

Environmental Science Case Study: Don't Drink The Water

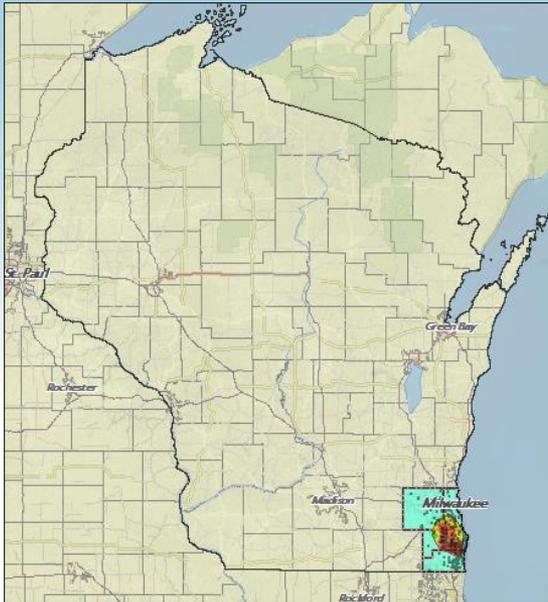
Groundwater Contamination
in
Southeast Wisconsin



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Brief History

Groundwater contamination from coal ash landfills has likely been occurring since the 1980s in Southeastern Wisconsin.



Map of Study Area: Waukesha, Milwaukee, Racine, and Kenosha counties.

- **1989:** We Energies signs land-use agreement requiring private water supply well sampling near power plant property
- **1993:** Molybdenum added to parameter list, detected at 14 of 20 wells sampled
- **2007:** We Energies testing finds levels above enforcement standard in >50% of wells tested
- **2009:** WE informs DNR and residents of testing results, starts distributing bottled water, purchasing properties in the vicinity of the power plant and landfills
- **2010:** Department of Health Services offers residents free sample kits for testing by the Wisconsin State Laboratory of Hygiene
- **2011:** WDNR begins collection of groundwater samples near the We Energies and Hunts Landfill properties
- **2013:** WDNR report on molybdenum levels in Caledonia investigates coal waste landfills, fails to find a source for molybdenum groundwater contamination

Background: Study Goal

- To investigate groundwater contamination in SE Wisconsin, see if coal ash may be contributing to it
- Driving Questions:
 - How widespread is the contamination?
 - Where is coal ash being “reused” in the area?
 - Is there a correlation between contamination and coal waste sites?

Background: Molybdenum

- Molybdenum is an essential nutrient at trace levels
 - Average American gets more than enough from food
- There has been little data on effects of too much molybdenum on human health
 - Documented reproduction and development impacts on animals
 - Reduced testosterone and sperm quality in men
 - Developmental impacts in children exposed in the womb
- EPA set lifetime health advisory level of 40 ppb
 - EPA advises children not drink >80 ppb for a single day
 - Wisconsin Dept. of Natural Resources has an “enforcement standard” to try to keep levels below 40 ppb
 - Wisconsin Dept. of Health Services advises that ≥ 90 ppb,

“you not use your water for drinking or in foods where water is a main ingredient, (like soup, coffee, tea, Jell-O, etc.) and that you find a different source of safe water to drink.”

Background: Molybdenum

- Molybdenum contamination generally comes from anthropogenic sources
- Natural concentrations rarely exceed 20 ppb in ground or surface waters
 - 99% of study samples in central and northern Wisconsin taken by WDHS had less than 20 ppb (2,700 wells)
 - Median value was 0.2 ppb.
- Mo reaches surface and groundwater as a result of molybdenite mining, the burning of fossil fuels, and weathering of Mo-containing shale bedrock
 - There is no molybdenite mining in WI
 - Testing has not shown soil and shale Mo levels in SE Wisconsin to be generally elevated

