

GET THE LEAD OUT

A hedonic housing price analysis of soil contamination
and remediation in Washington state



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Background



Lead Arsenate (PbHAsO_4)

Background



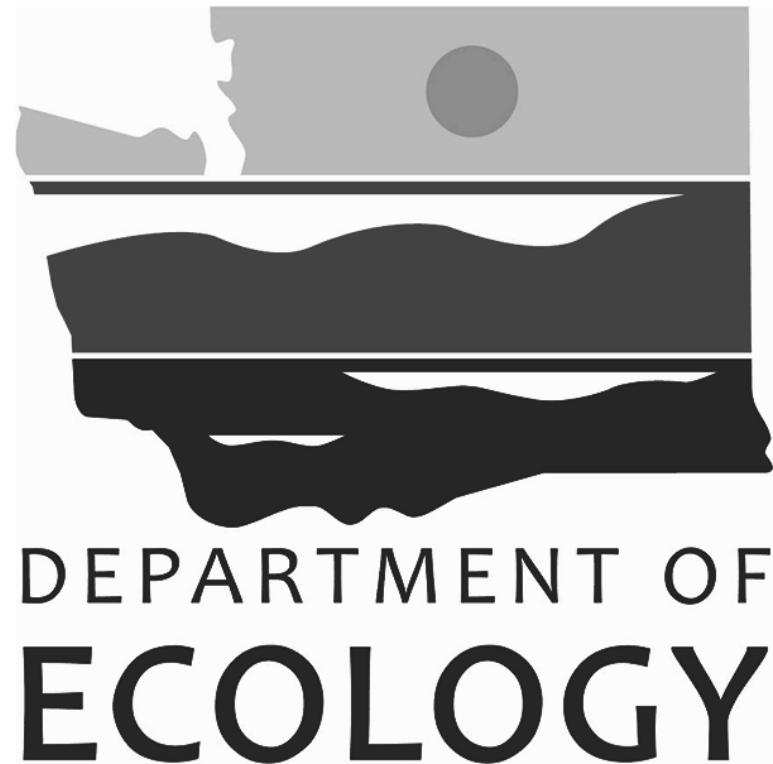
Area-Wide Soil Contamination

200,000
potentially
affected
acres in WA



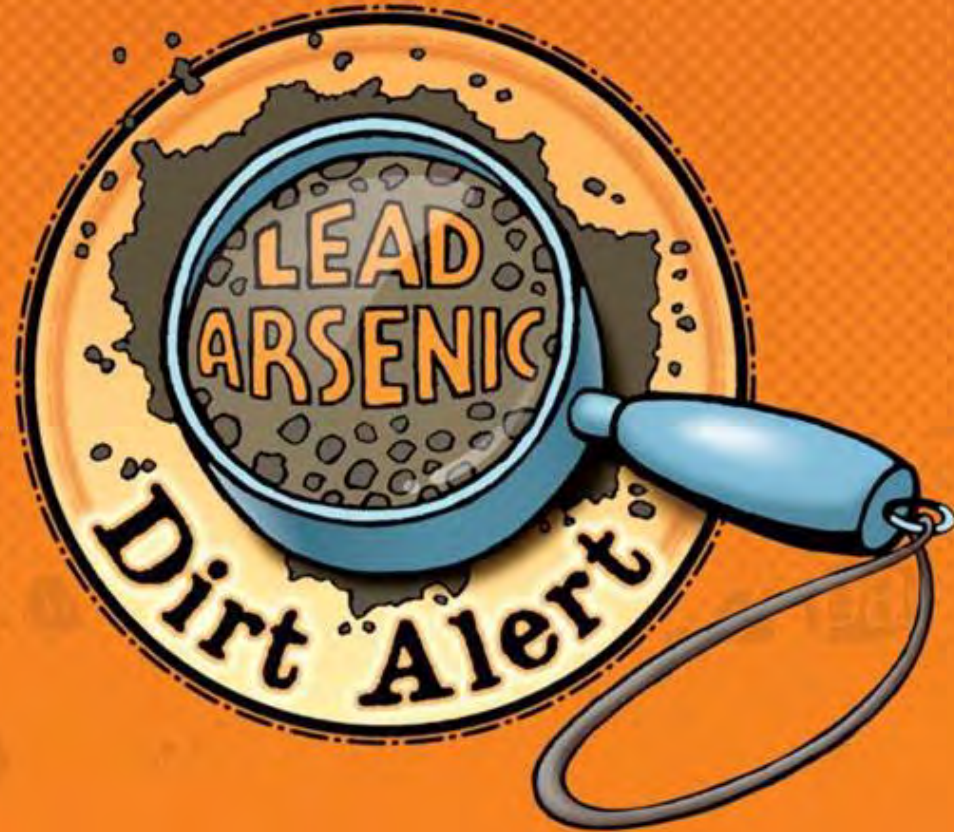
Model Toxics Cleanup Act

- Triggered by 1988 passing of a citizens' initiative
- Funds cleanups via a **hazardous substance tax on petroleum, pesticides**
- Aggressive standards for toxic cleanup in WA



Recommendations

- **Blood lead level testing**
- Awareness campaign
- Avoid contact
- Focus on smelter sites
- Focus on children



Recommendation

“Decisions about area-wide soil contamination should be made locally.”

