Lakeshore Air Toxics Study (LATS)

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Overview

- The Northwest Indiana Lakeshore area is a highly industrialized and heavily travelled area of the state
  - Includes U.S. Steel, BP Products, ArcelorMittal Indiana Harbor and Burns Harbor, I-65, I-80/94, I-90
- Studies have previously estimated that the area may have elevated air toxics concentrations
  - 2005 United States Environmental Protection Agency (U.S. EPA) National Air Toxic Assessment (NATA)
  - 2009 *USA Today* report *The Smokestack Effect*
  - U.S. EPA Assessing Outdoor Air Near Schools

Executive Summary

- Every modeled census tract had similar to lower additional lifetime cancer risks than the NATA for permitted stationary sources
  - The refined treatment of coke oven emissions and a better emissions inventory were factors in the Lakeshore study's additional lifetime cancer risk estimation being lower than previous estimates
  - IDEM believes the refined, current (2009-2011) inventory and detailed modeling analysis produced more accurate local results than previous estimates
- The greatest level of additional lifetime cancer risk and non-cancer hazard is attributable to onroad mobile sources (cars and trucks)
  - Existing and proposed U. S. EPA rules are expected to greatly reduce the risk and hazard from mobile sources over time
  - Benzene and Formaldehyde are the major mobile source pollutants
- Evaluation of comparable ambient air toxics monitoring data available show the Lakeshore area measured similar air toxic concentrations as other United States cities
- IDEM is working with permitted sources to explore opportunities for pollution prevention

Lakeshore Permitted Stationary Sources

Lakeshore Air Toxics Study Framework

- Compile a refined detailed modeling air toxics inventory
- Analyze data using Regional Air Impact Modeling Initiative (RAIMI)
- Calculate concentrations to determine:
  - Additional lifetime cancer risk
  - Noncancer hazards
  - Contributing permitted source or mobile sources
  - Contributing air toxics
- Compare results to:
  - Existing monitoring data
  - 2005 NATA
- Criteria pollutants not included in this study
  - Measured concentrations currently meet National Ambient Air Quality Standards (NAAQS) in the area

Inventory Verification and Results

- Permitted sources were sent emissions data for verification
  - More rigorous than used by the U. S. EPA
  - Stack data and locations
  - Requested most currently available data, 2011 in most cases
- Verified emissions data were returned by 95% of the permitted sources in the study
  - 99.9% of total emissions were verified
- 65 operating stationary permitted sources verified emissions
  - 132 separate air toxics
    - Chromium emissions speciated using Source Classification Code (SCC) Chromium (VI) percentages
  - 1955 estimated tons
  - 930 emission release points

Onroad Mobile Emissions Methodology

- Used volatile organic compounds (VOCs) emission rates from Motor Vehicle Emissions Simulator (MOVES) output run
  - U.S. EPA's tool for estimating emissions from onroad mobile sources
- Speciated VOC emission rates based on air toxics emission factors from MOVES Air Toxics Addendum
- Emissions generated based on 2010 Indiana Department of Transportation (INDOT) traffic count data
- Output separated by passenger and diesel vehicles
- Emissions modeled at 100 meter intervals along the roadway
- 676 tons of air toxics emitted
- 4912 individual emission release points on roads

Lakeshore Traffic Count

Lakeshore Emitted Pollutants

Chemical Abstract Number	Chemical Name	Estimated Total Annual Emissions (TPY)	Estimated Onroad Mobile Source Emissions (TPY)	Total Emissions (TPY)
71-43-2	Benzene	191.27	331.32	522.59
50-00-0	Formaldehyde	56.05	181.13	237.18
110-54-3	Hexane	115.49	13.36	128.85
108-88-3	Toluene	52.77	52.67	105.44
107-02-8	Acrolein	1.31	28.03	29.34
7440-47-3	Chromium compounds	0.32	0.01	0.33