Background: Study Motivation

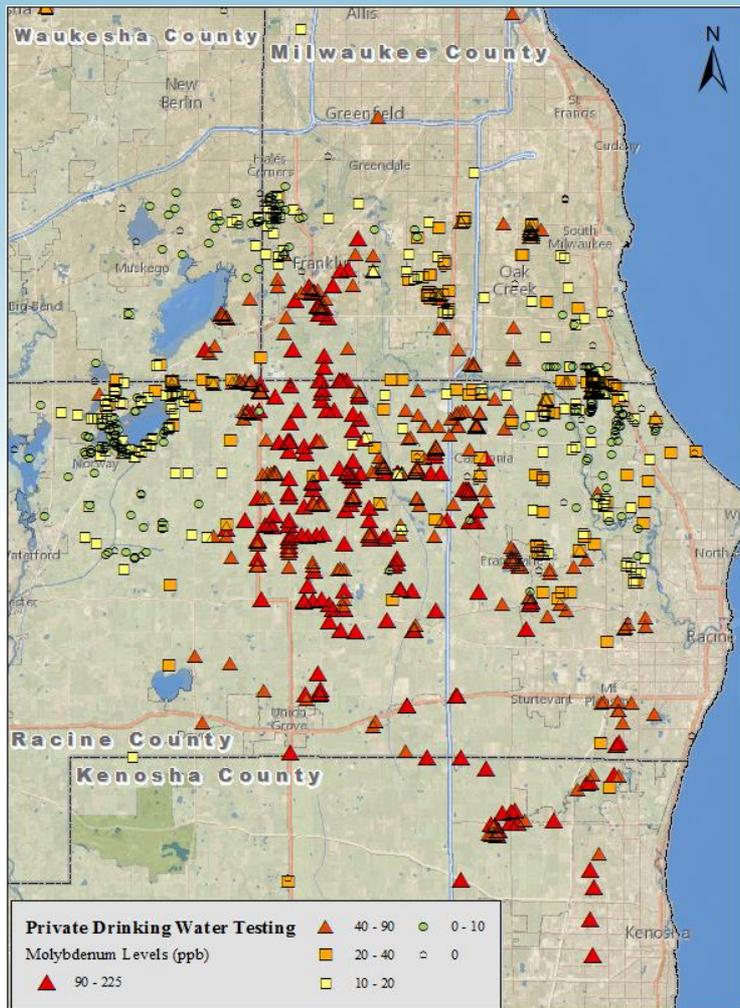
- Coal waste known to have high levels of Mo
- Coal waste landfills have been extensively examined
 - EPA documented “damage cases”
 - WDNR Caledonia study
- BUT only 40% of coal waste goes to landfills (nationally)
 - In Wisconsin, 85% of coal ash is “beneficially reused”
- “Encapsulated” vs. “unencapsulated” reuses

Methods

1. Gathered existing data on groundwater molybdenum levels and unencapsulated uses of coal waste
2. Collected additional targeted well samples
3. Conducted spatial analysis of relationship based on
 - Linear distance
 - Groundwater flow

Limit study to SE Wisconsin (based on data availability)