-Area Wide Soil Contamination Task Force

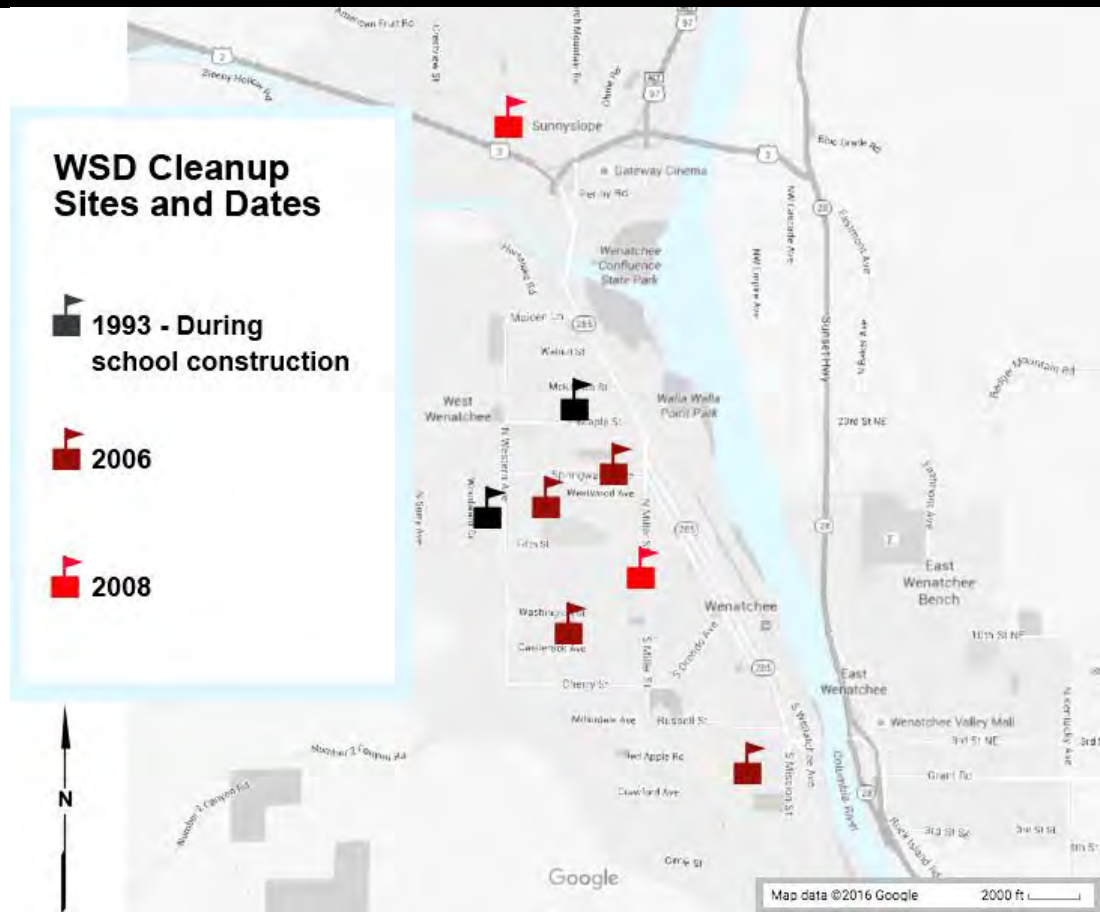
Wenatchee School District

8 SCHOOLS

on former orchard lands

2 remediated at time of construction in 1993

2 in 2006
4 in 2008



Get the lead out? **Why?**

But is lead in the dirt a million-dollar problem just because there's lead in the dirt? What if the lead in the soil is not getting into the people? If it doesn't, can you really call it a problem at all? And if it's not a problem, why spend \$1 million to fix it?

-Tracy Warner, Wenatchee World News, 09 SEPT 2005

Economic Impacts: Hedonic Analysis

Rosen (1974)

- Price of a house is the sum of the implicit prices of its characteristics
- Individual, implicit prices can be identified via regression
 - **Hedonic housing price analysis**

Economic Impacts: Environmental Quality

Housing prices impacted by:

- Air pollution
- Noise pollution
- Water quality
- Increasingly, soil contamination

Economic Impacts: Schools & Stigma

Boyd et al. (2010)

- School contamination
 - key driver of price effects
 - also a proxy for awareness
- No stigma
 - Rebound within 3 years



Economic Impacts: Announcements

Agency announcements as treatment variables

Kiehl (1995)

- Temporal omission/s can prevent ID of true source of price effects

Gampar-Rabindran et al. (2013)

- Conflating signals could lead to ambiguous effects



Data & Methods

- Hedonic regression analysis
- Media analysis

Hedonic Analysis: Questions

1. Did remediation have a significant and/or lasting impact on house prices?
1. Did media coverage of the contamination and remediation play a role in people's home-buying decisions?

