Lead Data Mapping: Methods and Tools for Lead Prioritization, Prevention and Mitigation

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EPA United States Environmental Protection Agency

Work-in-Progress Whole-of-Government Lead (Pb) "Blueprint" Examples for Michigan and West Virginia

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For 8/1/23 NEHA Conference Pb Mapping Session:
"Lead Data Mapping: Methods and Tools for Lead Prioritization, Prevention, and Mitigation"
New Orleans, LA

United States Environmental Protection Agency

Disclaimers

- Michigan Department of Health and Human Services (MDHHS) provided blood lead data used in this presentation, pursuant under Data Use Agreement 201909-157. Research included in this analysis was approved under IRBs through UNC (16-2302) and MDHHS (201703-12-EA). EPA assumes full responsibility for the analysis and interpretation of the data. MDHHS has had opportunity to review the use of Michigan's data as it is presented here.

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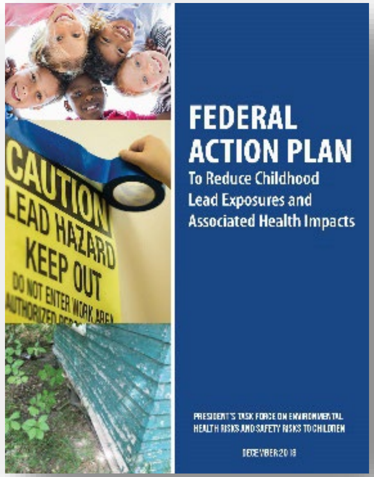
EPA Lead Strategy “Blueprint” to Identify High Exposure Locations

- Identifying Pb exposure hotspots is a U.S. priority
  - **EPA Lead Strategy Goal 2:** “Identify Communities with High Lead Exposures and Improve Their Health Outcomes”, supporting **Federal Lead Action Plan**
  - “By December 31, 2023, develop an interim blueprint for identifying high lead exposure risk locations based on research identifying lead exposure hotspots in Michigan, to be shared with internal and external public health partners for broader applicability and capacity building in the U.S.”

- “Blueprint”: step-by-step process – national-scale & state/local-scale with examples
  - includes problem formulation, identifying and ground-truthing hotspots with available data, determining drivers, and targeting actions
  - Builds on our published 2022 interagency paper roadmap and MI case study paper



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Work-in-progress “Blueprint” to Identify U.S. High Pb Exposure Risk Locations

Collaborative Engagement with Partners and Stakeholders

STEP 1
Problem Formulation: Questions to be Addressed?

STEP 2
Select, Compile Data

STEP 2A
Baseline housing and socioeconomic data (U.S. Census American Community Survey; American Housing Survey)

STEP 2B
Environmental data correlated with potential Pb exposures (e.g., EPA/OECA Pb Occurrence and Source tool (POST))

STEP 3
Identify and Ground-Truth Pb Hotspot Locations

STEP 3A – Using BLL Data
If available and robust, analyze blood lead level (BLL) data hotspots directly; ground-truth proxy Pb Indices (Xue et al. 2022 *EHP*)

STEP 3B – Using Pb Indices
Convergence of EJSCREEN, HUD DPI, others (see Xue et al. 2022 *EHP*; Zartarian et al. 2022 *AJPH*)

National-Scale Analysis

State and Local Scale with Examples for Capacity Building

STEP 4
Determine Hotspots Drivers; Prioritize Sources for Actions

Utilize Local Knowledge and Environmental Data (e.g., from EPA POST)

STEP 5
Take Actions and Target Resources

Enforcement and Compliance Assistance

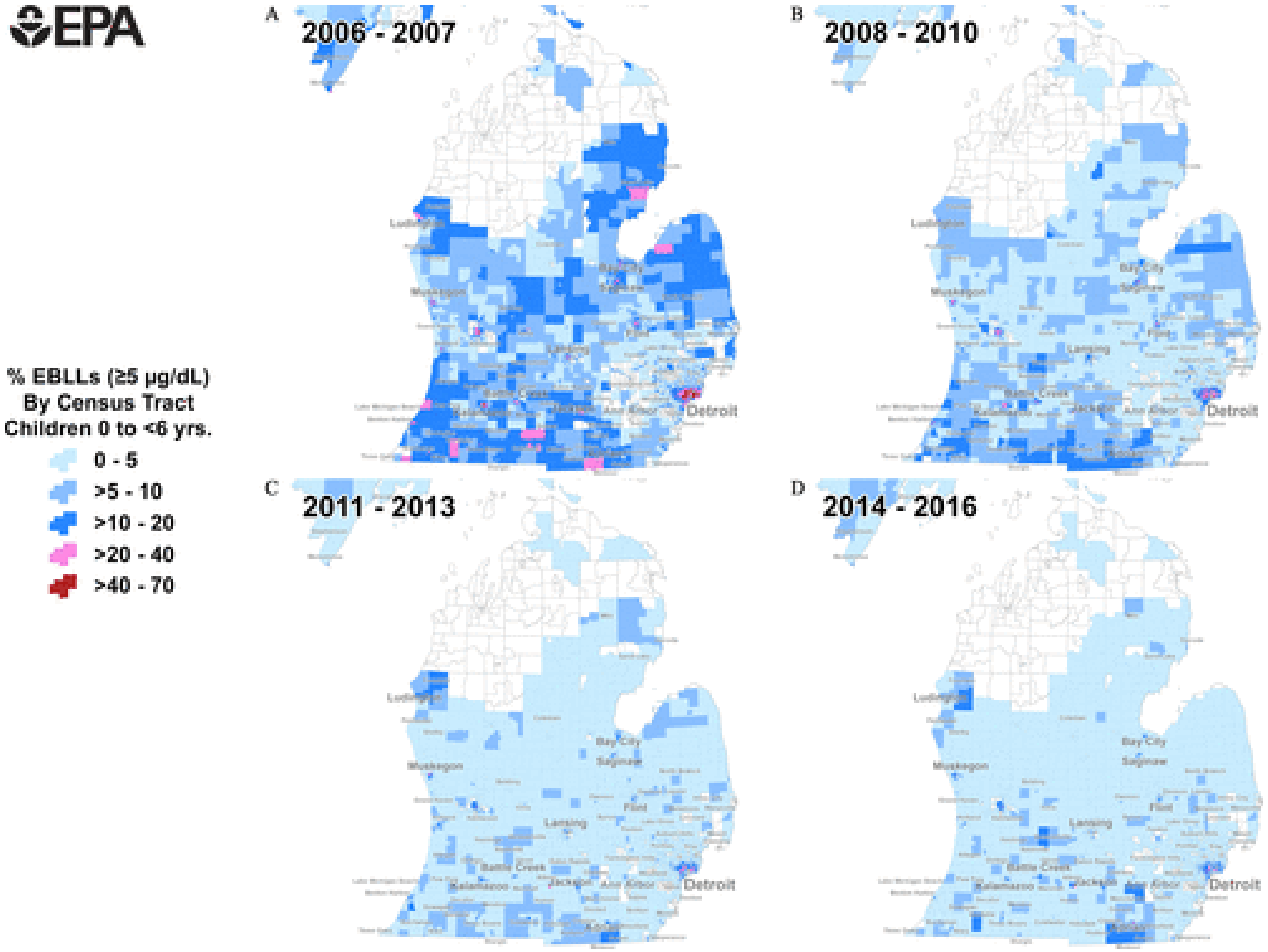
Outreach, Education, Mitigation, Toolkits, Increase Surveillance

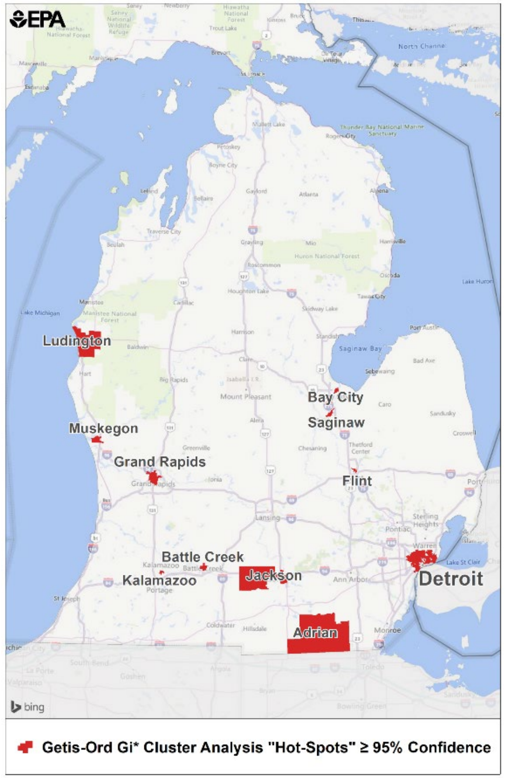
e.g., EPA Local Lead Action Plan; CDC Lead-Free Communities Initiative Toolkit; ORD Drinking Water Methods

Blueprint is based on EPA/HUD/CDC Zartarian et al., AJPH, 2022 “work-in-progress data integration roadmap.”

Work-in-Progress Michigan Blueprint Case Study

Mapping illustrates progress made in reducing exposures and helps identify locations needing further attention.





Xue et al., 2022, Figures 4 and 1
https://ehp.niehs.nih.gov/doi/10.1289/EHP9705

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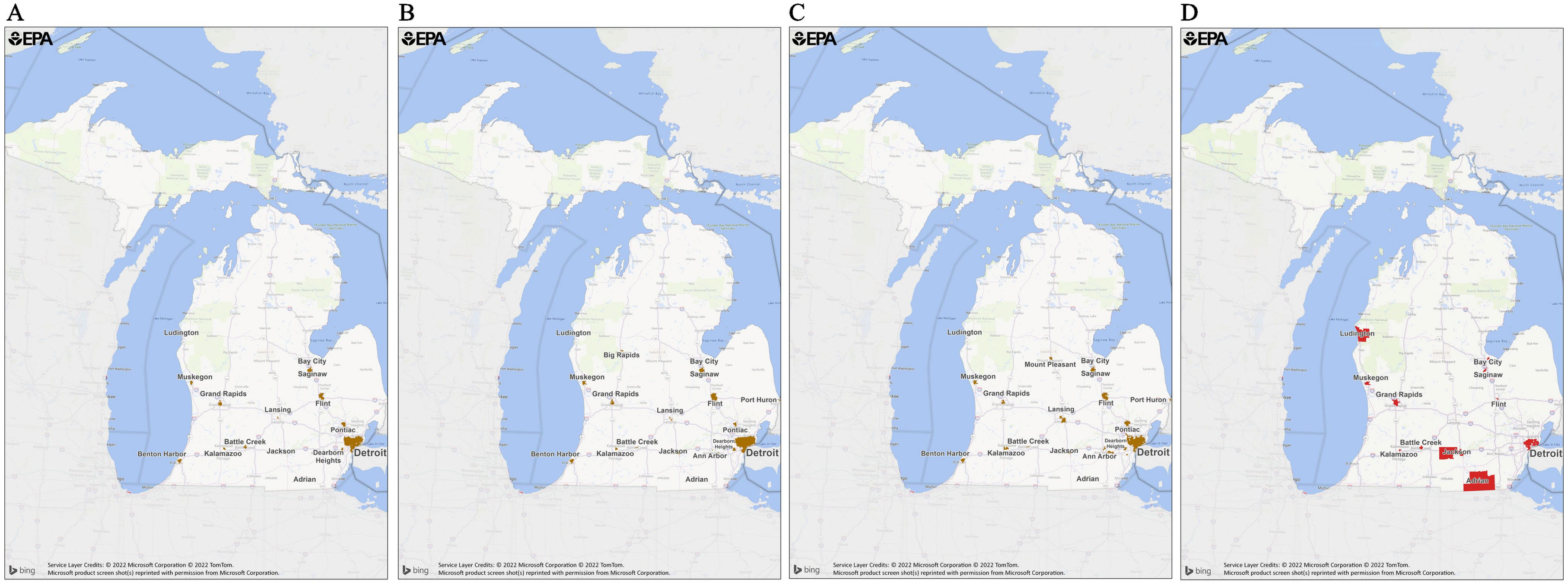
MI Study: STEP 1 – Problem Formulation

- **Questions:**
  - Where are the most disproportionately impacted communities?
  - Which places needing more attention might be eligible for federal or state lead mitigation programs?
  - Where could resources be focused to reduce lead-based paint exposures, replace lead service lines, address lead-contaminated soils, and other environmental sources?
  - Where might additional data (e.g., blood lead levels (BLLs); environmental) be needed to identify hotspots and local sources of exposure to target risk reduction efforts?
    - Where are high %EBLLs (elevated blood lead levels) overlapping with the Pb indices and environmental data from EPA POST (Pb Occurrence and Source Tool) where no testing has been done? Where to focus more BLL surveillance?
- **EPA partnering with MI (DHHS, EGLE) and HUD for joint, community-focused planning** to apply the science with environmental and public health agency programs: compliance assistance, monitoring and assurance; risk communication; outreach/education; technical assistance