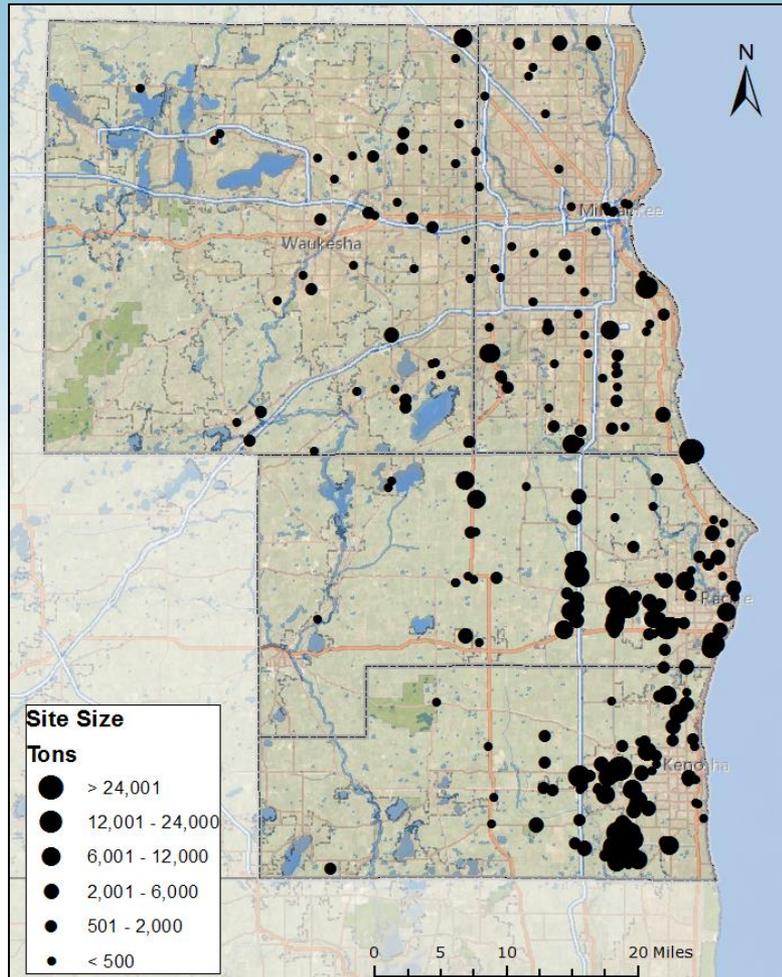
Results: Molybdenum Levels



	Percentage of wells	
Very High Levels of Molybdenum <i>(>90 ppb; Above Wisconsin Health Advisory Level)</i>	22%	45%
High Levels of Molybdenum <i>(40-90 ppb; Above DNR Enforcement Standard)</i>	23%	
Moderate Levels of Molybdenum <i>(20-40 ppb; Below DNR Enforcement Standard)</i>	15%	32%
Low Levels of Molybdenum <i>(10-20 ppb; Slightly Elevated Concentrations)</i>	17%	
Natural Background Range <i>(0-10 ppb)</i>	16%	23%
No Molybdenum Detected <i>(0 ppb)</i>	7%	

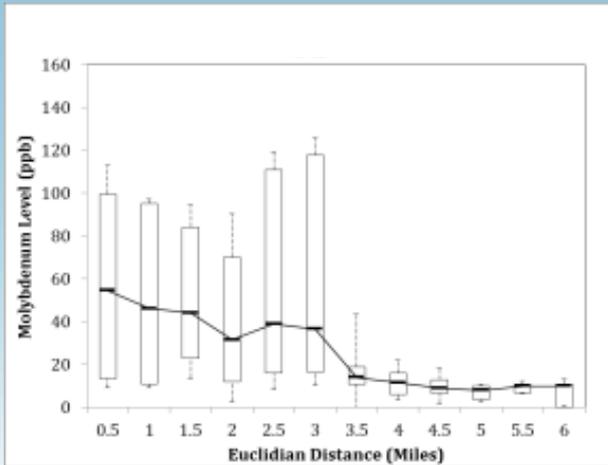
- Median level in U.S.=1.0 ppb
- Median level in Central/Northern WI= 0.2 ppb