Lakeshore Modeling

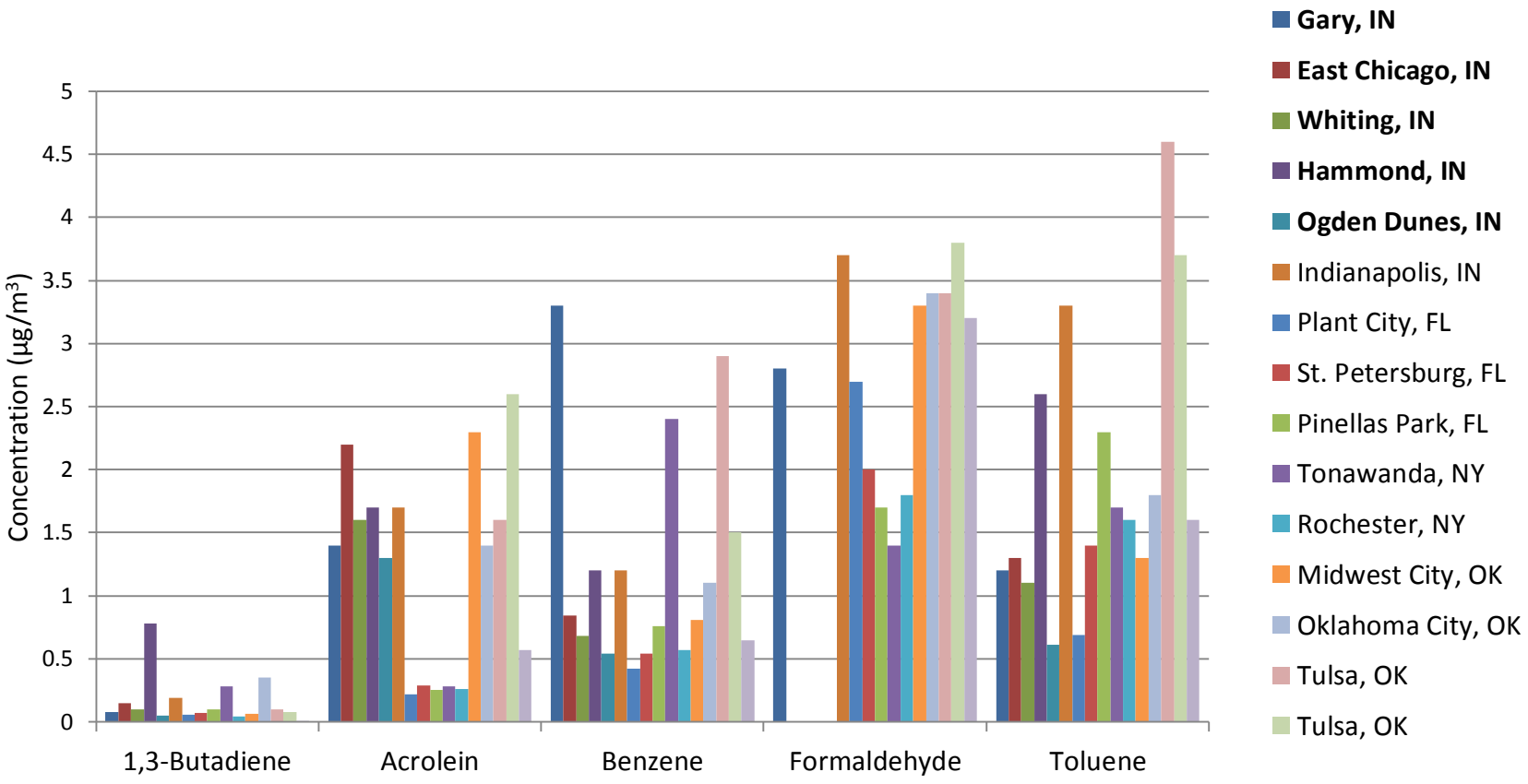
- Used RAIMI
  - The U.S. EPA, Region 6, established the Regional Air Impact Modeling Initiative (RAIMI) to evaluate the potential for health impacts as a result of exposure to multiple contaminants from multiple sources, at a community level of resolution
  - Used the Industrial Source Complex Version 3 (ISC3) dispersion model
  - Meteorological data processed through RAIMI was from South Bend surface air station
  - Coke batteries were modeled based on methods used in the Indianapolis Public Schools (IPS) School 21 Air Toxics Study