STEPS 2 & 3 –

Select and Compile Data and Identify Pb Hotspots



EPA EJSCREEN Pb Paint EJ Index

EPA Schultz et al.[13] Modeled BLL Data

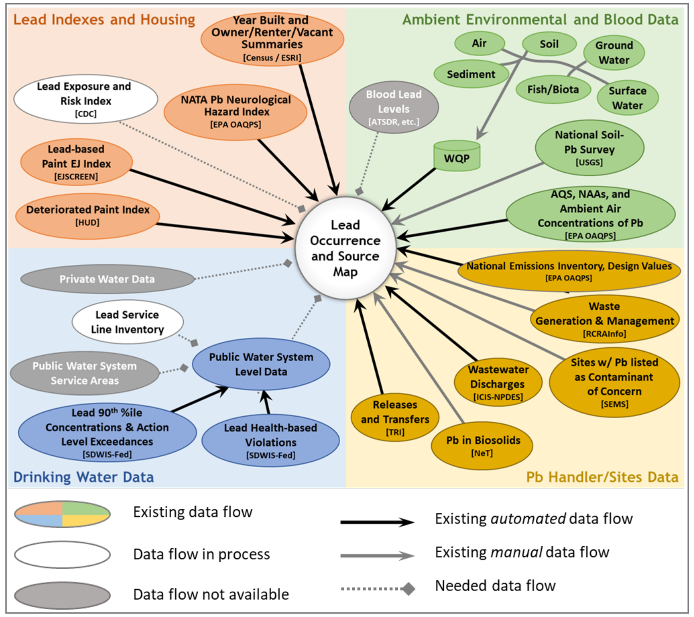
HUD Deteriorated Paint Index

Exceedance Rate of EBLL (≥ 5 µg/dL) Data (2014-2016)

3 Available Pb Exposure Models/Indices Based on Old Housing and Sociodemographics (2 from EPA, 1 from HUD) are Statistically Consistent (i.e., Kappa Score >0.8)

3 Pb Exposure Models/Indices vs. BLLs: Kappa Scores ~0.5 Suggests Other Environmental Sources

Environmental Pb Data Sources from EPA/OECA tool



Zartarian et al., 2022, AJPH

Xue et al., 2022, *EHP* https://ehp.niehs.nih.gov/doi/10.1289/EHP9705

Blood Lead Level (BLL) Data Used for MI Analysis

- ORD obtained and geocoded children's BLL data from the Michigan Department of Health and Human Services Childhood Lead Poisoning Prevention Program
  - ~1.9 million BLL data points from 2006-2016
  - Xue et al., 2022 *EHP* focused on 2014-2016 for data robustness and comparison purposes
  - EPA/ORD updated the analysis with 2017-2019 data from MDHHS
  - Analyses conducted at census tract scale

- "Exceedance Rate of Elevated BLLs" developed (percent children ages 0-5 years old tested with a BLL ≥5 μg/dL) – see Xue et al., 2022

- Getis-Ord Gi* Geospatial Cluster Analysis performed by on Exceedance Rate of Elevated BLLs – see Xue et al., 2022

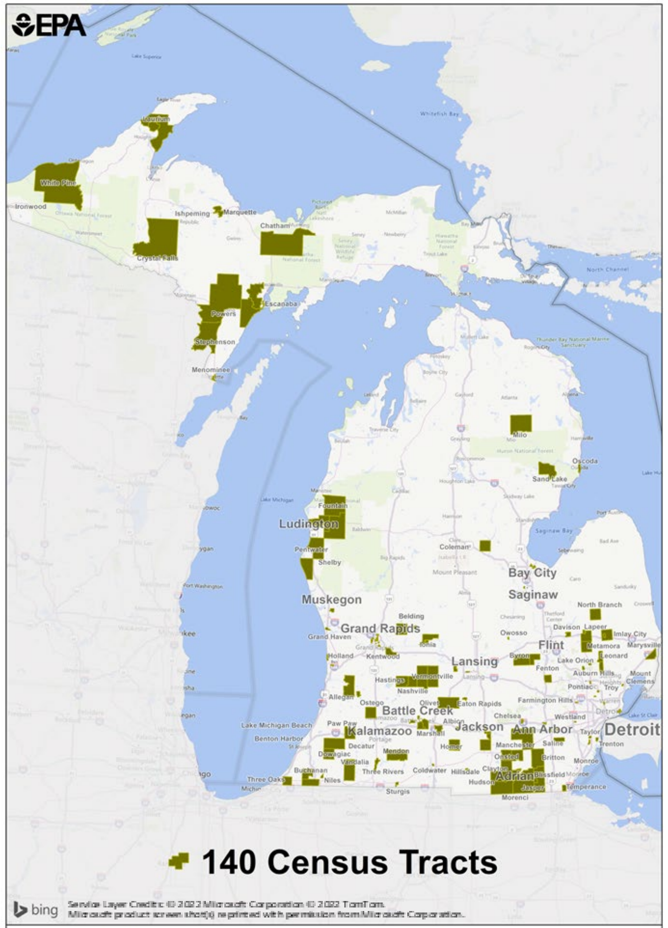
Pb Indices Used for Analyses Based on Public Housing Age and Sociodemographic Data

- **EPA EJSCREEN 2017 Pb Paint EJ Index** (www.epa.gov/ejscreen) **– "EJSCREEN Index"**
  - Originally developed at census block group level by EPA OEJ
  - Uses American Community Survey 2011-2015 5-year summary file
  - EPA ORD aggregated the data by averaging index values per census tract

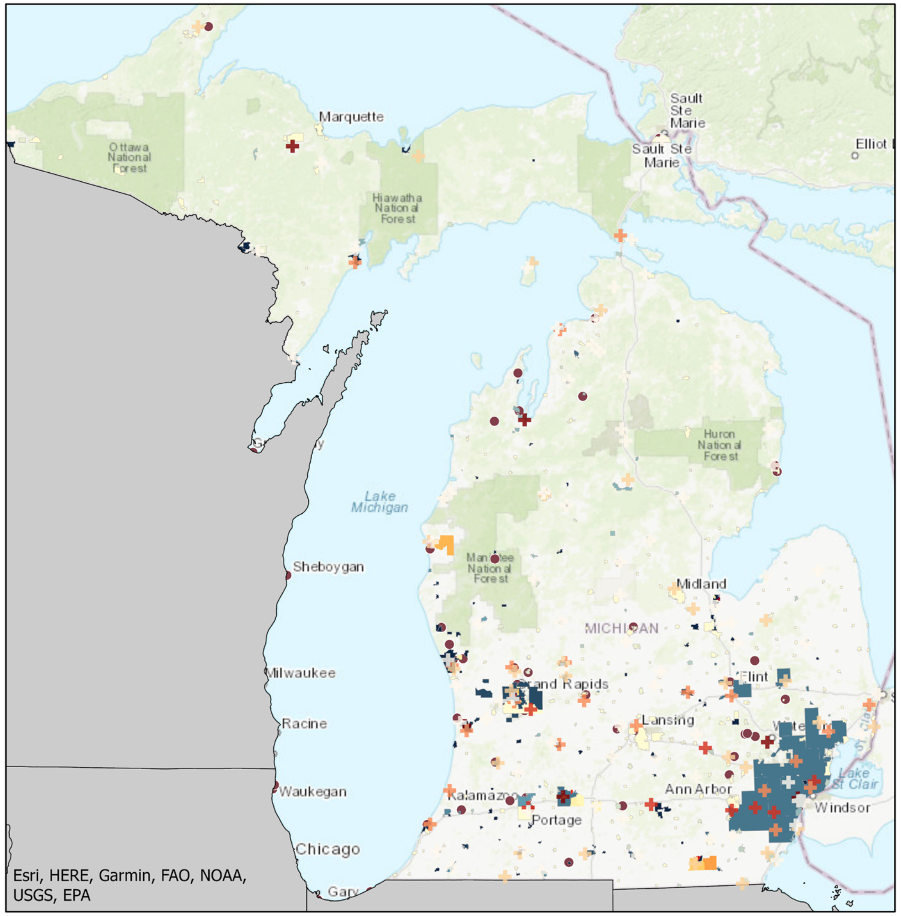
- **EPA published model** (Schultz et al., 2017, Env. Justice) – **"Schultz Model"**
  - Multiple regression model approach to predict children's BLLs at census tract level was evaluated against 3 States measured BLL data
  - EPA ORD Modeled BLL values are for the year 2015 and children ages 1-2 years old
  - Uses American Community Survey 2012-2016 5-year summary file

- **HUD Deteriorated Paint Index (**Garrison & Ashley, 2020**) – "HUD Index"**
  - Provided by the US Department of Housing and Urban Development (https://hudgis-hud.opendata.arcgis.com/datasets/deteriorated-paint-index-by-tract)
  - Uses 2011 American Housing Survey and 2009-2013 American Community Survey Data

STEP 4 - Prioritize Critical Lead (Pb) Exposure Pathways and Sources *using available data and local knowledge*



High % EBLL Census Tracts Not Identified by Old Housing and Sociodemographics (based on all 3 Pb exposure indices/model)



Legend

- SEMS Universe of Sites with Lead Listed as a Contaminant of Concern
- Point Source Pb Emissions from 2017 National Emissions Inventory
- Percentage of Known/Potential Lead Service Lines for Community Water Systems Reporting to MI LSL Inventory (100 – 0)

Xue et al., 2022, Figure S10
https://ehp.niehs.nih.gov/doi/10.1289/EHP9705

Data from EPA/OECA Pb Occurrence and Source Tool (POST) & Region 5: Environmental variables correlated with potential lead exposures based on literature, program/regional office expertise and data.

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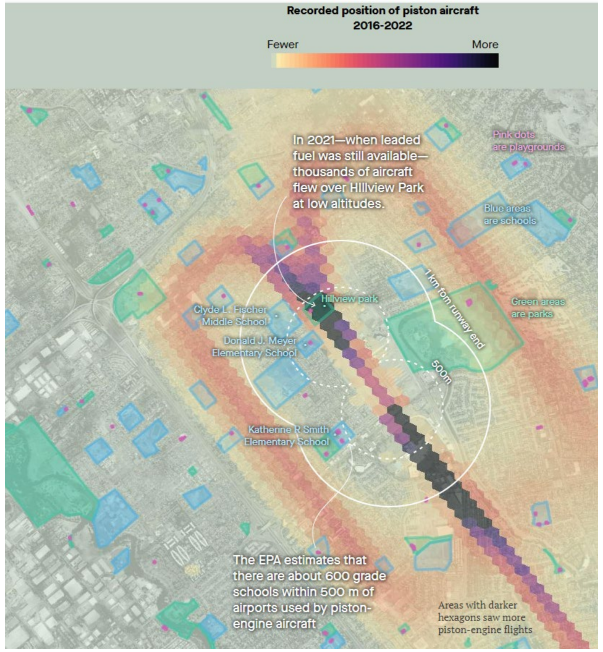
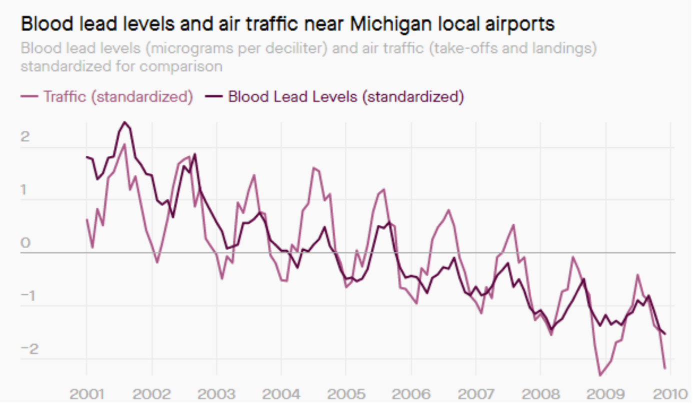
Detailed Analysis Using EPA's Localized Pb Occurrence and Source Tool (POST)

- Using POST in EPA's draft blueprint to pilot the whole-of-government approach for reducing Pb exposures.
- Even with the tool there are extensive data gaps, including:
  - Flight data (see right)
  - Localized Occurrence Data for Pb in Soil
  - Localized lead service lines (LSL) data (except for Grand Rapids)





Left: Example visualization of piston aircraft density between 50 – 10,000 feet between 2015-2022 from Quartz analysis of ADS-B Exchange Flight data - https://qz.com/2158594/do-you-live-near-enough-to-a-small-airport-to-have-lead-exposure. Base map: ©Maxar ©Mapbox ©OpenStreetMap.