Results: Coal Ash Use



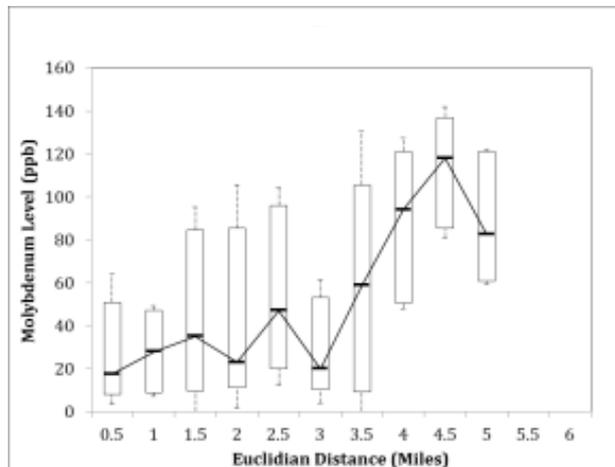
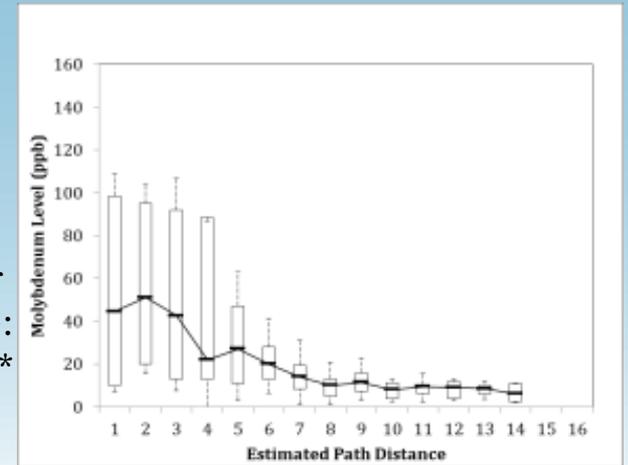
- Found records for >1.6 million tons of coal ash used in construction projects
- Able to map ~ 1 million tons in the four-county region
- Data for 1988-present, some years missing

