

# **Anomalous Soil Concentrations of PCDDs, PCDFs, and PCBs in a Community in Michigan: A Case Study**

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***The University of Michigan Dioxin Exposure Study***

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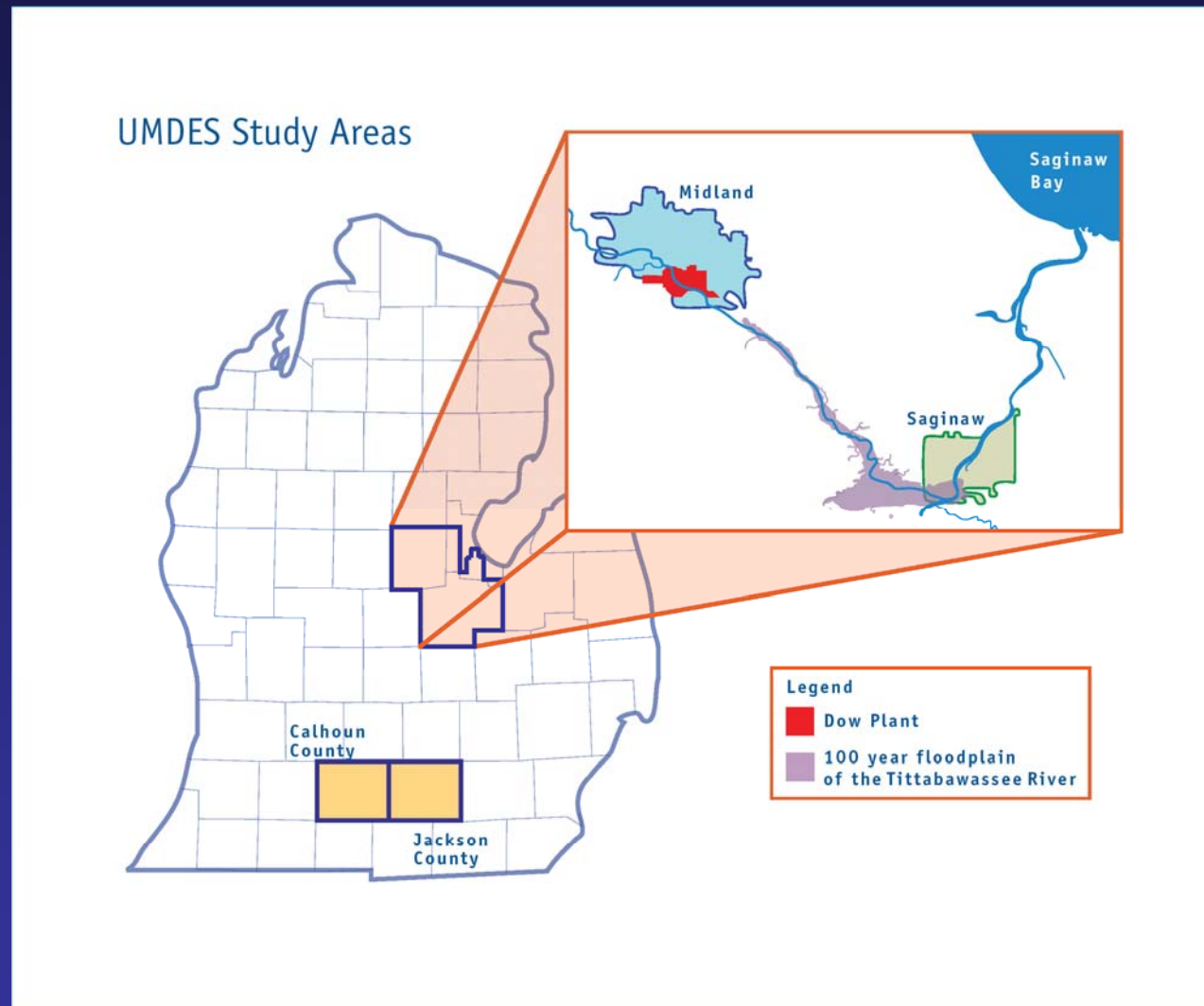
**This study was funded by The Dow Chemical Co. through an unrestricted grant to the University of Michigan.**