Right: A study analyzing the effect of Leaded Aviation Gasoline on Blood Lead in Children (Zahran et. al 2017). Note: Monthly blood lead levels (micrograms per deciliter) under 72 months living within 10 km of airport. Data collected between January 2001 to December 2009. Piston-engine aircraft for 27 airports. Standardized scale for comparison, mean 0. Figure from: https://qz.com/2173461/leaded-airplane-fuel-is-poisoning-a-new-generation-of-americans. Data from: https://www.journals.uchicago.edu/doi/abs/10.1086/691686?journalCode=jaere&

Example of Soil Pb Data in Michigan (from USGS) and from Local Studies Conducted in Neighboring States

With permission from Indiana University Environmental Resilience Institute & Notre Dame Lead Innovation Team

Data shown from MapMyEnvironment: https://iupui-earth-science.shinyapps.io/MME_Global/

Visualizing studies with Soil Pb Sampling from:
Notre Dame Lead Innovation Team

Smith, D.B., Cannon, W.F., Woodruff, L.G., Solano, Federico, Kilburn, J.E., and Fey, D.L., 2013, Geochemical and mineralogical data for soils of the conterminous United States: U.S. Geological Survey Data Series 801, 19 p., https://pubs.usgs.gov/ds/801/

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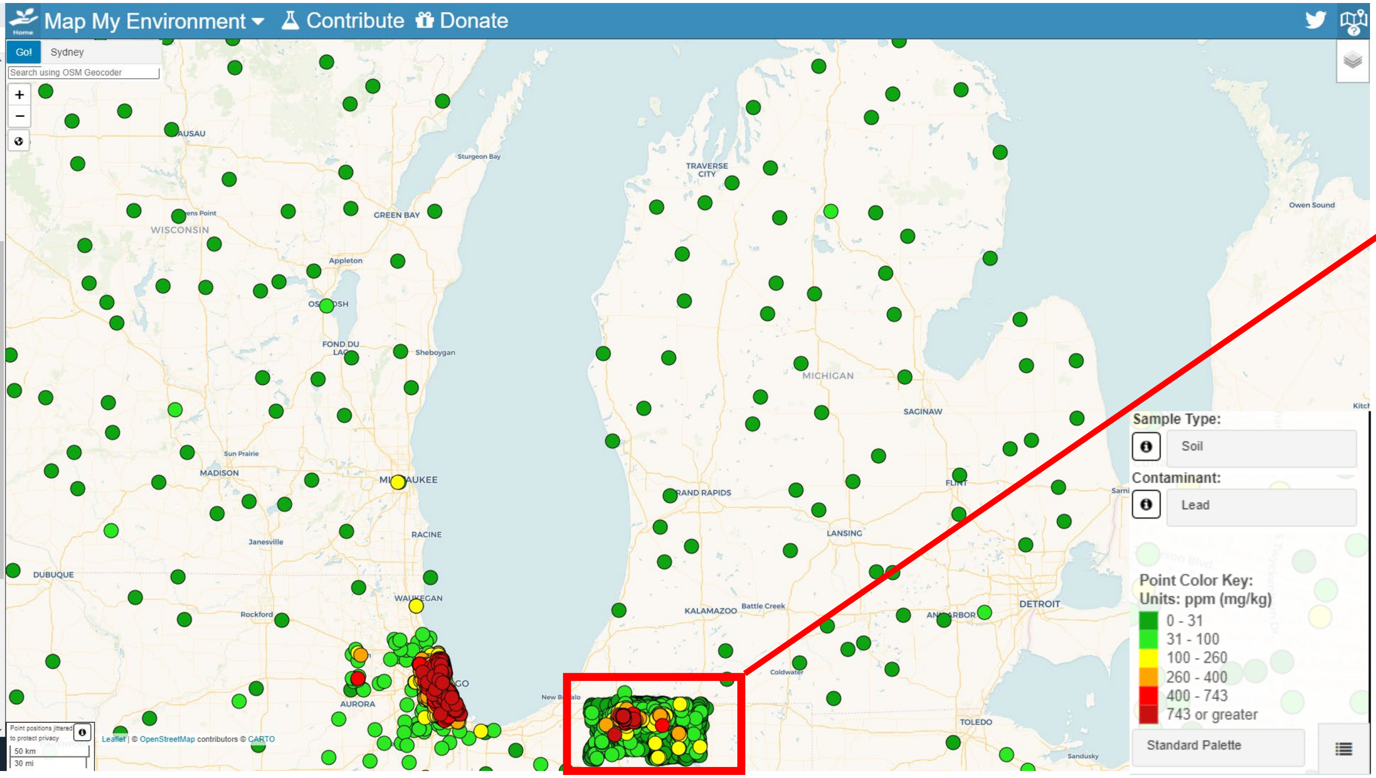
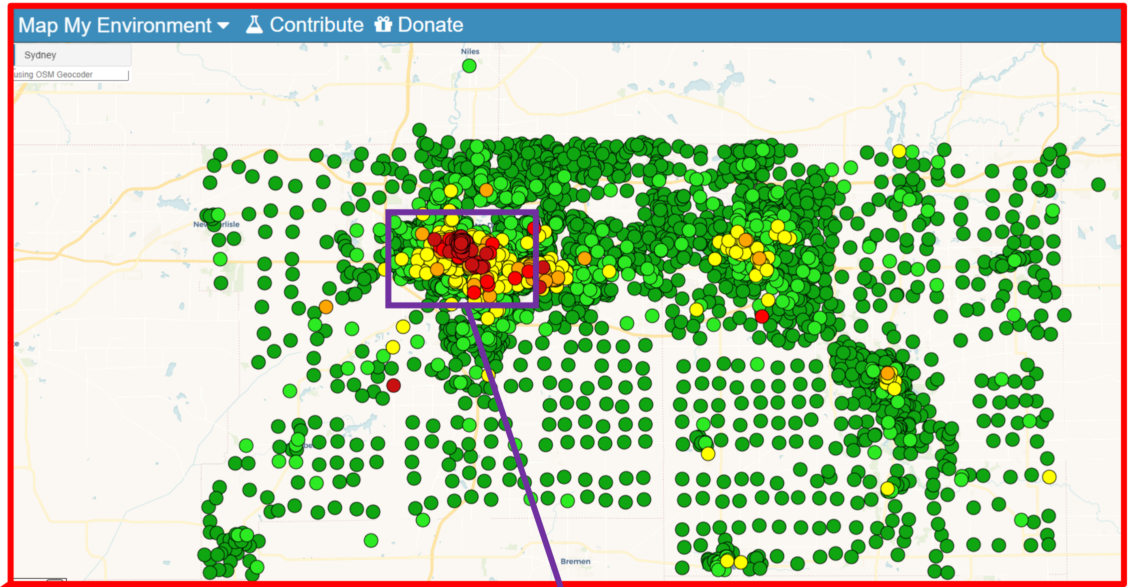
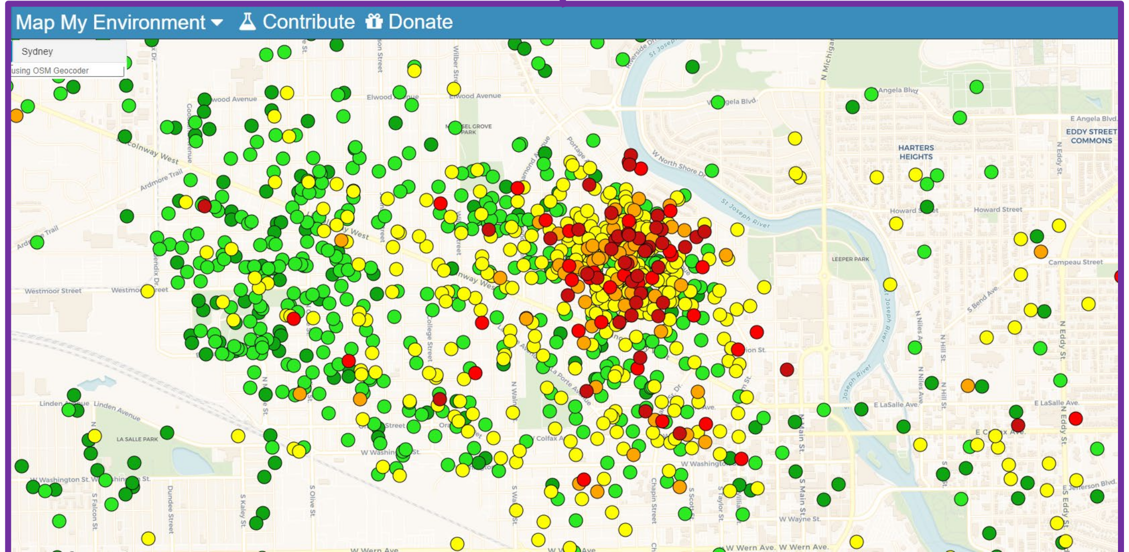
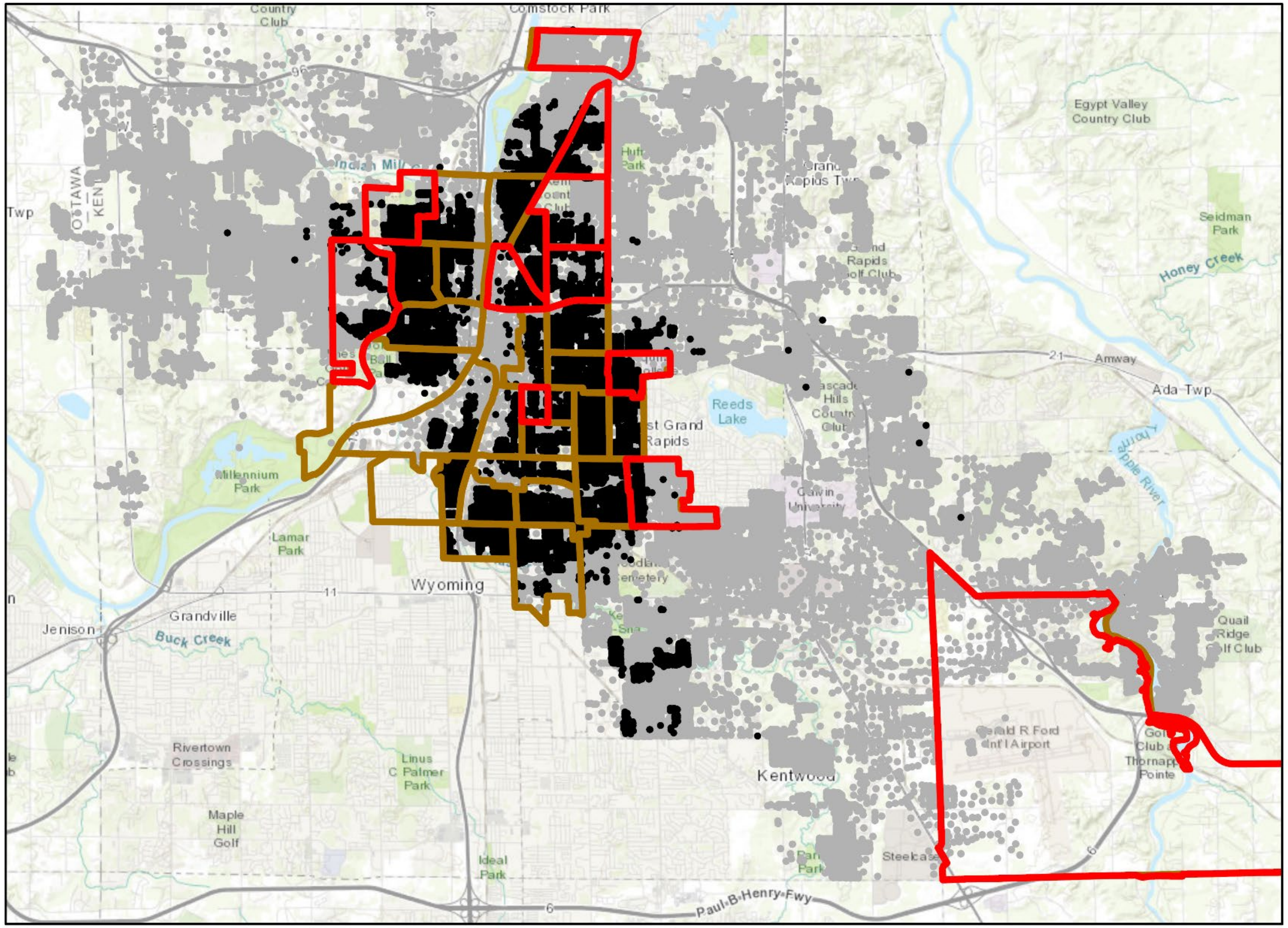