Lakeshore Ambient Air Toxics Monitors

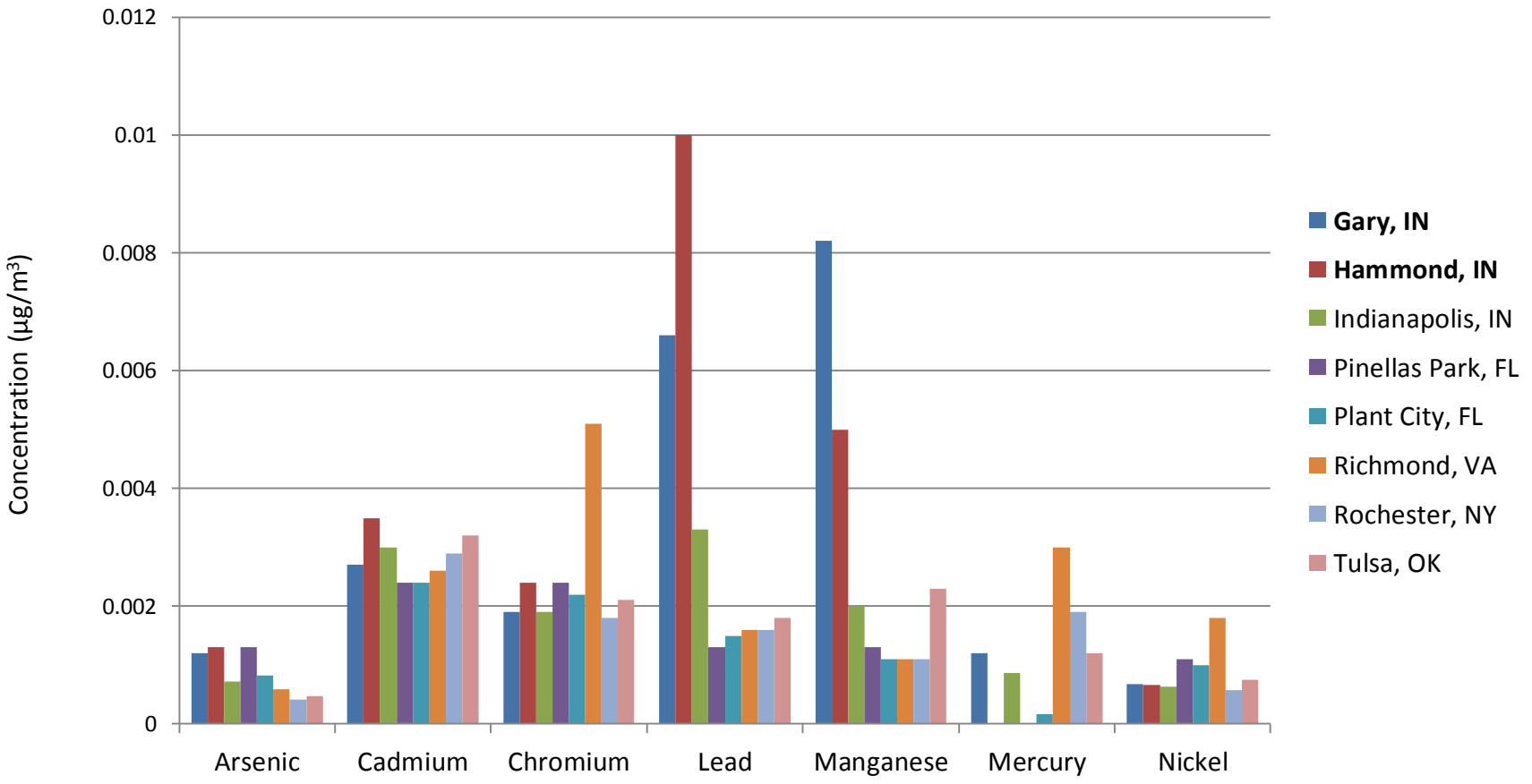
- East Chicago
- Hammond
- Whiting High School
- Gary
- Ogden Dunes
- Data from 2009-2011 analyzed
- More ambient air toxics monitors in Lakeshore area than throughout rest of Indiana
- Also compared to monitors in:
  - Indianapolis; St. Petersburg, FL area; Tonawanda, NY; Rochester, NY; Oklahoma City, OK; Tulsa, OK and Richmond, VA

Northwest Indiana
ToxWatch Air Toxics Monitors

Air Toxics Monitored Results



Metals Monitoring Results



Cancer Risk and Non-cancer Hazard

- Additional lifetime cancer risk is the estimated probability of developing cancer from respiratory exposure over a lifetime, per million people
  - Additional lifetime cancer risk under 1 is negligible
  - Additional lifetime cancer risk between 1 and 100 may warrant further action
  - Additional lifetime cancer risk over 100 may warrant immediate action
- The noncancer hazard is the ratio of the exposure concentration to the Reference Concentration (RfC)
  - If the noncancer hazard is less than 1, no adverse health effects are expected; over 1 then adverse health effects may be possible