**The University has complete independence to design, carry out and report all aspects of the study.**



# Geographic Sampling Areas

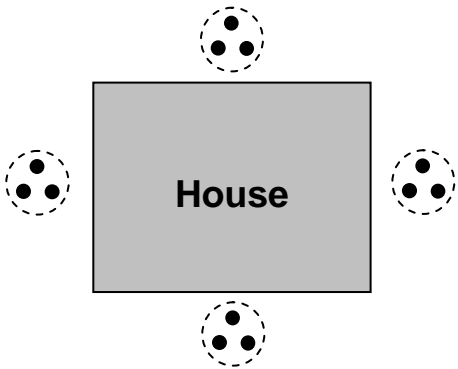


- Floodplain (FP)
- Midland Plume
- Near Floodplain (NFP)
- Other Midland/Saginaw (Other M/S)
- Jackson/Calhoun (J/C)





# Location of Soil Samples

Soil samples were taken at various locations on participants' property

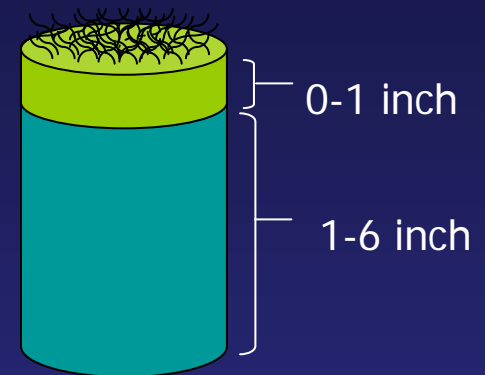
<p><b>House perimeter:</b></p> <p>Up to 4 stations, 3 cores per station</p>	
<p><b>Soil contact:</b></p> <p>Up to 2 stations, 3 cores per station</p>	<p>Flower garden    Vegetable garden</p> 
<p><b>Near river:</b></p> <p>Up to 1 station, 3 cores per station</p>	<p>Close to Tittabawassee River</p> 