Spatial Overlay of City of Grand Rapids Lead Water Service Line Map & Census Tracts with High Percentage of EBLLs



- **Red**– MI Census Tracts in 80-100th %ile for exceedance rate (% of children's BLLs > 5µg/dL) that are not well explained by old housing and sociodemographics
- **Brown** - MI Census Tracts in 80-100th %ile for exceedance rate (% of children's BLLs > 5µg/dL) that are well explained by old housing and sociodemographics
- **Black** – "Service Line Contains Lead"
- **Gray** – "Service Material Up to Code"

EBLL Data from: Xue et al., 2022, Figure S10
https://ehp.niehs.nih.gov/doi/10.1289/EHP9705

Lead Service Line Data Accessed on 4/14/23 from:
https://www.grandrapidsmi.gov/Government/Departments/Water-System/Lead-in-Drinking-Water/Lead-Water-Service-Line-Map

STEP 5: Provide Information Toolkits, Science Translation and Other Resources to High Exposure Risk Communities

- **EPA Local Lead Action Plan (https://www.epa.gov/lead/llap-guide): A Guide for Local Leaders**

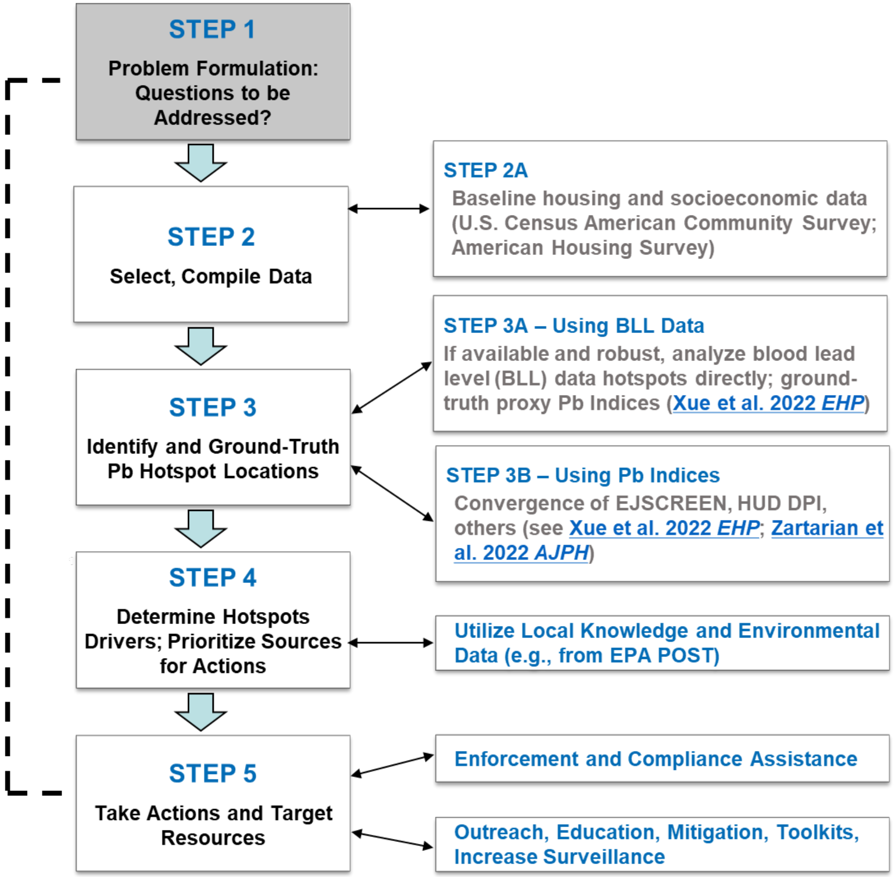
- **Examples of outreach efforts**

- Lead Awareness Outreach and soilSHOP Events
  https://www.atsdr.cdc.gov/soilshop/index.html
- Renovation, Repair, and Painting Training, Lead-Safe Certification Program
  https://www.epa.gov/lead/rrp-program-training-providers
- In-home Childcare Provider Focused Outreach
- Prenatal/Pregnancy Focused Outreach
- Community Lead Awareness

soilSHOP
Screening, Health, Outreach and Partnership

Work-in-Progress West Virginia Blueprint Case Study

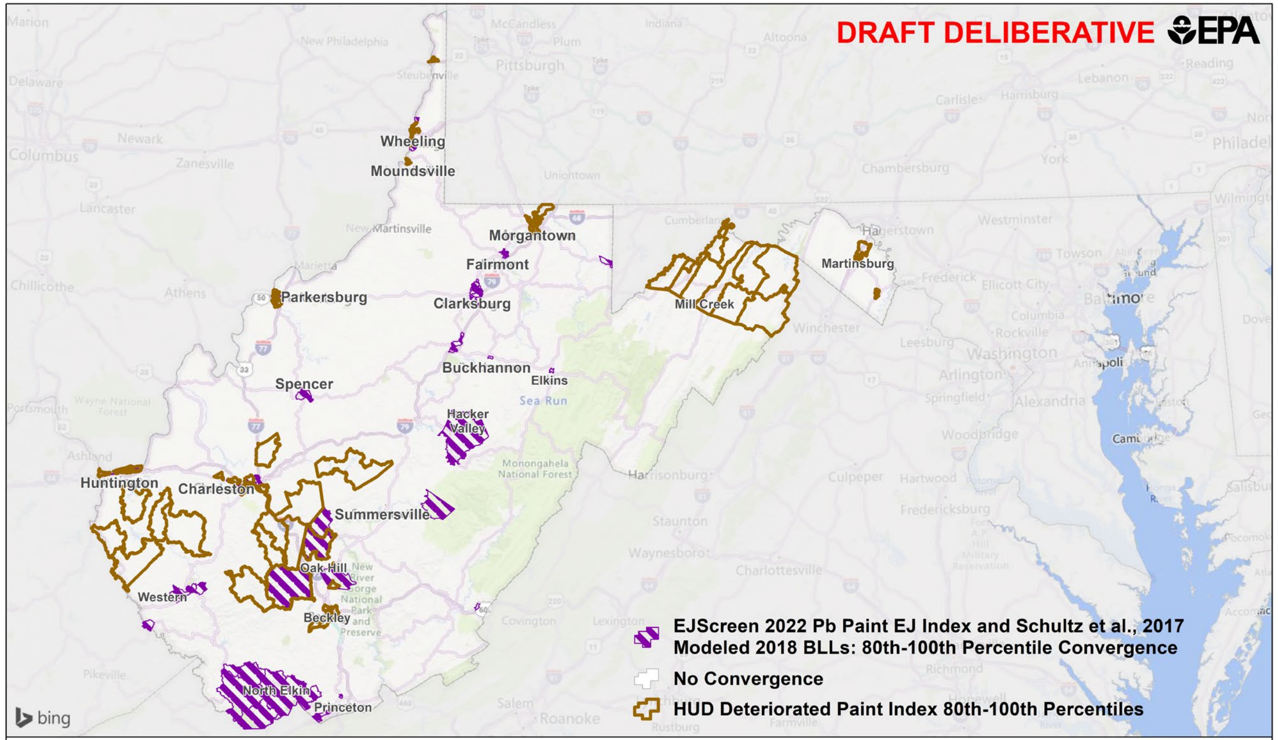
WV Study: STEP 1 – Problem Formulation



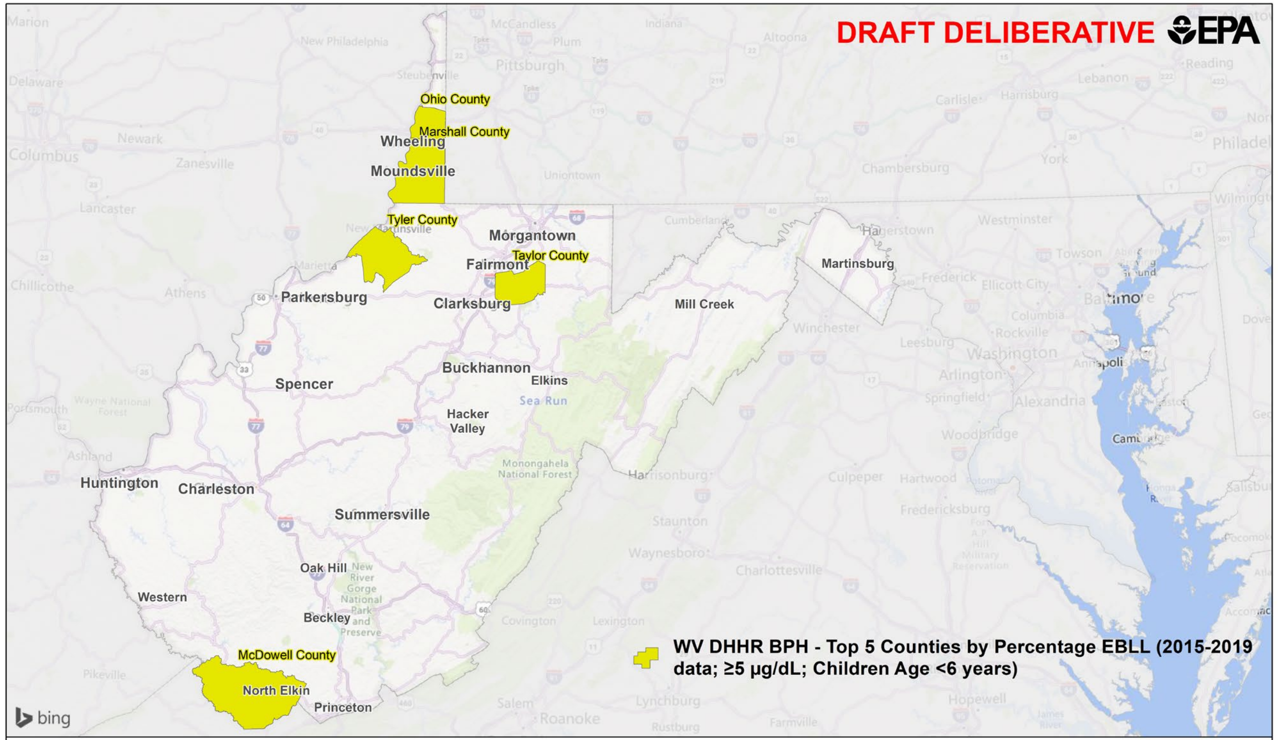
- **Questions:**
  - Where to focus children's BLL surveillance efforts?
  - Where to focus other Pb outreach and public health awareness (e.g., for Pb in drinking water and Pb-based paint)

- **EPA partnering with West Virginia DHHR, HUD for joint, community-focused planning** to apply the science with environmental and public health agency programs: compliance assistance, monitoring and assurance; risk communication; outreach/education; technical assistance

STEPS 2 & 3 –
Select and Compile Data and Identify Pb Hotspots



Areas of 80th-100th State Percentile Census Tract Convergence:
Schultz et al. (2017) Multiple Regression Model Approach & EJScreen 2022 Pb Paint EJ Index with HUD Deteriorated Paint Index Top 20 Percentiles



WV DHHR BPH - Top 5 Counties by Percentage EBLL (2015-2019 data; ≥5 µg/dL; Children Age <6 years)

Data Source
https://dhhr.wv.gov/wvchildhoodleadpoisoning/Documents/Lead%20Data%202011-2019/rptGrantCoTots%20(1).pdf

WV map created using methodology in Xue et al., 2022, *EHP*
https://ehp.niehs.nih.gov/doi/10.1289/EHP9705

WV Study: STEP 4 - Prioritize Critical Lead (Pb) Exposure Pathways and Sources *using available data and local knowledge*

- West Virginia has 415 Community Water Systems (CWS) that serve less than 50,000 residents.
  - This means that corrosion control treatment steps are not required unless the system exceeds the lead and/or copper action level.
- Relationships between source water quality, drinking water treatment approaches and other factors on the release of Pb from lead service lines (LSL) and other premise plumbing Pb sources are likely not well understood.
- Looking for data to identify CWS that may be at increased risk to drinking water Pb exposure based on water quality, corrosion control treatment status, regulatory (Lead and Copper Rule) results, prevalence of LSL, and other considerations.