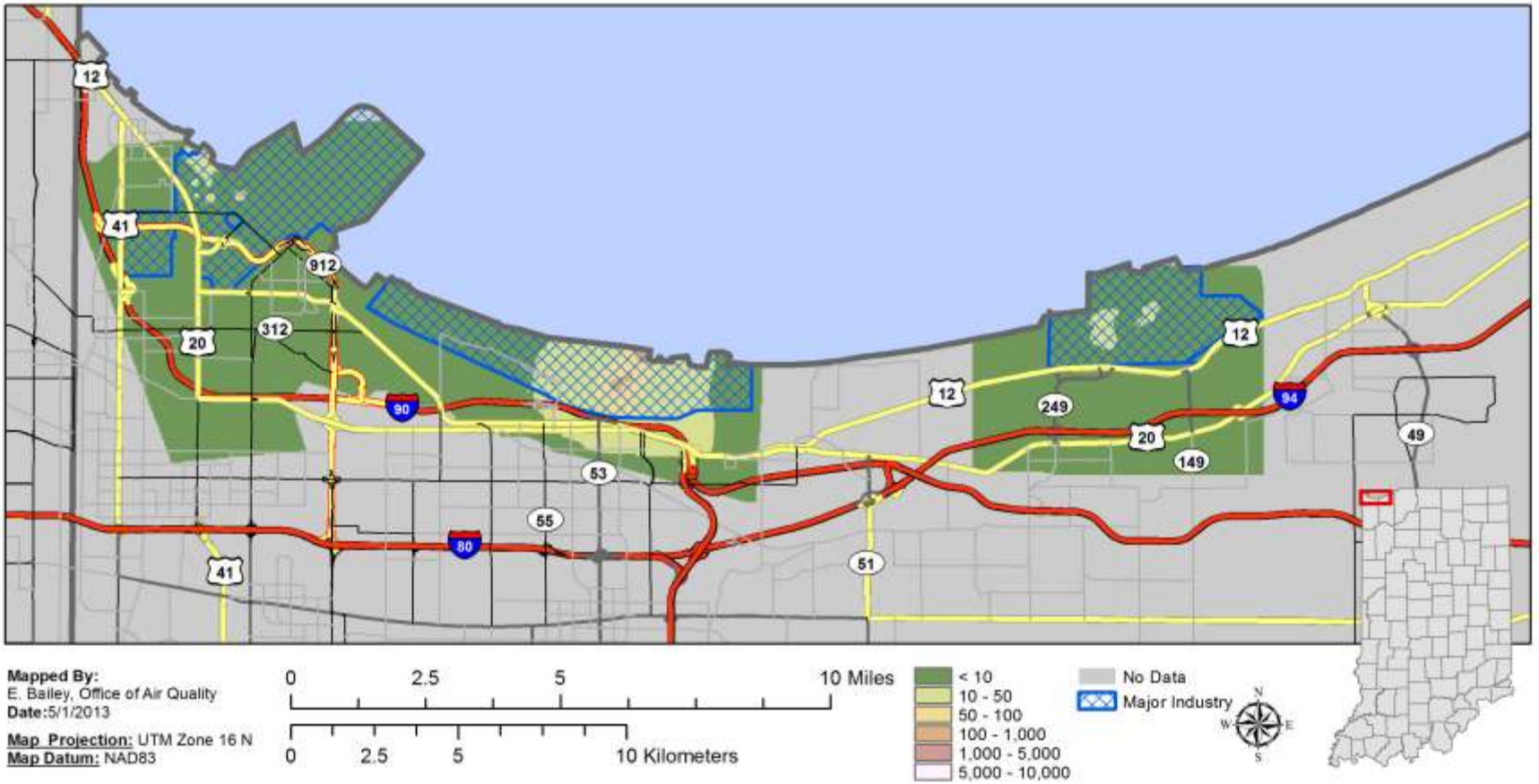
Risk Characterization Modeling Results

- Cancer Risk
  - Total average cancer risk over the analyzed study area was 17.3 additional lifetime cancer risk per million people
  - Onroad mobile sources average additional lifetime cancer risk was 18.6
  - Permitted sources average additional lifetime cancer risk was 4.6
    - BP North America, ArcelorMittal Burns Harbor, U. S. Steel and NLMK-Indiana were the highest contributing facilities
  - Benzene, formaldehyde and chromium compounds were the modeled additional lifetime cancer risk drivers
- Non-cancer Hazard
  - Total average non-cancer hazard was 4.2
  - Onroad mobile sources average non-cancer hazard was 7.2
  - Permitted sources average non-cancer hazard was 0.26
  - Acrolein was the non-cancer hazard driver