# Compositing and Analysis of Soil Samples



- Cores were extruded, separated into two strata and the vegetation removed



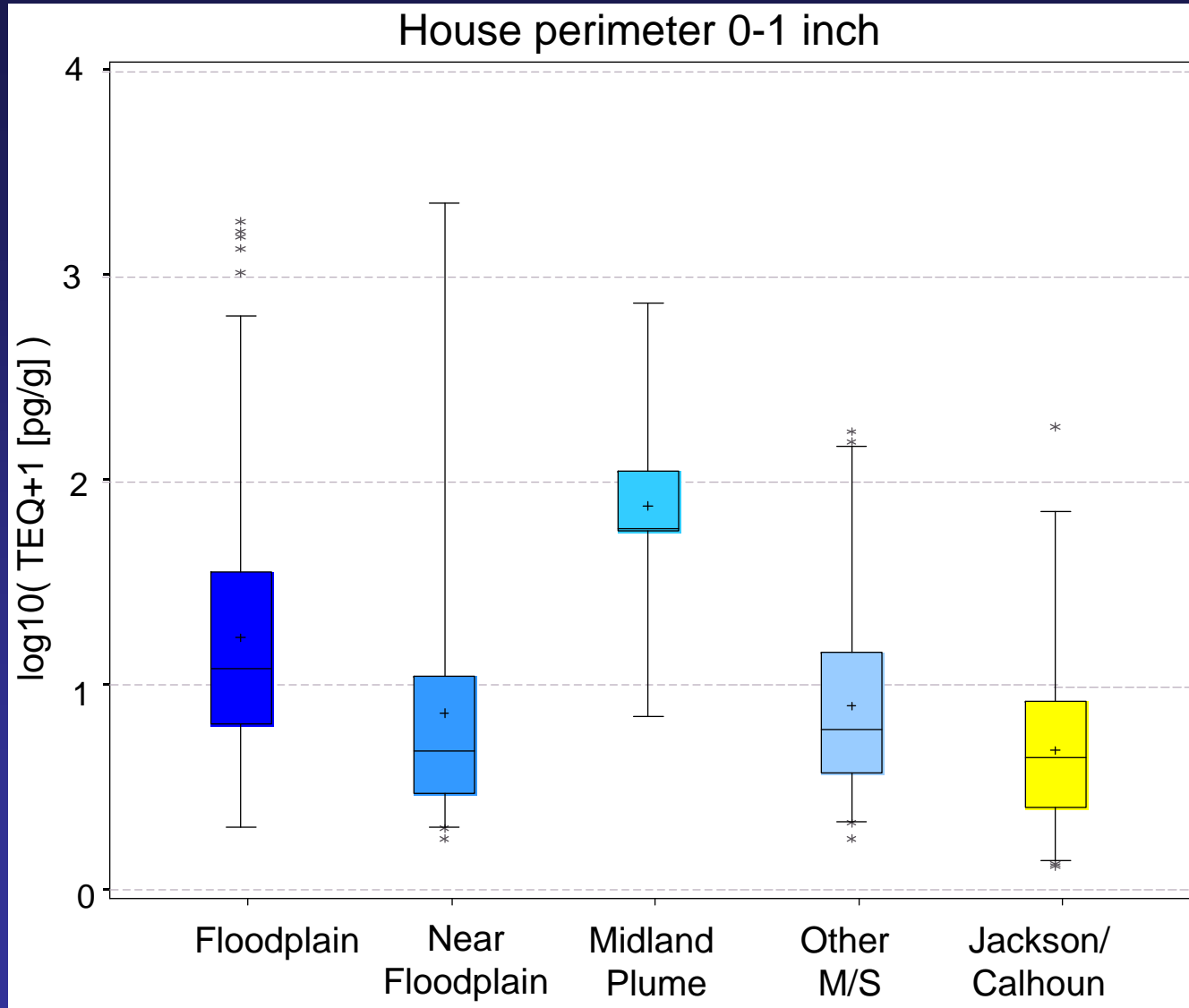
- Strata were composited  
House perimeter: 0-1 inch, 1-6 inch  
Near river: 0-1 inch, 1-6 inch  
Garden: 0-6 inch



- Composites were sent to Vista Labs for analysis for WHO (2005) 29 congeners by HRGC/HRMS