WV Study: STEP 5: Provide Information Toolkits, Science Translation and Other Resources to High Exposure Risk Communities

➢ **EPA Local Lead Action Plan: A Guide for Local Leaders**

- *Web-based framework available on [EPA's lead website]*
- *Includes checklists, action plan template, resources, best practices, case studies*

ASSESSING LOCAL LEAD HISTORY & DATA

Get a baseline of the lead history and lead data available for the local area

Checklist 1

IDENTIFYING POTENTIAL LEAD ISSUES

Find potential lead issues across media and sectors in the local area

Checklist 2

IDENTIFYING OPPORTUNITIES TO ADDRESS LEAD

Find gaps that may exist and opportunities to take action to address the local lead issues

Checklist 3

Source: EPA Region 3, Noelle Watanabe

PLANNED NEXT STEPS

- Continued collaborative whole-of-government discussions
- Obtaining additional data sets
- Capacity building
- Ground-truthing and outreach with state partners
- Incorporating additional info on LSL identification approaches into EPA Local Lead Action Plan (LLAP)
- Collaborative journal manuscript and additional presentations

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  - EPA ORD, Region 5, Region 3, OECA; MDHHS; MI EGLE; WV DHHR; HUD
- EPA Pb mapping team and MI Pb paper coauthors/contributors
- EPA, HUD, & CDC collaborators and coauthors of state-of-science Pb mapping paper

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Tapping into Lead Service Line Information: Two City Case Study

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[3] US EPA Office of Ground Water and Drinking Water

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2023 NEHA Annual Educational Conference & Exhibition
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Disclaimer: The views expressed in this presentation are those of the author and do not necessarily reflect the views or policies of the U.S. EPA

Background

- Bipartisan Infrastructure Law * provides $15 billion for “lead service line (LSL) replacement projects and associated activities directly connected to the identification, planning, design, and replacement of LSL.”

- This law creates an opportunity to evaluate the impact of LSL prevalence on lead exposure

- Goal of current study is to use existing data to assess association between LSL and children’s elevated blood lead levels (EBLL) in two midwestern cities.

*https://www.whitehouse.gov/briefing-room/statements-releases/2021/11/06/fact-sheet-the-bipartisan-infrastructure-deal/

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Data & Approach

- LSL prevalence
  - Ohio Utility #3 and Michigan Utility #5 provided Lead Service Lines (LSL) data to EPA
  - EPA aggregated LSL data to 2010 census tracts and calculated %LSL per tract
  - Weighting by the population size of children aged 0-5 year in census block groups

- EBLL prevalence $= \frac{\#\text{children tested in the census tract with } \textbf{EBLL}}{\#\text{children tested in the census tract}} \times 100,$

  where an elevated blood lead level (**EBLL**) is when child's blood lead level ≥ 5µg/dL, per Xue et al. 2022 (https://ehp.niehs.nih.gov/doi/10.1289/EHP9705)

- Approach
  - Compare the predictive value of LSL prevalence to other Pb exposure indices and models (EJSCREEN Index, HUD Index, Random Forest Regression EBLL Prediction Model)
  - Using linear regression or weighted quantile sum (WQS) regression
  - We regressed logit, $\ln(\theta/(1-\theta))$, on standardized predictors to compare them
  - where θ is the EBLL prevalence

Methods- Compare LSL prevalence with Pb indices

- **EPA EJSCREEN 2017 Pb Paint EJ Index** (www.epa.gov/ejscreen) **– "EJSCREEN"**
  - Originally developed at census block group level by EPA OEJ
  - Uses American Community Survey 2011-2015 5-year summary file
  - Based on pre-1960 homes,% low income, % minority, population
  - EPA ORD aggregated the data by averaging index values per census tract

- **HUD Deteriorated Paint Index** (Garrison & Ashley, 2020) **– "HUD DPI"**
  - Provided by the US Department of Housing and Urban Development (https://hudgis-hud.opendata.arcgis.com/datasets/deteriorated-paint-index-by-tract)
  - Uses 2011 American Housing Survey and 2009-2013 American Community Survey Data
    - 2011 American Housing Survey: occupied pre-1980 households that reported a large area of peeling paint
    - 2009-2013 American Community Survey: presence of children in household, housing tenure status (owned, rented, or other), household income, race (white, black, other), ethnicity (Hispanic or non-Hispanic), and education level

- **EPA/ORD Work-in-Progress Random Forest Regression EBLL Prediction Model – "RF Model"**
  - Based on Ohio 2007-2011 BLL data and 2013 Ohio Dept Health report model, and currently includes the following 5 predictors: % homes built prior to 1940, % homes built prior to 1950, % families whose income-to-poverty ratio was > than 2, % population with either high-school or higher education, % non-Hispanic African Americans
  - Demographic data originate from the American Community Survey 2013-2017 5-year summary file

Methods- RF Regression model of EBLL prevalence

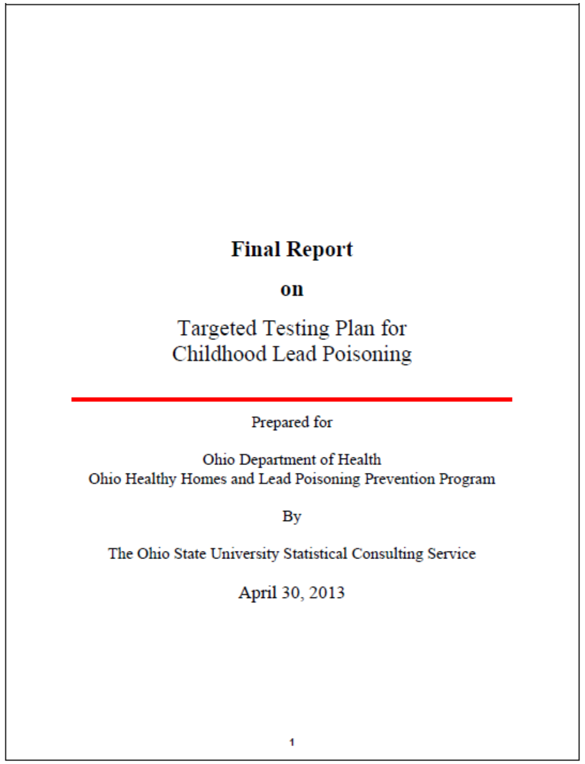
EPA/ORD Work-in-Progress Random Forest Regression EBLL Prediction Model for Children < 6 years

In prior work, we assessed data published in a 2013 report prepared for the Ohio Department of Health

A set of 29 housing-demographic variables for census tracts were identified through RF regression model developed from Ohio, 2007-2011

these were most important:

- percent of houses built before 1940 (DP04),
- percent of houses built before 1950 (DP04),
- percent of population that is African American (non-Hispanic) (DP1),
- percent of households with income to poverty ratio greater than 2 (B17026),
- percent of population with a high school degree or higher (DP02)



Final Report

on

Targeted Testing Plan for
Childhood Lead Poisoning

Prepared for

Ohio Department of Health
Ohio Healthy Homes and Lead Poisoning Prevention Program

By

The Ohio State University Statistical Consulting Service

April 30, 2013

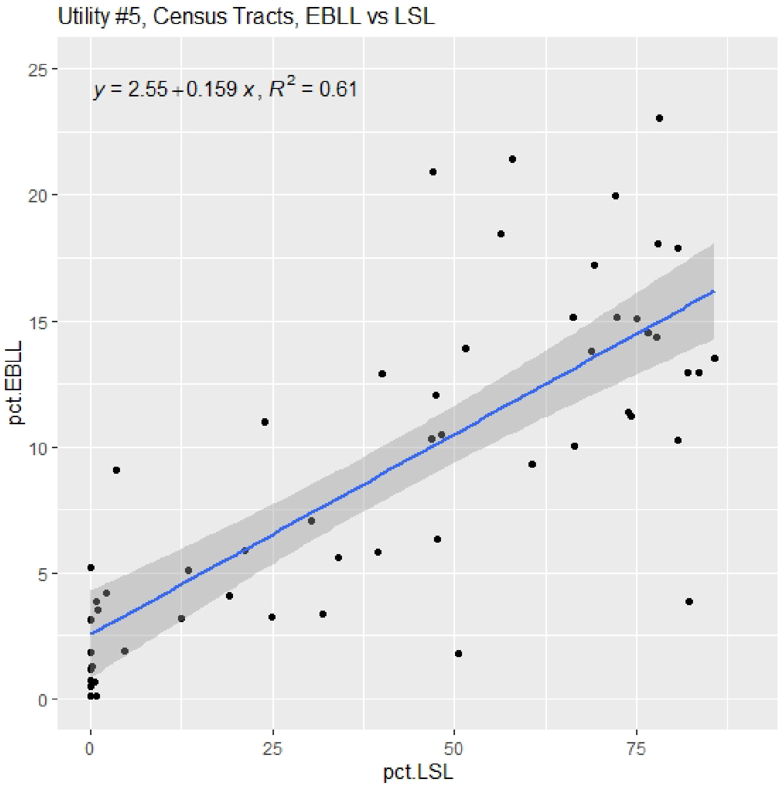
1

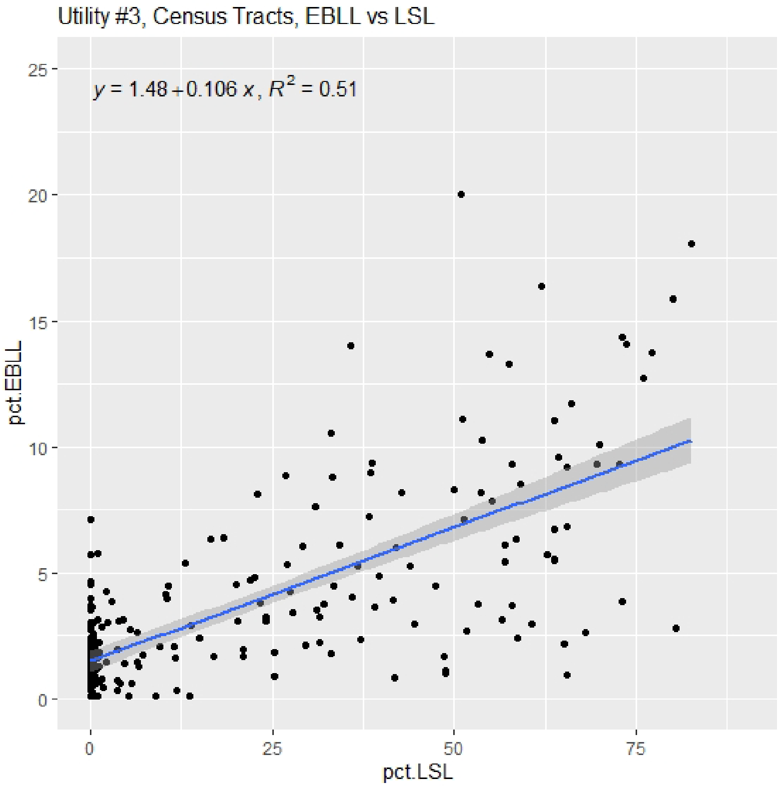
Moderate to strong correlation between LSL prevalence and EBLL prevalence

Utility #5 (N=57)

Utility #3 (N=232)

Percent EBLL





Percent LSL

Strong correlation between LSL prevalence and EBLL prevalence

Strong correlation between LSL prevalence and EBLL prevalence, at census tract, where EBLL is children's BLL ≥ 5µg/dL

For Michigan **Utility #5:**

Pearson Correlation (**LSL percent**, **EBLL percent**)

= 0.78, ($p = 6.9e-13$); 95%CI: 0.65, 0.87 (df= 55)

For Ohio **Utility #3:**

Pearson Correlation (**LSL percent**, **EBLL percent**)

= 0.71, ($p < 2.2e-16$); 95%CI: 0.64, 0.77 (df= 230)

Correlation between LSL prevalence and recognized Pb Covariates

Utility #5 (N=57)

	Pct_LSL_w
Pct_LSL_w	1.00
z_Pct_LSL_w	1.00
pct.home_pre1950	0.90
pct.home_pre1940	0.89
RF.OH0711	0.84
Z_RF.OH0711	0.84
Observed	0.78
logit	0.74
EJS_PbPI	0.55
z_EJS_PbPI	0.55
HUD_DPI	0.47
z_HUD_DPI	0.47
pct.black	0.26
pct.HS_higher	-0.51
pct.inc_pov_ratio_g2	-0.61

Utility #3 (N=232)

	Pct_LSL_w
Pct_LSL_w	1.00
Z_Pct_LSL_w	1.00
pct.home_pre1940	0.77
pct.home_pre1950	0.75
Observed	0.71
RF.OH0711	0.70
z_RF.OH0711	0.70
logit	0.63
HUD_DPI	0.52
z_HUD_DPI	0.52
EJS_PbPI	0.43
z_EJS_PbPI	0.43
pct.black	0.33
pct.HS_higher	-0.42
pct.inc_pov_ratio_g2	-0.47

Utilities #3 and #5 (N=289)

	Pct_LSL_w
Pct_LSL_w	1.00
Z_Pct_LSL_w	1.00
pct.home_pre1940	0.80
pct.home_pre1950	0.79
Observed	0.75
RF.OH0711	0.73
z_RF.OH0711	0.73
logit	0.69
HUD_DPI	0.48
EJS_PbPI	0.48
z_HUD_DPI	0.48
z_EJS_PbPI	0.48
pct.black	0.23
pct.HS_higher	-0.47
pct.inc_pov_ratio_g2	-0.50

Observed = EBLL prevalence

LSL prevalence vs. HUD DPI, EJSCREEN, or RF model, Utilities #5 (n=57)

WQS Regression	WQS Regression	WQS Regression	Linear Regression	Linear Regression	Linear Regression	Linear Regression	Linear Regression	Linear Regression
	component	**Mean weight**	**Component**	**Coefficient**	**SE**	**T value**	**P value**	**Signif.**
			(intercept)	-2.821	0.123	-23.004	< 2e-16	***
EJ Screen	Pct_LSL_w	0.880	z_Pct_LSL_w	0.911	0.148	6.161	0.000	***
	EJS_PbPI	0.120	z_EJS_PbPI	0.163	0.148	1.099	0.276	
			(intercept)	-2.821	0.113	-24.930	< 2e-16	***
HUD DPI	Pct_LSL_w	0.750	z_Pct_LSL_w	0.801	0.129	6.206	0.000	***
	HUD_DPI	0.250	z_HUD_DPI	0.425	0.129	3.293	0.002	**
			(intercept)	-2.821	0.123	-22.935	< 2e-16	***
RF Model	Pct_LSL_w	0.640	z_Pct_LSL_w	0.820	0.228	3.598	0.001	***
	RF.OH0711	0.360	z_RF.OH0711	0.213	0.228	0.936	0.353	

Signif. Codes *0.05, **0.01, ***0.001

Result: As 'predictor of' or 'contributor to' Pb exceedance, LSL prevalence outperformed HUD DPI, EJSCREEN, or RF model.