Modeled Total Additional Lifetime Cancer Risk

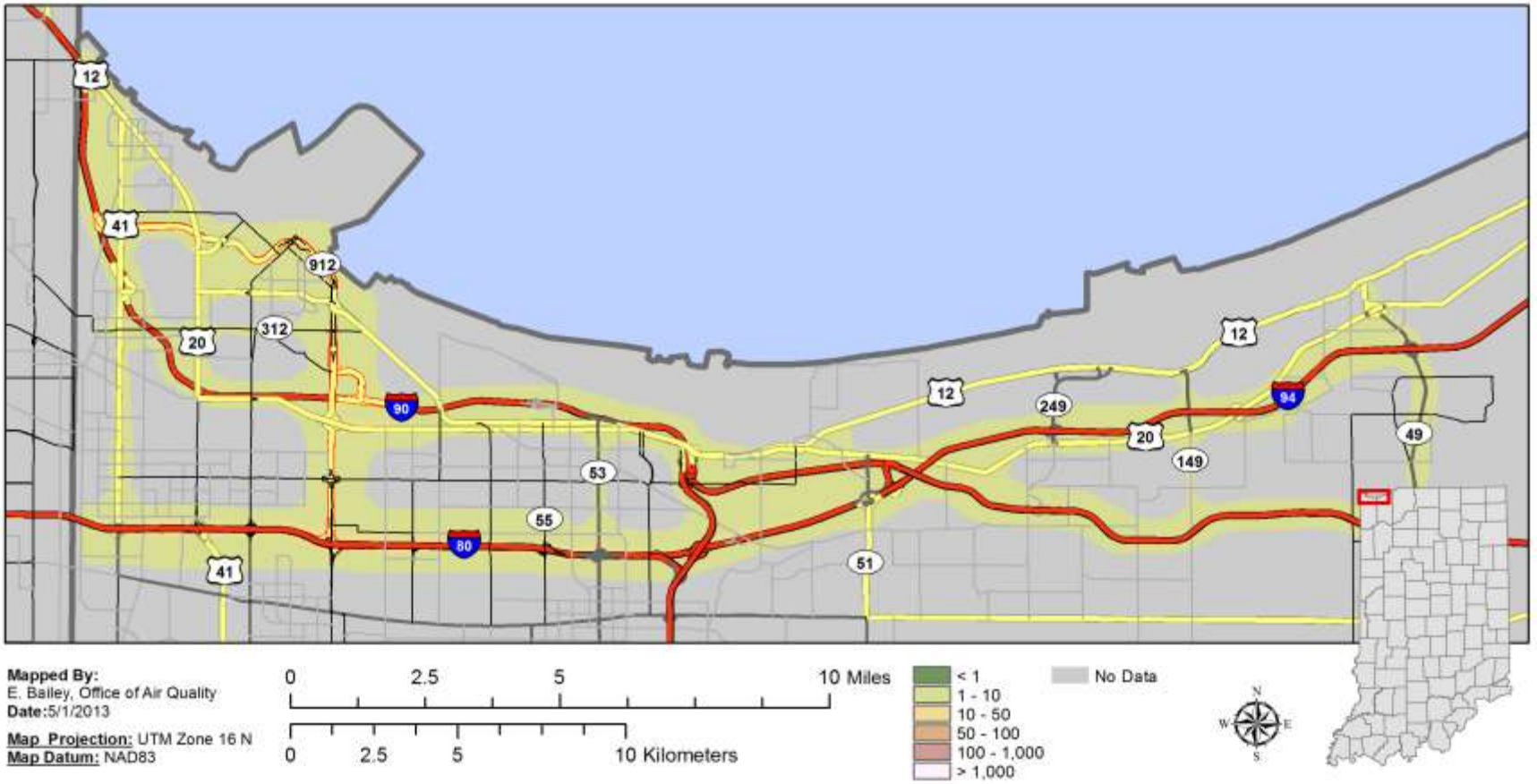
Modeled Onroad Mobile Additional Lifetime Cancer Risk