# Comparison of TEQ<sub>DFP29-2005</sub> for Geographic Areas



Line in box = median

+ = geometric mean

Lower box margin = 25<sup>th</sup> %ile

Upper box margin = 75<sup>th</sup> %ile

Lower whisker = 1<sup>st</sup> %ile

Upper whisker = 99<sup>th</sup> %ile

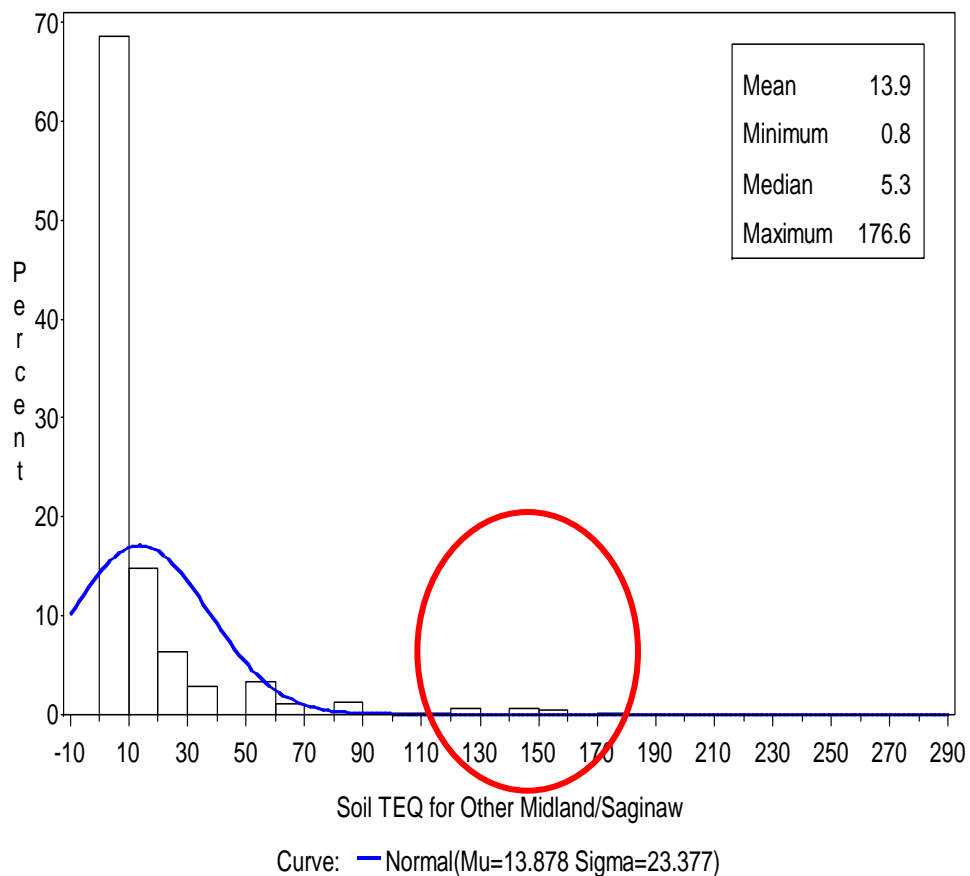
\* = below 1<sup>st</sup> %ile or above 99<sup>th</sup> %ile