United States Environmental Protection Agency

LSL prevalence vs. HUD DPI, EJSCREEN, or RF model, Utilities #3 (n=232)

WQS Regression	WQS Regression	WQS Regression	Linear Regression	Linear Regression	Linear Regression	Linear Regression	Linear Regression	Linear Regression
	component	Mean weight	Component	Coefficient	SE	T value	P value	Signif.
			(intercept)	-3.849	0.062	-61.845	< 2e-16	***
EJ Screen	Pct_LSL_w	0.783	z_Pct_LSL_w	0.692	0.069	9.993	< 2e-16	***
	EJS_PbPI	0.217	z_EJS_PbPI	0.203	0.069	2.931	0.004	**
			(intercept)	-3.849	0.062	-61.893	< 2e-16	***
HUD DPI	Pct_LSL_w	0.866	z_Pct_LSL_w	0.665	0.073	9.097	< 2e-16	***
	HUD_DPI	0.134	z_HUD_DPI	0.219	0.073	2.993	0.003	**
			(intercept)	-3.849	0.059	-64.713	< 2e-16	***
RF Model	Pct_LSL_w	0.520	z_Pct_LSL_w	0.452	0.084	5.391	0.000	***
	RF.OH0711	0.480	z_RF.OH0711	0.467	0.084	5.581	0.000	***

Signif. Codes *0.05, **0.01, ***0.001

Result: As 'predictor of' or 'contributor to' Pb exceedance, LSL prevalence outperformed HUD DPI, EJSCREEN, or RF model.

LSL prevalence vs. HUD DPI, EJSCREEN, or RF model, Utilities #3 and #5 (n=289)

WQS Regression	WQS Regression	WQS Regression	Linear Regression	Linear Regression	Linear Regression	Linear Regression	Linear Regression	Linear Regression
	component	**Mean weight**	**Component**	**Coefficient**	**SE**	**T value**	**P value**	**Signif.**
			(intercept)	-3.646	0.056	-64.991	< 2e-16	***
EJ Screen	Pct_LSL_w	0.867	z_Pct_LSL_w	0.819	0.064	12.769	< 2e-16	***
	EJS_PbPI	0.133	z_EJS_PbPI	0.187	0.064	2.912	0.004	**
			(intercept)	-3.646	-65.251	-65.251	< 2e-16	***
HUD DPI	Pct_LSL_w	0.769	z_Pct_LSL_w	0.808	12.667	12.667	< 2e-16	***
	HUD_DPI	0.231	z_HUD_DPI	0.210	3.291	3.291	0.001	**
			(intercept)	-3.646	0.055	-66.618	< 2e-16	***
RF Model	Pct_LSL_w	0.772	z_Pct_LSL_w	0.627	0.080	7.835	0.000	***
	RF.OH0711	0.228	z_RF.OH0711	0.387	0.080	4.838	0.000	***

Signif. Codes *0.05, **0.01, ***0.001

Result: As 'predictor of' or 'contributor to' Pb exceedance, LSL prevalence outperformed HUD DPI, EJSCREEN, or RF model.

Findings

In two cities with available lead service line (LSL) and blood lead level data:

- Moderate to strong correlation between LSL prevalence and: 1) prevalence of blood lead exceedance and 2) housing and sociodemographic variables known to be relevant to lead exposure

- LSL prevalence was a stronger indicator of blood-Pb exceedance than EJSCREEN Pb Paint Index, HUD Deteriorated Paint Index, or a random forest predictor of blood-Pb exceedance.

- This work suggests LSL prevalence is an important predictor of EBLL and should be considered in hotspot analyses

- Study findings relevant only to the two Midwest utilities studied

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Acknowledgements/ Disclaimers

Acknowledgements

- Michigan Department of Health and Human Services (MDHHS) provided blood lead data used in this presentation, pursuant to a Data Use Agreement. EPA assumes full responsibility for the analysis and interpretation of the data.
- This presentation includes analyses with blood lead data provided by the Ohio Department of Health (ODH), through the Ohio Public Health Information Warehouse. The Department specifically disclaims responsibility for any analyses, interpretations, or conclusions from these data.
- Research included in this analysis was approved under Institutional Review Boards (IRBs) through University of North Carolina at Chapel Hill (UNC; 16-2302), MDHHS (201703-12-EA) and ODH (2019-41).
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Disclaimer

- The views expressed in this presentation are those of the authors and do not necessarily reflect the views or policies of the U.S. EPA.

United States Environmental Protection Agency

Questions?

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Region 1 Integrated Lead Strategy

National Environmental Health Association 2023 Conference

August 1, 2023

Overview

- Region 1 Strategy & Approach
- Leveraging Data to Address Areas Still at Risk
- Connecticut Geographic Initiative
- Lessons Learned

New England Housing Factors

- New England has some of the oldest housing in the United States.
- Over a third of housing was built before 1950, where deteriorating lead-based paint is most likely to exist along with aging water infrastructure which can include lead service lines.

EPA's National Lead Strategy to Reduce Lead Exposures and Disparities in US Communities

November 2022

Goal 1: Reduce Community Exposures to Lead Sources

Goal 2: Identify Communities with High Lead Exposures and Improve their Health Outcomes

Goal 3: Communicate More Effectively with Stakeholders

Goal 4: Support and Conduct Critical Research to Inform Efforts to Reduce Lead Exposures and Related Health Risks

Region 1 Cross-Office Lead Team

Enforcement	Sharon Hayes, Kristi Rea Simoneau and Deborah Cohen
Regional Administrator	Kathleen Nagle and Jeff Norcross
Superfund	Carol Tucker
Lands	Dan Wainberg, Amanda Triebwasser and Jessica Dominguez
Water	Jane Downing and Jeri Weiss
Management Support	Alex Dichter
Laboratory	Scott Clifford
Research & Development	Valerie Zartarian and Megan Christian

Key Federal Lead Regulations

Housing & Schools

- Toxic Substances Control Act
- Renovation, Repair & Painting Rule
- Residential Lead-based Paint Hazard Reduction Act

Water & Air

- Safe Drinking Water Act
- Clean Air Act (National Air Quality Standards & Hazardous Air Pollutants)

Soil & Land

- Comprehensive Environmental Response, Compensation, and Liability Act
- Brownfields Revitalization Act
- Resource Conservation & Recovery Act

Regional Priorities

Protecting Vulnerable Populations in Targeted Locations

Early pilots – increasing public awareness

PROTECTING THE PUBLIC
EPA's RRP: RENOVATION, REPAIR & PAINTING RULE

THE RULE

EPA's RRP Rule protects the public and workers from lead-based paint hazards associated with renovation, repair and painting activities. These activities can create hazardous lead chips and dust when lead-based paint surfaces are disturbed. The rule requires firms to be Lead Safe certified and at least one worker on the job site to be Renovator certified.

WHY THE RRP RULE IS IMPORTANT

Even low levels of lead in the blood of children can cause serious impacts on the way children develop, learn, and behave. Lead poisoning is 100% preventable!

Compliance with the RRP Rule protects children and workers, but it also protects firms from costly enforcement actions and liability. The max penalty for RRP violations is over $40,000.

Expanding Web Resources

PROTECT YOUR TAP
a quick lead check

How to find a water meter, service line and how to identify pipe materials, using visual aides.

Tips are included to reduce exposure to lead.

Testing water is the only way to know if lead is present.

Click here

New Approaches:

Connecticut Geographic Initiative

- In 2020, EPA Region 1 began a cross-office, multimedia lead initiative involving outreach, education, compliance assistance, and enforcement activities across media programs in priority Connecticut counties to reduce the risk of future childhood lead exposure.
- Region 1 focused in Hartford, Fairfield and New Haven Counties
- Due to the COVID-19 pandemic, conducted remote or virtual activities for most of 2020 and 2021 and conducted virtual and traditional field work in 2022-2023.

Phased Approach to Identify Vulnerable Populations at Risk for Lead Poisoning

Gather available data including age of housing and presence of children under age of six to identify an initial set of communities for consideration, community stakeholders and regulated entities.

Work with local partners and ORD to gather available EBL data and identify partnerships for joint action and assistance.

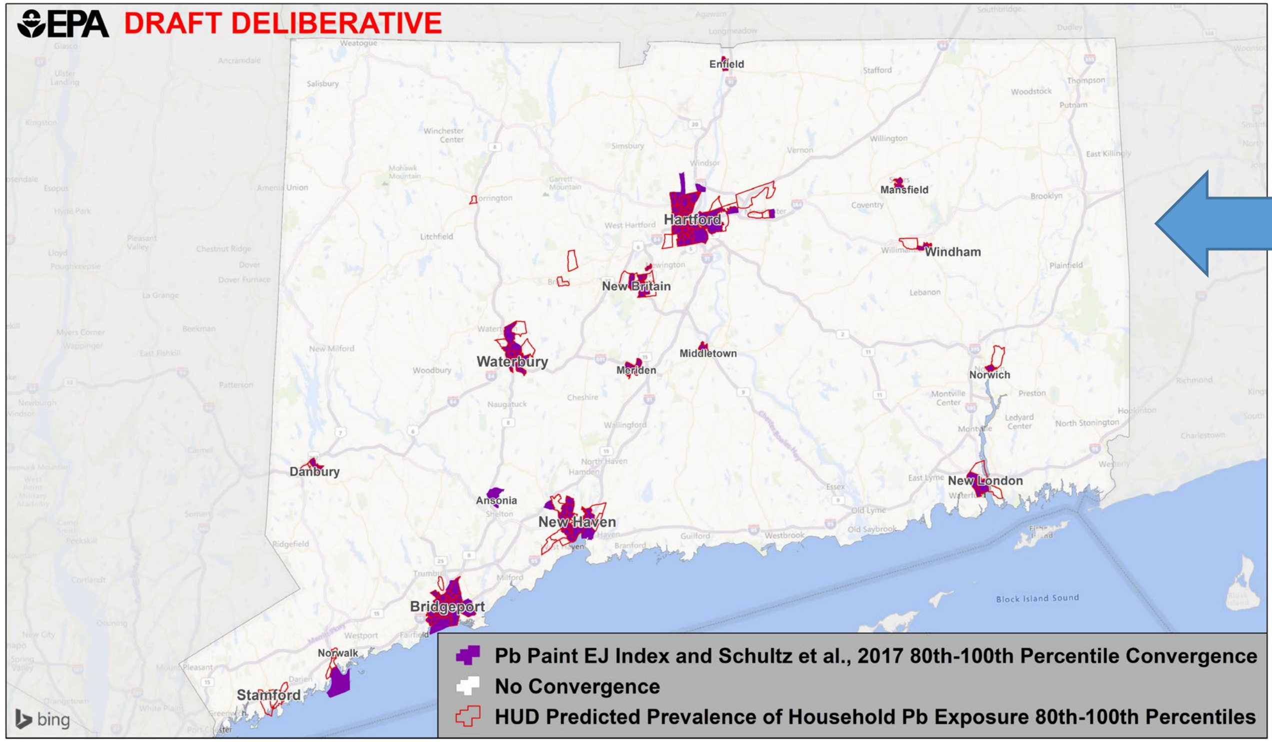
Identified communities are prioritized for cross-program action.