Modeled Permitted Source Additional Lifetime Cancer Risk

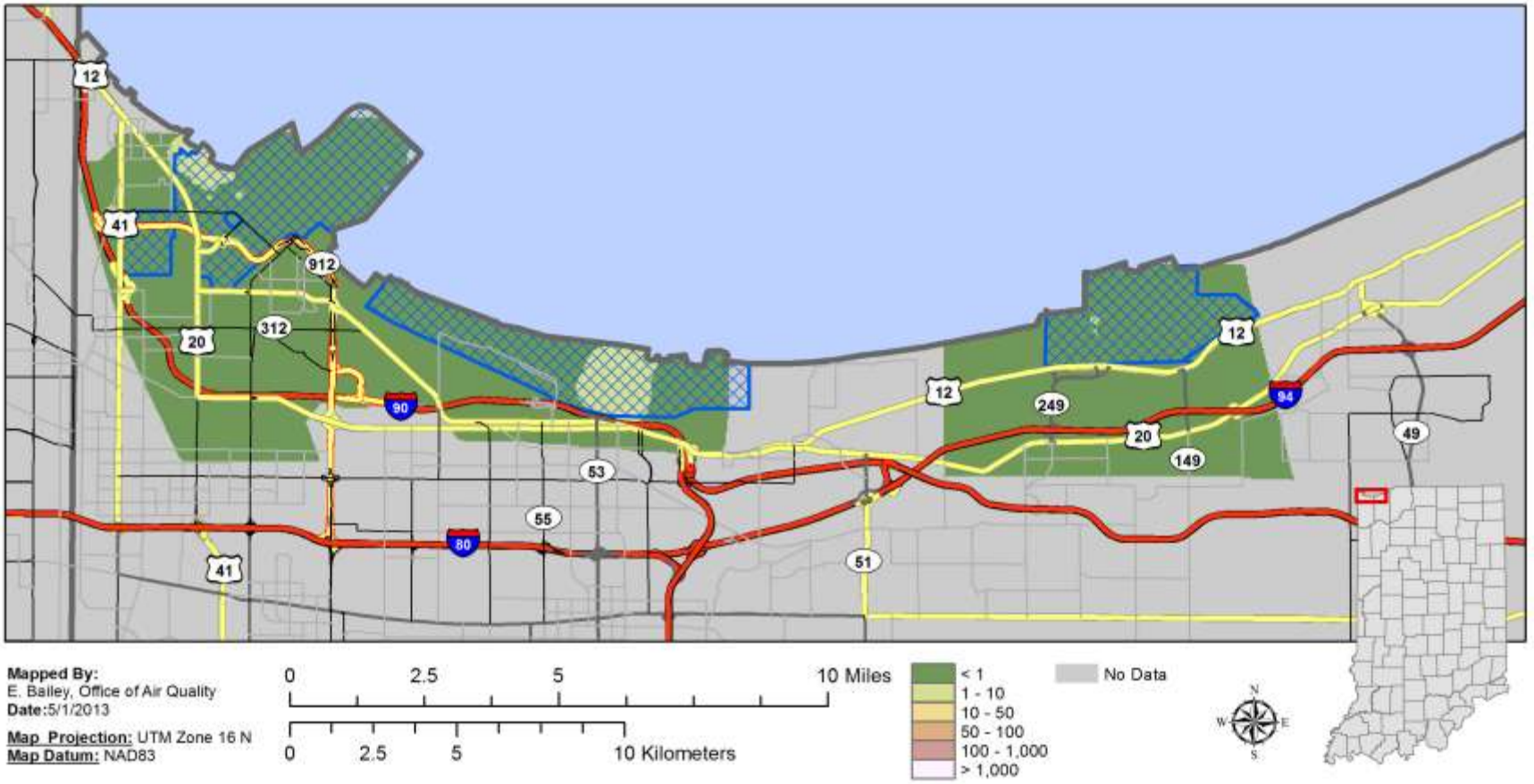


Modeled Total Non-cancer Hazard

Modeled Onroad Mobile Non-Cancer Hazard



Modeled Permitted Source Non-cancer Hazard



Monitoring Risk Characterization

Monitor Site	Number of Pollutants Monitored	Cumulative Additional Lifetime Cancer Risk	Cancer Risk Driver	Monitor Site	Number of Pollutants Monitored	Cumulative Additional Lifetime Cancer Risk	Cancer Risk Driver
Richmond, VA	45	153	Chromium	**Hammond**	**47**	**89**	**1,3-Butadiene**
Indianapolis	49	121	Formaldehyde	Rochester, NY	43	74	Formaldehyde
Tulsa, OK	46	119	Formaldehyde	Midwest City, OK	39	72	Formaldehyde
Gary	**51**	**119**	**Formaldehyde**	St. Petersburg, FL	34	61	Formaldehyde
Oklahoma City	46	110	Formaldehyde	Tonawanda, NY	37	52	Formaldehyde
Pinellas Park, FL	41	104	Chromium	**East Chicago**	**39**	**27**	**Benzene**
Plant City, FL	41	102	Formaldehyde	**Whiting**	**39**	**26**	**Benzene**
Tulsa, OK	39	92	Formaldehyde	**Ogden Dunes**	**39**	**20**	**Benzene**

Bold= Lakeshore area Monitors

Acrolein and Monitoring Issues

- Acrolein is a common pollutant found in many urban areas
  - Most commonly associated with the burning of organic materials and from motor vehicles
  - Can be formed in the air when pollutants react with sunlight and other chemicals.
  - Exposure may cause watery eyes, burning of the nose and throat and a decreased breathing rate
- Acrolein monitored concentrations has recently become a national concern
  - Current methods appear to bias results high so actual acrolein concentrations are likely lower than those recorded
  - Evidence indicates that new procedures may need to be developed in order to better quantify acrolein concentrations in monitoring data

Model to Monitoring Ratio

- Model to monitoring comparisons are completed to assess if there are any potential gaps with the emissions and modeling data
  - A model to monitor ratio of 1 indicates the concentrations are the same
  - U. S. EPA considers modeled to monitored ratios from 0.33 to 3 as acceptable and from 0.5 to 2 to be good model to monitor agreement.