Housing Variables

Housing Variables Summary Statistics (n=19,086)

Variable	Mean	Std. Dev.	Min	Max
Price (in 2015\$)	193,399.8	123,209.2	25,195	1,600,000
Floor Area (sq.ft)	1,483.2	477.9	604	2,719
Bedrooms	2.9	0.8	1	9
Age (years)	50.0	30.4	2	115
Garage Area (sq.ft)	373.5	264.4	0	2,304

Hedonic Analysis: Conceptual Form

$$\ln \text{PRICE} = f(\text{H}, \text{N}, \text{E}, \text{R}, \text{M})$$

H = House characteristics

N = Neighborhood characteristics

E = Environmental quality

R = Risk perception

M = Temporal market factors

Hedonic Analysis: Functional Forms

Form A – Inclusive treatment variables grouped in 6-month intervals

(0-6 months from announce, 0-9 months from announce, ..., 0-36 months from announce, all in one regression)

$$\ln \text{PRICE}_{ijt} = \beta_0 + \sum_x \beta_x H_{ijt} + \sum_y \beta_y E_{ijt} + \delta_i + \lambda_t + \epsilon_{ijt}$$

Form C – Concentric treatment variables grouped by treatment type

(0-6 months from announce, 6-9 months from announce, ..., 30-36 months from announce, all in one regression)

$$\ln \text{PRICE}_{ijt} = \beta_0 + \sum_x \beta_x H_{ijt} + \sum_y \beta_y E_{ijt} + \delta_i + \lambda_t + \epsilon_{ijt}$$

Form D - Media Treatment Variables Regressed Without Environmental Treatment Variables

$$\ln \text{PRICE}_{ijt} = \beta_0 + \sum_x \beta_x H_{ijt} + \sum_z \beta_z M_{ijt} + \delta_i + \lambda_t + \epsilon_{ijt}$$

Hedonic Analysis: Functional Form A

Variables	0-6 months	0-9 months	0-1 years	0-1.5 years	0-2 years	0-2.5 years	0-3 years
Announced	-0.042 (0.060)	-0.060 (0.068)	-0.070 (0.056)	-0.095 (0.054)	-0.105 (0.058)	-0.098 (0.055)	-0.098 (0.062)
Listed	0.011 (0.041)	-0.008 (0.041)	0.077 (0.048)	0.064 (0.040)	0.027 (0.040)	0.012 (0.048)	-0.015 (0.036)
Started	-0.009 (0.097)	-0.055 (0.054)	-0.056 (0.074)	-0.072 (0.058)	0.025 (0.048)	0.044 (0.052)	0.131* (0.063)
Ended	0.052 (0.062)	0.079* (0.035)	0.053 (0.055)	0.050 (0.051)	0.007 (0.056)	0.007 (0.085)	-0.036 (0.099)
Delisted	0.054** (0.020)	0.047** (0.019)	0.031 (0.026)	-0.072 (0.122)	-0.038 (0.103)	-0.052 (0.092)	-0.065 (0.025)

Hedonic Analysis: Functional Form C

Variables	Announced	Listed	Started	Ended	Delisted
0-6 months	-0.045 (0.059)	0.016 (0.034)	0.015 (0.075)	0.015 (0.075)	0.052** (0.018)
6-9 months	-0.040 (0.063)	-0.029 (0.059)	-0.067 (0.053)	-0.067 (0.053)	0.078 (0.090)
9-12 months	-0.080 (0.076)	0.179 (0.153)	0.004 (0.049)	0.004 (0.049)	-0.052 (0.081)
1-1.5 years	-0.130* (0.058)	-0.021 (0.029)	0.007 (0.036)	0.007 (0.036)	-0.177 (0.236)
1.5-2 years	-0.135* (0.059)	-0.068 (0.044)	0.156* (0.067)	0.156* (0.067)	0.029 (0.064)
2-2.5 years	-0.078 (0.064)	-0.081 (0.061)	0.035 (0.088)	0.035 (0.088)	-0.056 (0.042)
2.5-3 years	-0.051 (0.080)	-0.033 (0.047)	0.161 (0.103)	0.161 (0.103)	0.002 (0.031)

Hedonic Analysis: Functional Form D

Days between article publication and sale date	Coefficient
0-30	-0.0512 (0.0358)
31-60	-0.0933** (0.0284)
61-90	-0.0321 (0.0554)
Constant	10.67*** (0.0534)
R-squared	0.292

Robust standard errors in parentheses

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

A Revised Approach

Coordinated Resource Management

- Collaborative, consensus-based, stakeholder decision-making process
- Allows for greater regional empowerment
- Utilizes community knowledge

A Revised Approach

Coordinated Resource Management

- Awareness & Outreach
- Regional Empowerment
- Needs & Perceptions
- Data Collection
- Funding

Yakima: 58,050 Affected Acres

Further Work



Questions?

