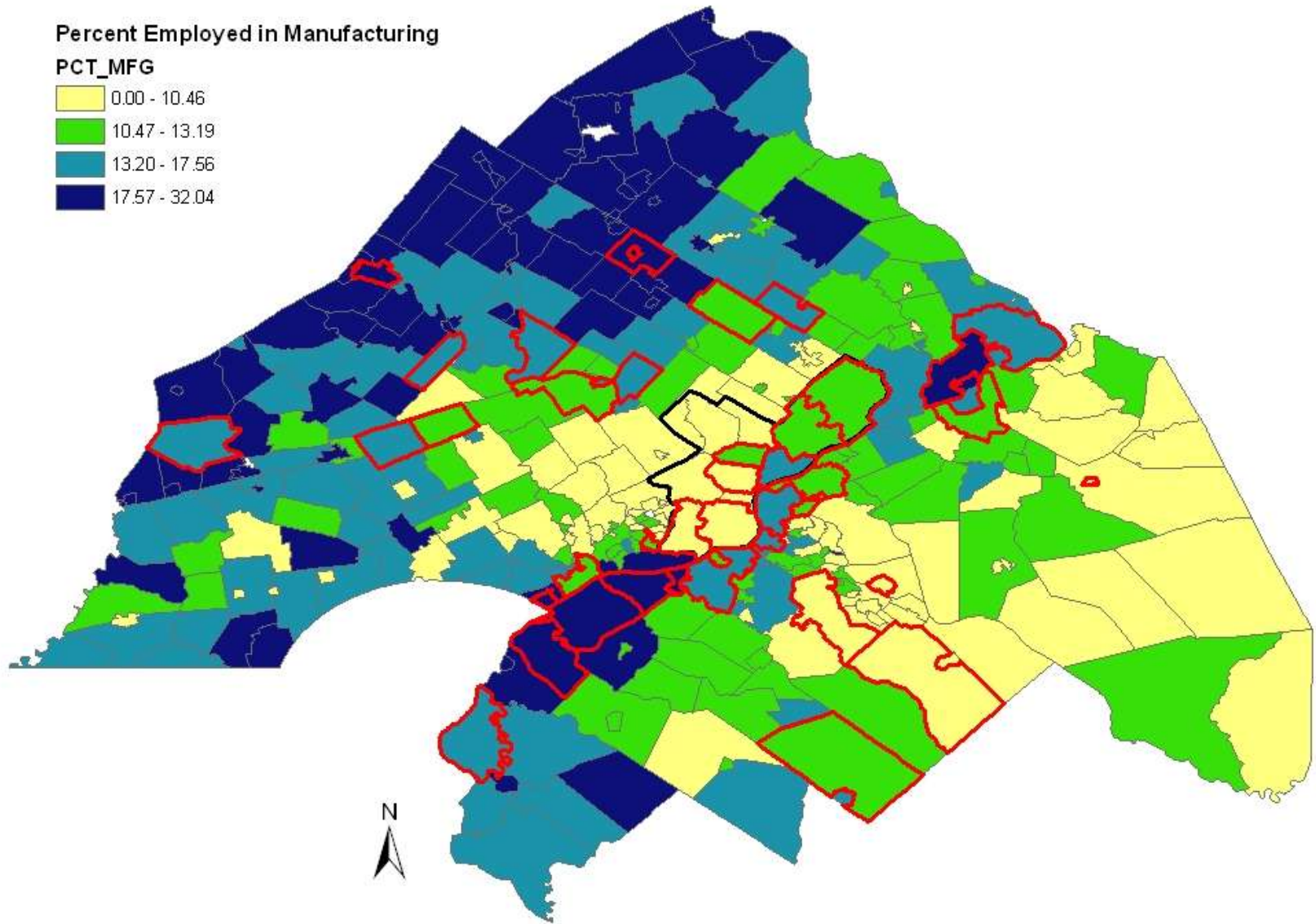
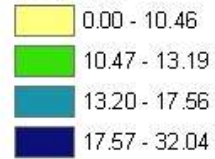
RISK	Percent Extensively Burdened	Risk Ratio (95% CI)
Percent Employed in Manufacturing		
0 – 10.46	7.61	0.66 (0.30 – 1.44)
10.47 – 13.80	11.96	1.18 (0.61 – 2.28)
13.81 – 19.10	13.98	1.48 (0.80 – 2.77)
19.11 – 48.96	8.70	0.78 (0.37 – 1.63)

Why?

Extensively Burdened Communities, by Percent Employed in Manufacturing

Percent Employed in Manufacturing

PCT_MFG



Conclusions

Conclusions:

1. Distributional injustice (Shrader-Frechette 2001) exists, in that 39 out of 369 communities are more burdened than 90% of communities.
2. Risk of hazard burdening more than 7x greater for communities along the Delaware, the location of earliest industrialization; relatively few communities with large numbers of people working in manufacturing in 1999 are extensively burdened.
3. Risk of hazard burdening jumps up sharply when population exceeds 1% African-American, and more than 2% Hispanic.
4. But risk of burdening is only lower for white communities at more than median income level (whiteness alone is not enough).

New Questions

Theories of Environmental Inequality:

1. Existing theory is unable to explain or predict the burdening of predominantly white communities—how can theory be extended to incorporate these cases?
2. Do we need to theorize a different process for “environmental injustice formation” for communities in early-industrializing cities (such as Philadelphia, Boston and Baltimore) vs. late-industrializing cities (such as Los Angeles and Phoenix)?

Methods for Measuring Environmental Inequality:

1. How much racial/ethnic and social class status diversity is there among Philadelphia’s extensively burdened communities?
2. Do the number of points awarded for different hazards bias the results toward more wealthy communities (as in the case of NPL Superfund sites), OR toward poorer minority communities (as in the case of incinerator sites)?
3. Are Superfund and incinerator communities demographically different?

Historical Research Investigating the Formation of Environmental Inequality in Greater Philadelphia

Qualitative (Historical) Research Questions:

1. During the period of Philadelphia's most intense and rapid industrial growth (1830s-1920s), who lived near "noxious industry"?
2. What was the relationship between the racialization of space, and industrial development?
3. How did the deindustrialization era of 1970-2000 re-racialize formerly industrial space?
4. Why were waste handling facilities sited in certain areas after 1970?