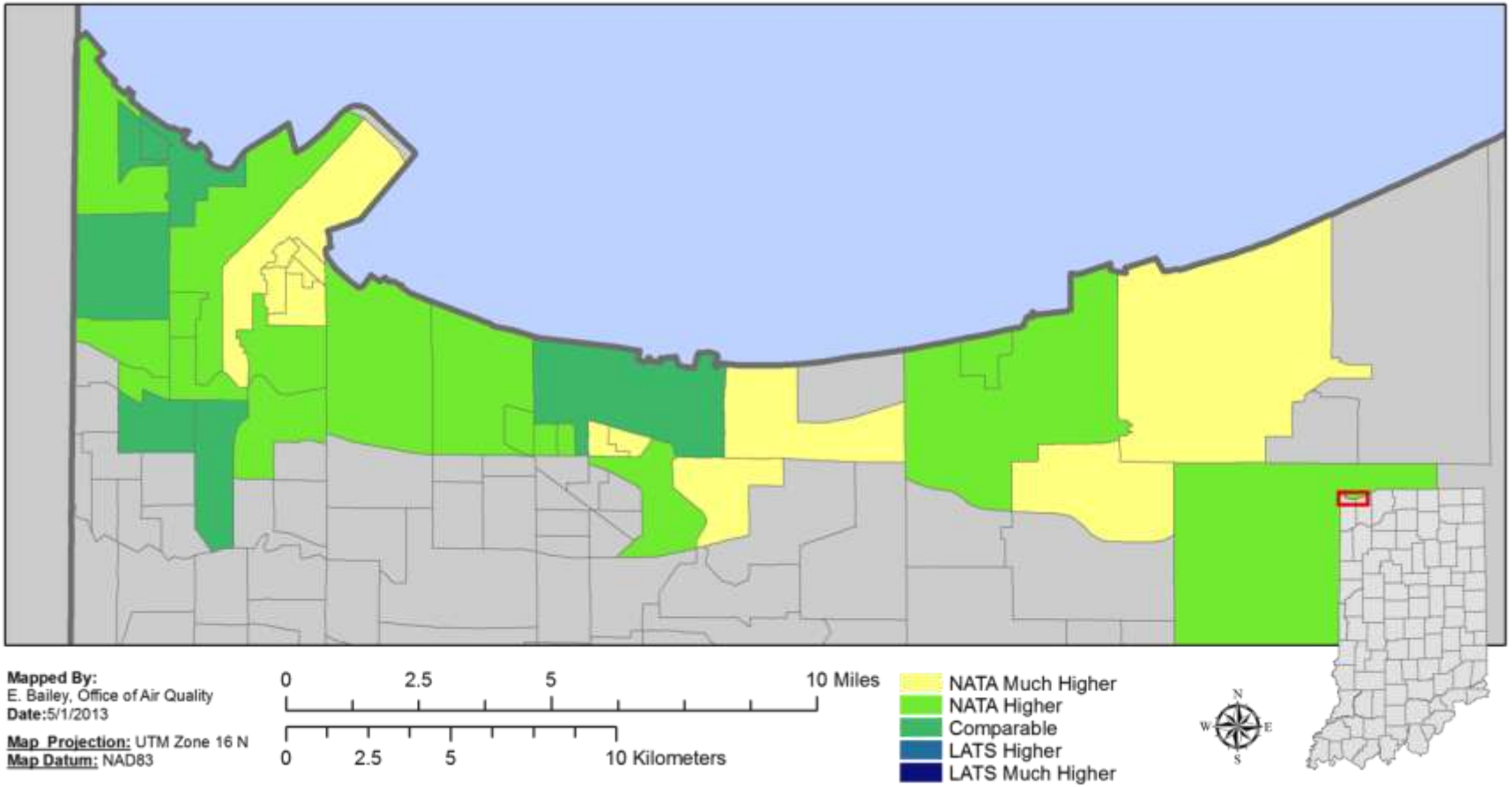
Lakeshore Air Toxics Results

- The average ratio for benzene, acetaldehyde, formaldehyde and chromium compounds are in the acceptable range
- Due to monitoring issues, acrolein's ratio is outside of the acceptable range