# Histograms of TEQ<sub>DFP-2005</sub> of HP 0-1 Inch Samples

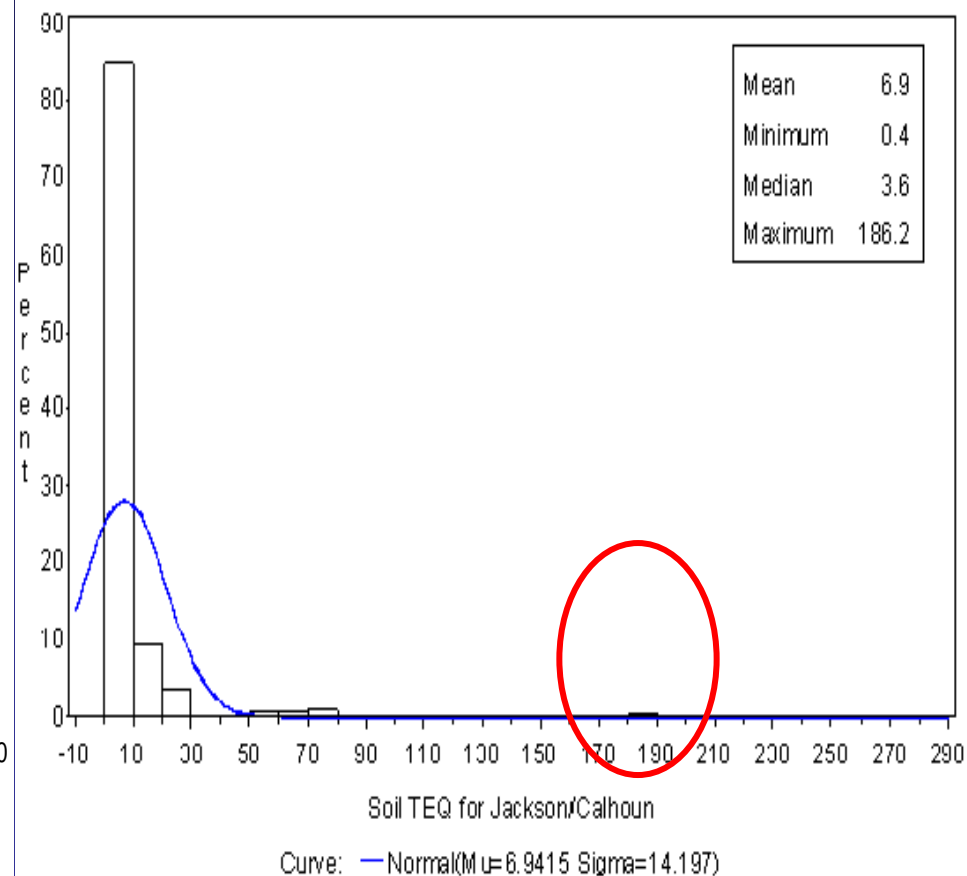
## Other Midland/Saginaw

The distribution of soil HP 0-1 inch TEQ 2005 for Other Midland/Saginaw



## Jackson/Calhoun

The distribution of soil HP 0-1 inch TEQ 2005 for Jackson and Calhoun





# Follow Up Study Methods

## To be eligible, respondent needed to

- Be located outside of Floodplain and Plume
- Have a TEQ of one soil sample above 2.5 std. dev. above mean of HP 0-1 inch samples in J/C and Other M/S (= 87.5 pg/g)
- Have elected to receive soil sampling results

## Follow up study consisted of

Open ended interview

- House characteristics (age, history of flooding)
- Soil movement
- Property treatment (trash burning, pesticide use)

Analysis of uncomposited soil cores

## Seven respondents were selected

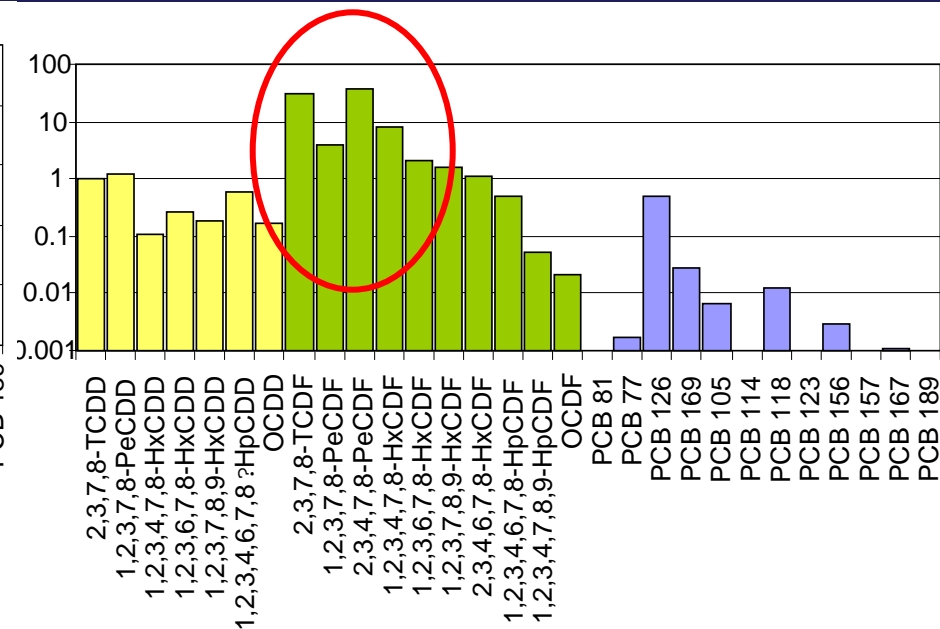
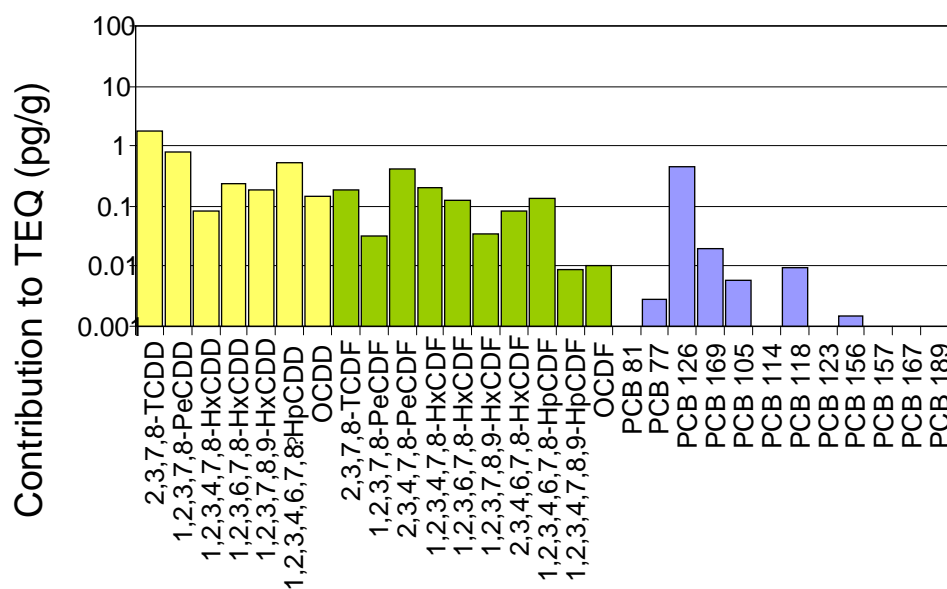
- 1 from NFP, 4 from Other M/S and 2 from J/C
- 3 profiled here