Monitor progress, track results, and identify lessons learned.

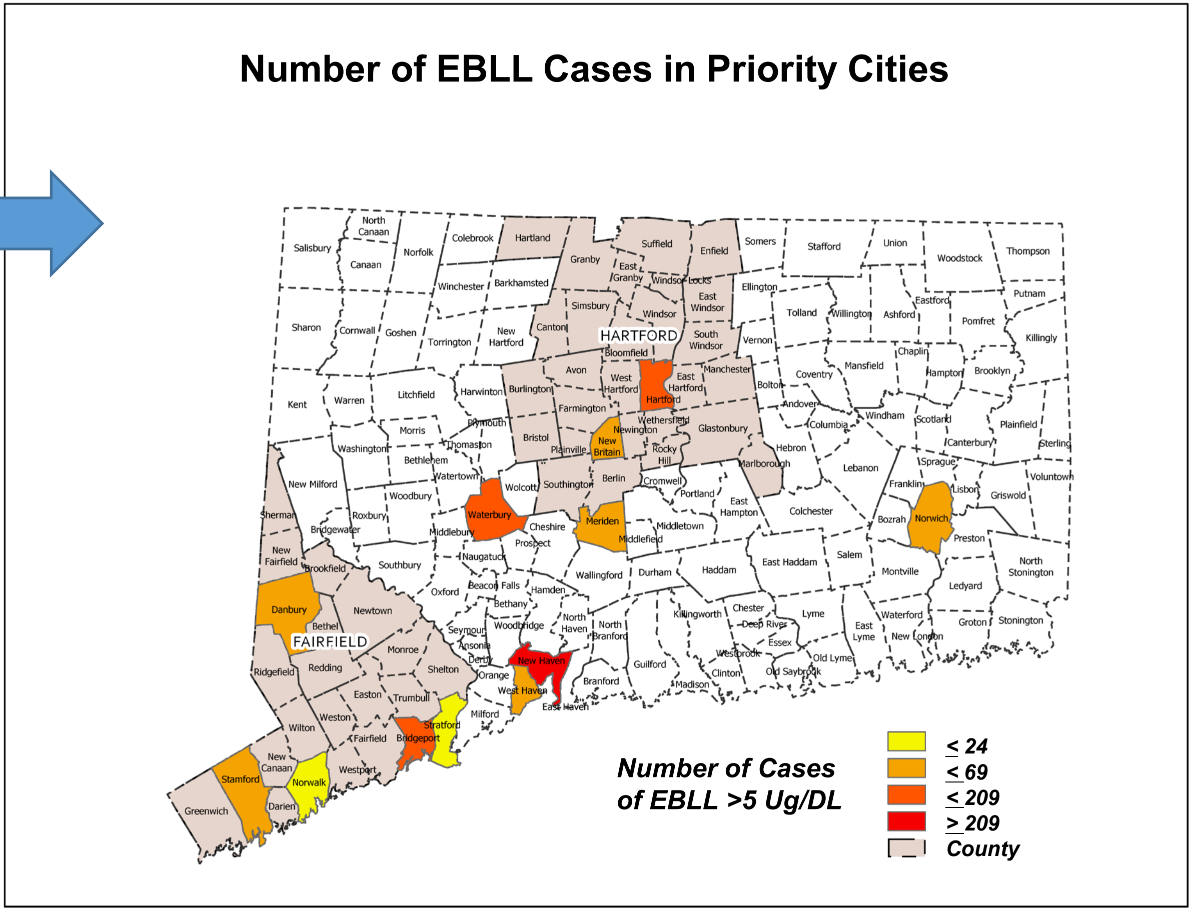
ORD Technical Assistance to Region 1
Supporting R1 CT Geographic Initiative

CT Convergence of Available CT Data for Housing Age and Sociodemographics (EPA & HUD):
Mapping Analysis by ORD

Children's Blood Lead Data from CT Department of Public Health Report (2017):
Mapping Analysis by Region 1

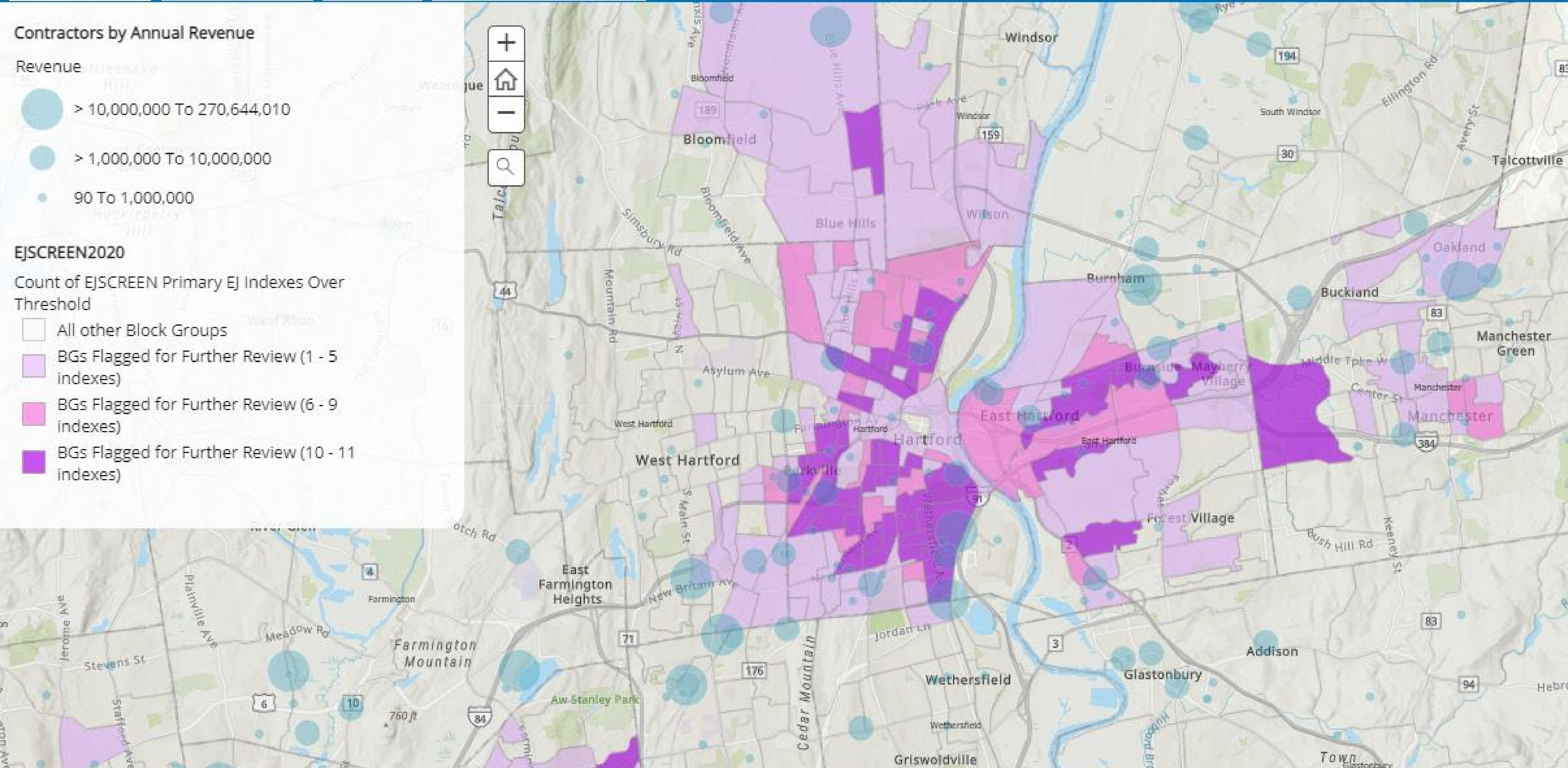


Top 20 Percentile Data Convergence: EPA EJSCREEN 2017 Pb Paint EJ Index & EPA Schultz et al., 2017 modeled Blood Lead Levels **(purple)** Overlaid with HUD Deteriorated Paint Index Top 20 Percentiles **(pink)**



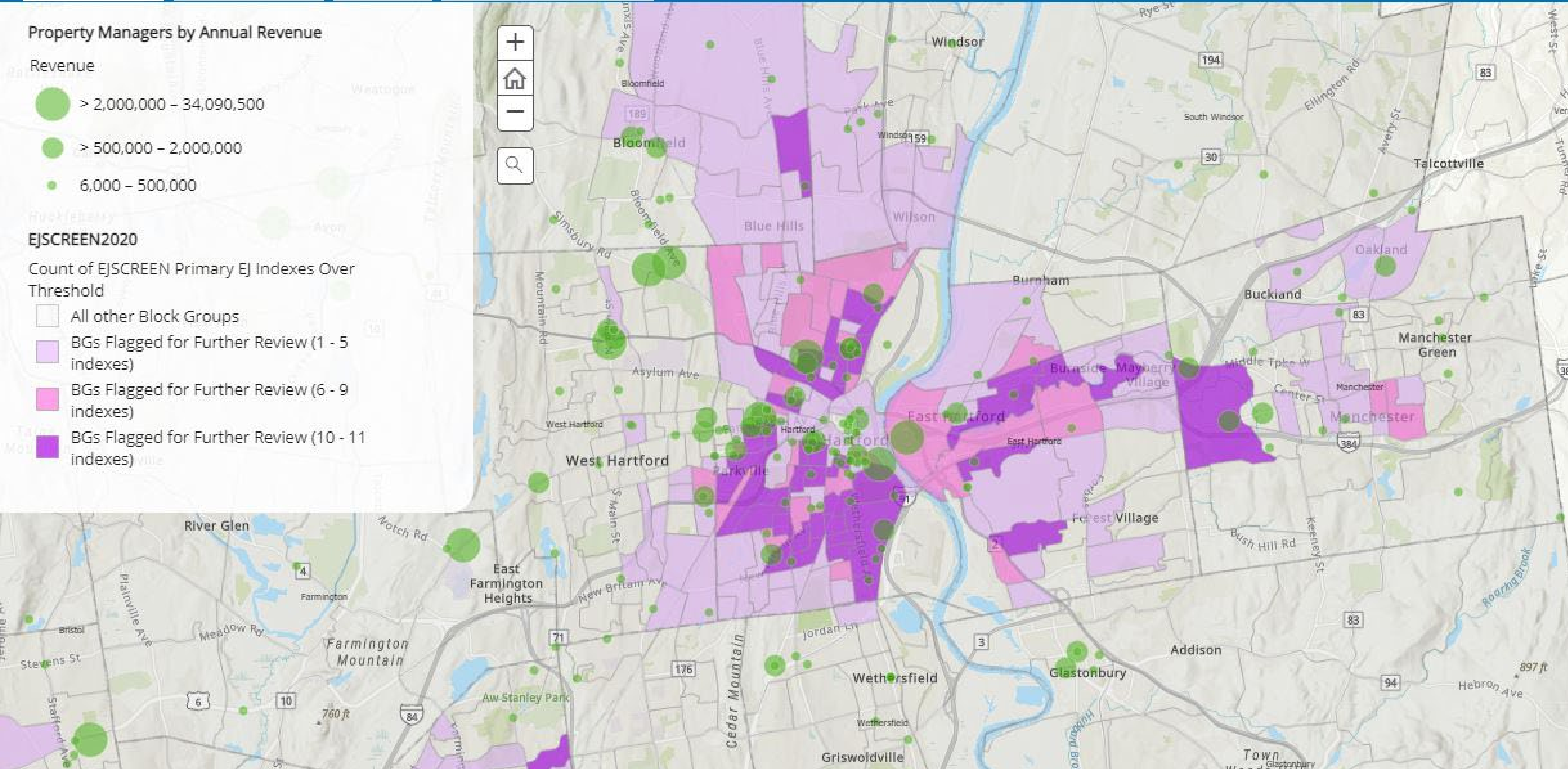
Connecticut Renovation, Repair and Painting Program – Targeting Inspections and Compliance Assistance

State Overview | Hartford County | Outreach | Connecticut Data Viewer



Part 2: Connecticut Renovation, Repair and Painting Program – Targeting Inspections and Compliance Assistance