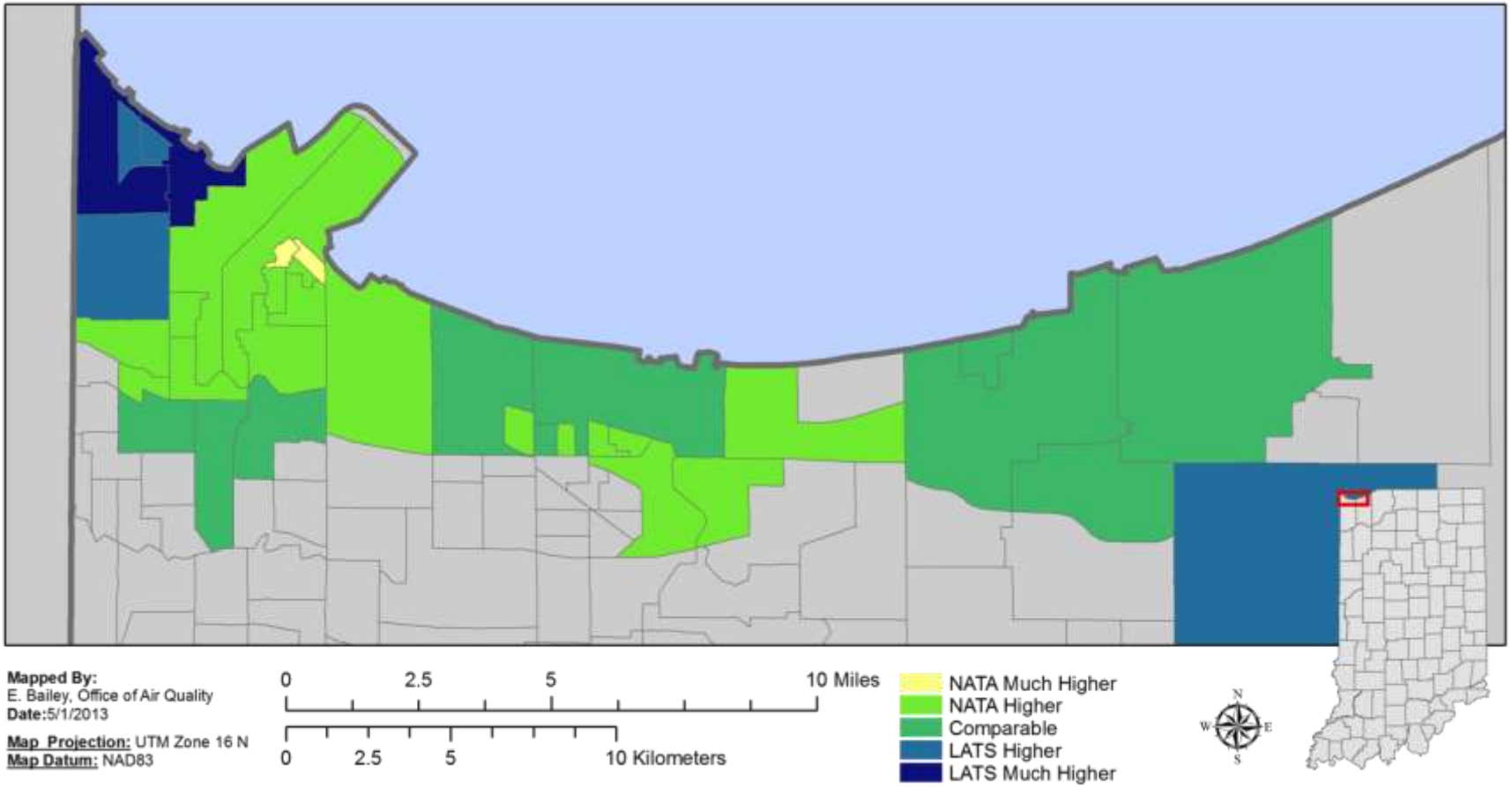
Modeling to 2005 NATA Comparison

Source	Average Modeled Cancer Risk	2005 NATA Estimated Cancer Risk	Cancer Risk Difference	Average Modeled Non-cancer Hazard	2005 NATA Estimated Non-cancer Hazard	Non-cancer Hazard Difference
Total	19.2	21.4	-2.2	5.5	0.66	4.9
Onroad	18.4	6.7	11	6.5	0.44	6.1
Point Source	3.1	18.9	-15.8	0.20	0.29	-0.09

Point Source Cancer Risk
Census Tract Comparison



Point Source Non-cancer Hazard Census Tract Comparison



Health Protective Assumptions

- Cancer risk and non-cancer hazard factors are health protective
  - Results based on 70 year exposure
  - Factors account for sensitive groups
- ISCST3 used instead of AERMOD
  - ISCST3 over predicts; therefore is more health protective
- 95% Upper Confidence Limit (UCL) used to analyze monitoring data
  - More health protective assumption
- Risk characterization limited by database capacity
  - Only higher risk receptors were analyzed

Next Steps and Future Considerations

- The greatest level of cancer risk and non-cancer hazard is attributable to onroad mobile sources
  - Mobile Source Air Toxics (MSAT) regulations expected to lower onroad mobile emissions and risk
    - Should reduce benzene emissions by 61,000 tons nationwide by 2030
    - Mass transit and carpooling also reduce onroad mobile source emissions
- Since there is still off-property risk from permitted sources, opportunities for pollution prevention may be explored
  - BP changing processes to meet MSAT requirements and adding fenceline monitoring equipment
  - U. S. Steel changing coke oven process
    - Reducing air toxics by removing byproduct emissions, combusting all process gases, and eliminating potential of fugitive leaks
- Continue to refine an enhanced modeling/risk characterization tool

Conclusions

- A better emissions inventory was a key factor in the Lakeshore study's additional lifetime cancer risk estimation being lower than previous estimates
- The greatest level of cancer risk and non-cancer hazard is attributable to onroad mobile sources
- Permitted stationary sources had similar to lower modeled additional lifetime cancer risks than the previous estimates
- Comparable monitoring data indicate the Lakeshore area contains similar air toxic concentrations as those measured at other United States cities

Questions?

Visit Webpage:
http://www.idem.IN.gov/toxic/2342.htm

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