Results: Regional Relationships



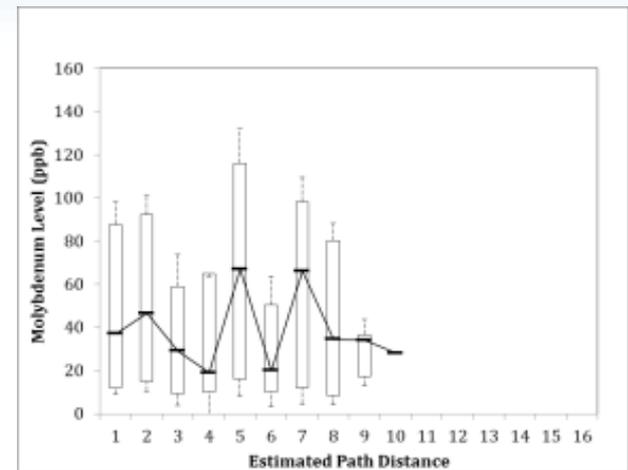
Linear Distance:
coal ash sites*

Estimated groundwater
flow distance:
coal ash sites*

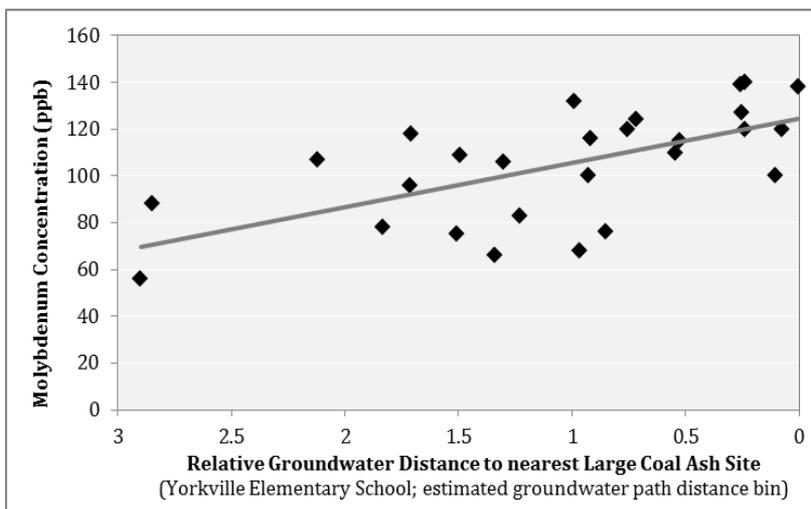
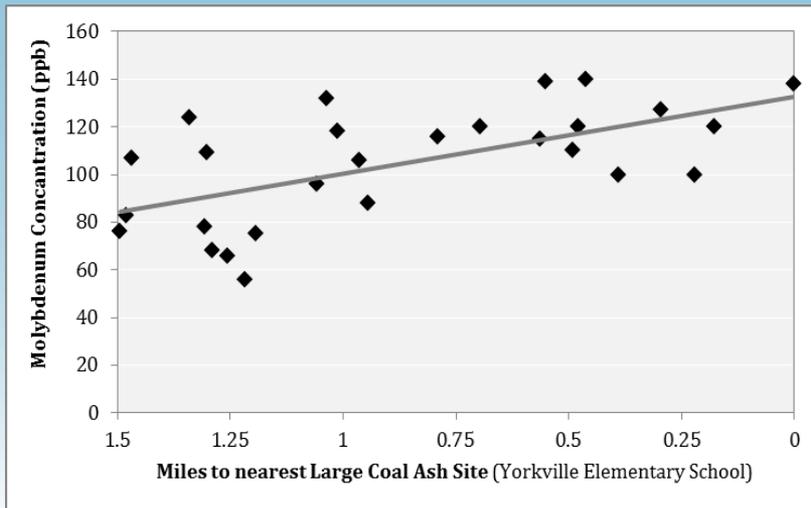


Linear Distance:
Other sources

Estimated groundwater
flow distance:
Other sources



Results: Targeted Study



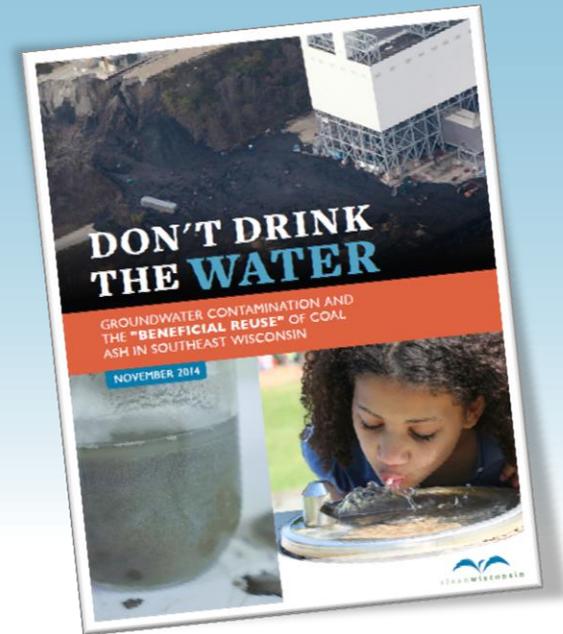
- Statistically significant negative relationships
- Supports trends found at the regional level
- Other elements associated with coal ash contamination also found to be elevated (As, B)

Discussion / Conclusions

- Both Mo contamination and use of coal ash in construction projects is widespread in SE Wisconsin
- As expected, the strongest predictive variable in this study was near-surface groundwater flow
- Despite information gaps, still found statistically significant relationships that warrant further investigation.

What we did with the work

- Last November, we published our report: “Don’t Drink the Water”
- We did a lot of press on our report
 - TV, print, radio
- We went to D.C. to talk about EPA’s new coal ash rule
 - Met with Sen. Baldwin, the Council on Environmental Quality, and the Office of Management and Budget
- WDNR’s reaction: no reason to change anything, need more research, study is inconclusive



Further Study Needed

- Fill information gaps in SE Wisconsin
- Conduct detailed hydrogeological investigations at select, representative sites
- Investigate other regions in WI to see if these findings can be generalized
- Strengthen coal ash reuse regulations to ensure that everyone has safe, clean drinking water