# Other Midland/Saginaw 1: Initial Data

HP 0-1 Inch Composite  
 $TEQ_{DFP-2005} = 5.5 \text{ pg/g}$

Garden Composite  
 $TEQ_{DFP-2005} = 89.4 \text{ pg/g}$



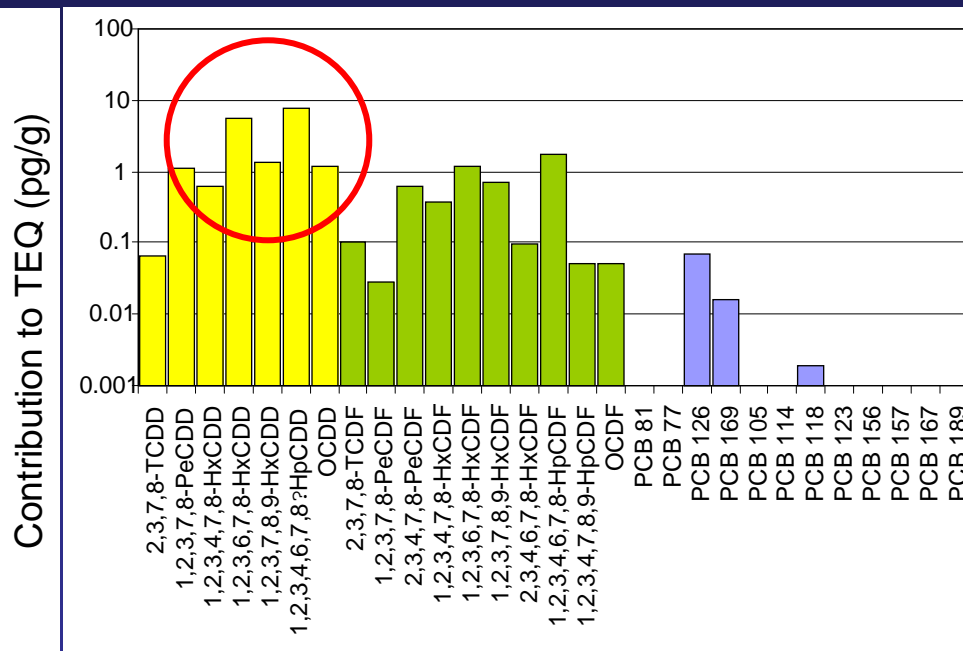
- TEQ of Garden is higher than TEQ of HP 0-1 Inch
- Garden has different congener pattern, high in PCDFs