State Overview | Hartford County | Outreach | Connecticut Data Viewer

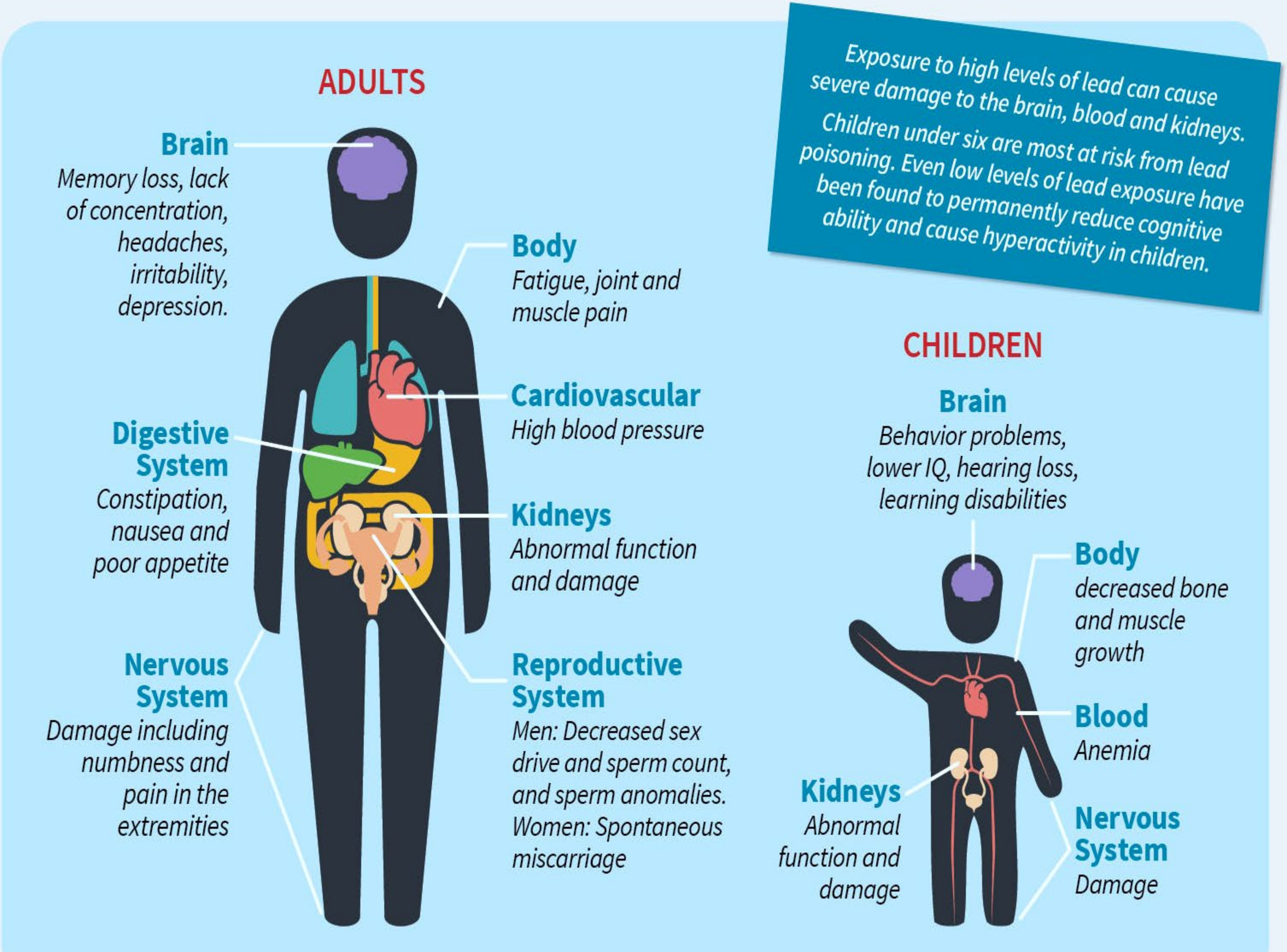


Protecting Your Family from Lead

Hartford Parent University

What is lead poisoning?

- There is no safe level of lead for the body
- Children absorb 4-5x more lead than adults
- Irreversible health impacts can occur with low levels of lead in the body



Source: Clean Water Action Fund

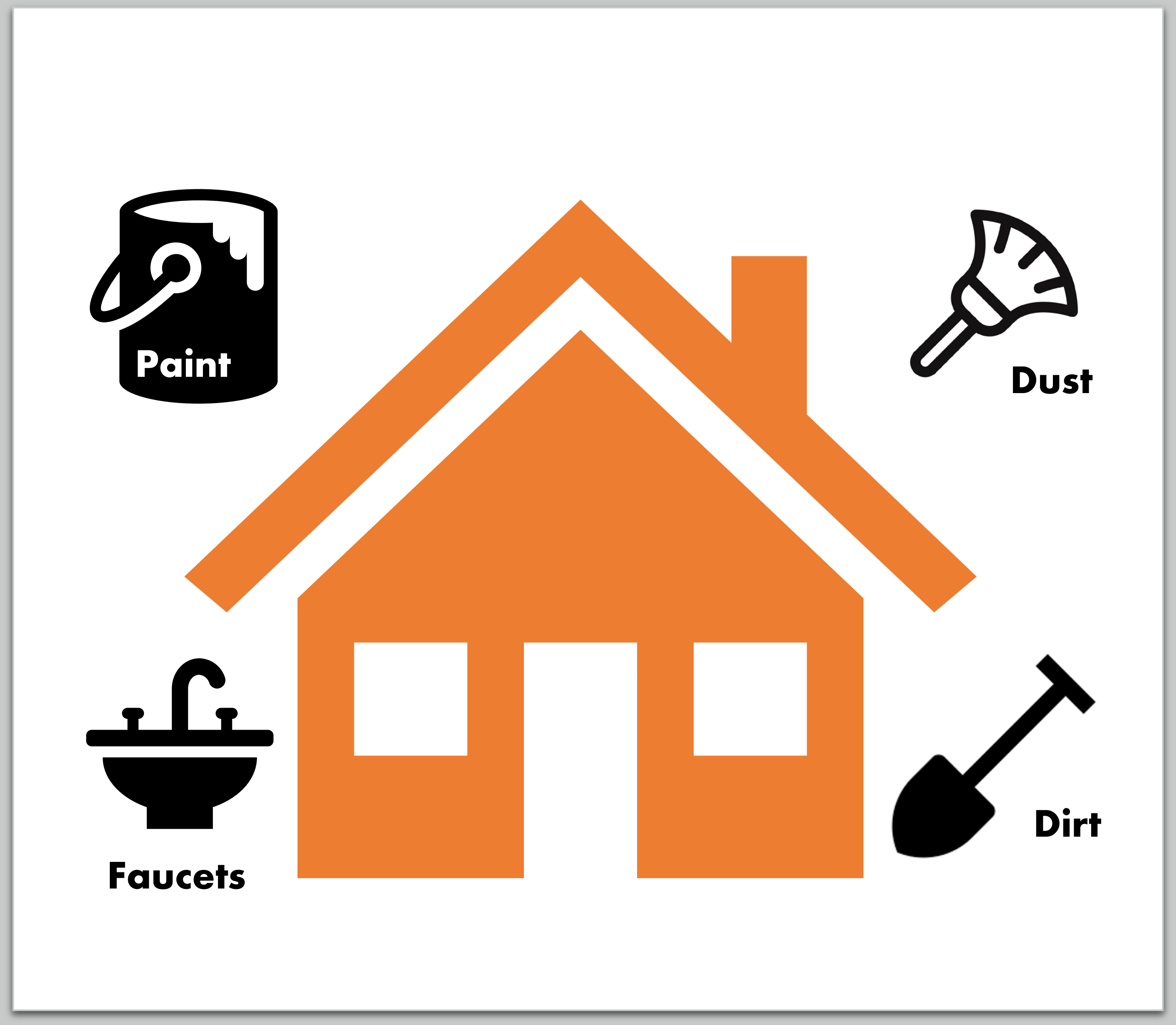
WHERE IS LEAD?

When was your home built?

IF YOUR HOME WAS BUILT BEFORE 1978 ASSUME THERE'S LEAD

Don't know the age of your home?

- **Check your lease**
- **Ask your landlord**
- **Check online real estate database**



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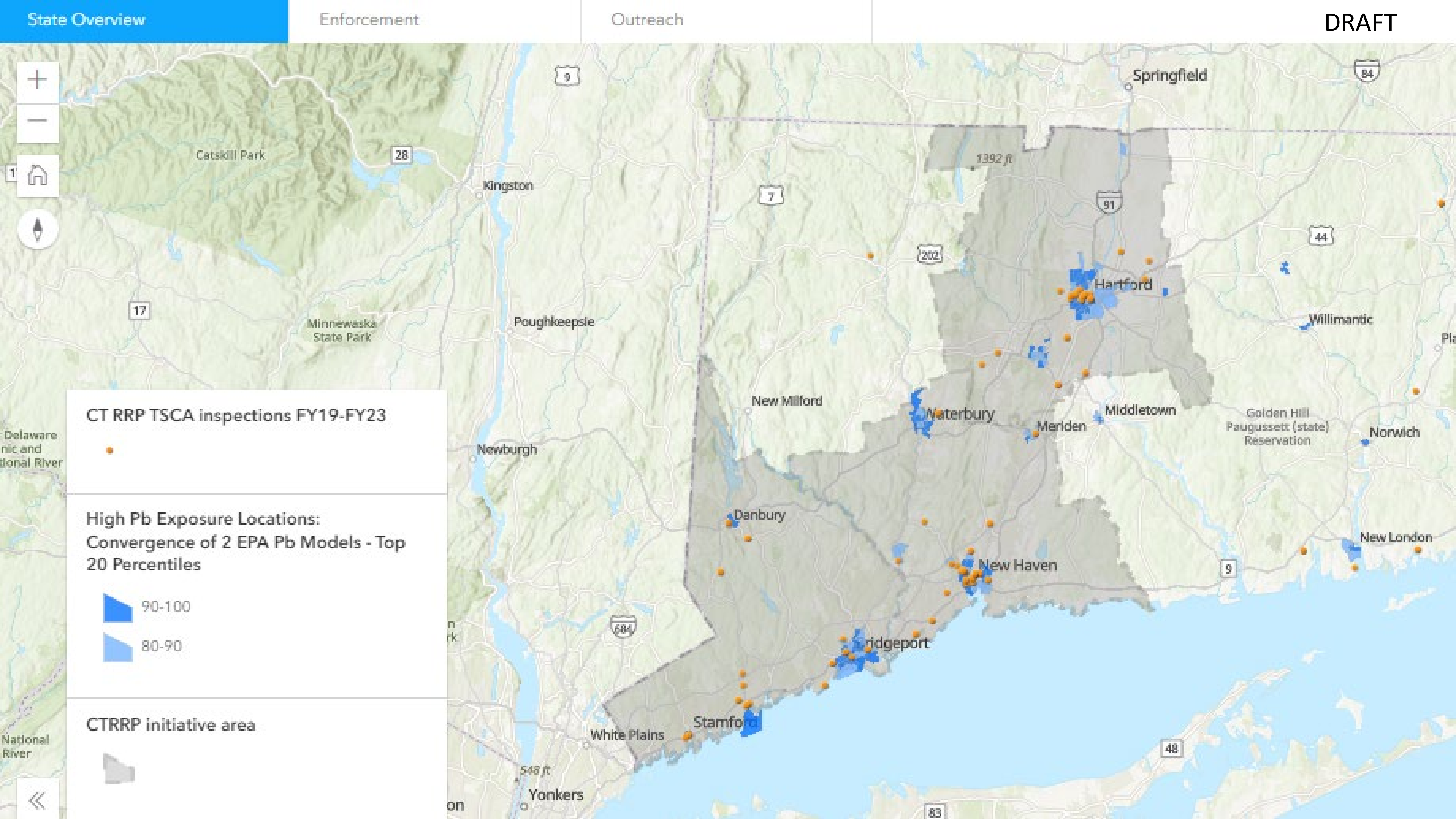
State Overview
Enforcement
Outreach
CT RRP TSCA inspections FY19-FY23
High Pb Exposure Locations: Convergence of 2 EPA Pb Models - Top 20 Percentiles
90-100
80-90
CTRRP initiative area
Springfield
Hartford
Willimantic
Waterbury
Meriden
Middletown
Norwich
New Milford
Danbury
New Haven
New London
Bridgeport
Stamford
White Plains
Yonkers
Kingston
Poughkeepsie
Newburgh
Catskill Park
Minnewaska State Park
Golden Hill Paugussett (state) Reservation
1392 ft
548 ft

Lessons Learned

- Use data, information and resources to identify areas that have not benefitted from traditional approaches.
- Lead exposure risk is not spread equitably within a town or neighborhood.
- Increase access to on-demand training, resources and assistance to prevent multimedia lead exposure.
- Combining agency resources – inspections, compliance monitoring, education and program work has maximum impact.
- Need time to produce partnerships and results.

Thank you and Questions

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