# Other M/S 1: Comparison Patterns

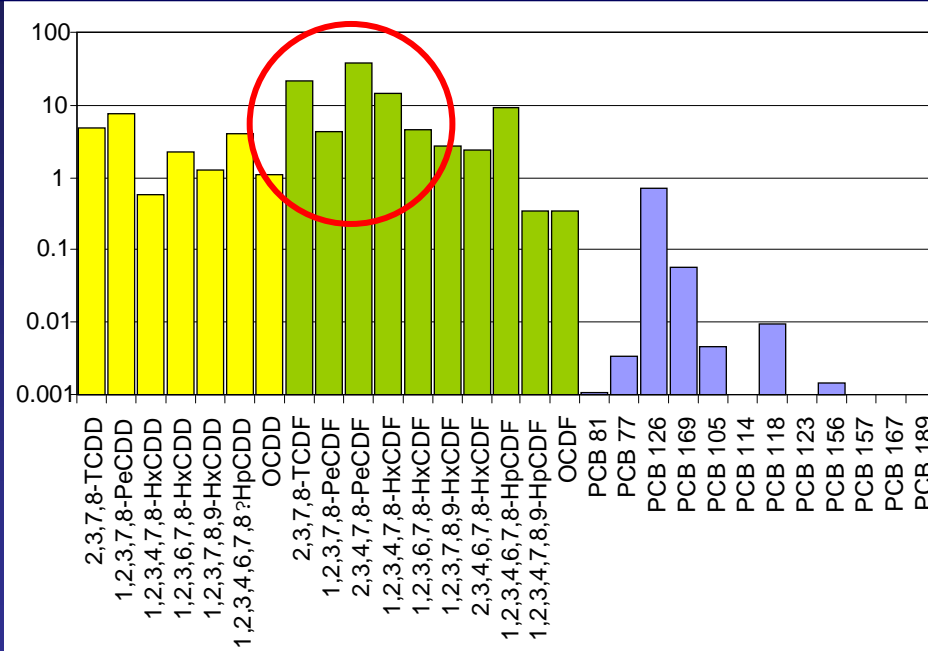
Commercial Potting Soil

TEQ<sub>DFP-2005</sub> = 22.8 pg/g



“Typical Floodplain”

TEQ<sub>DFP-2005</sub> = 121 pg/g



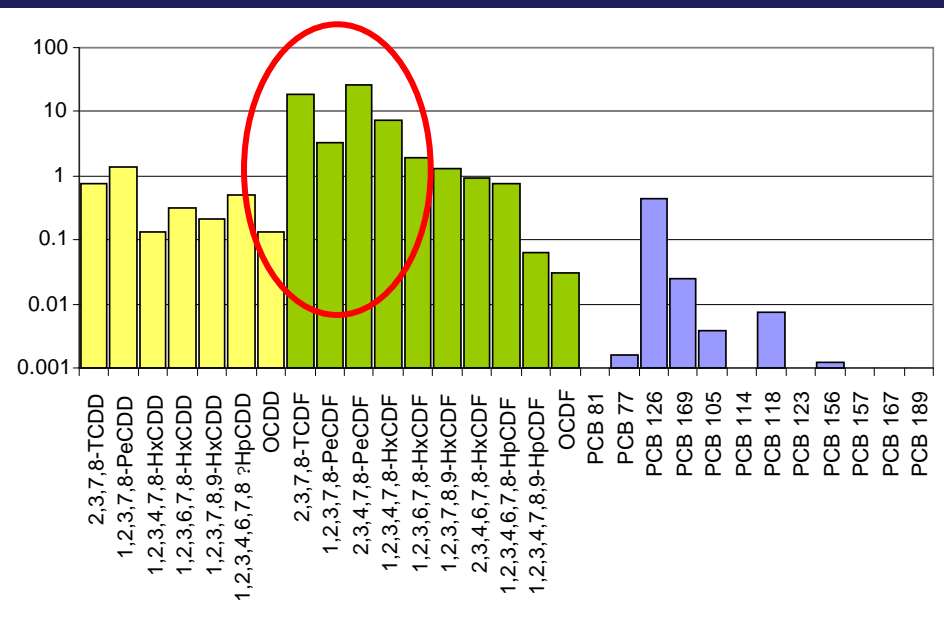
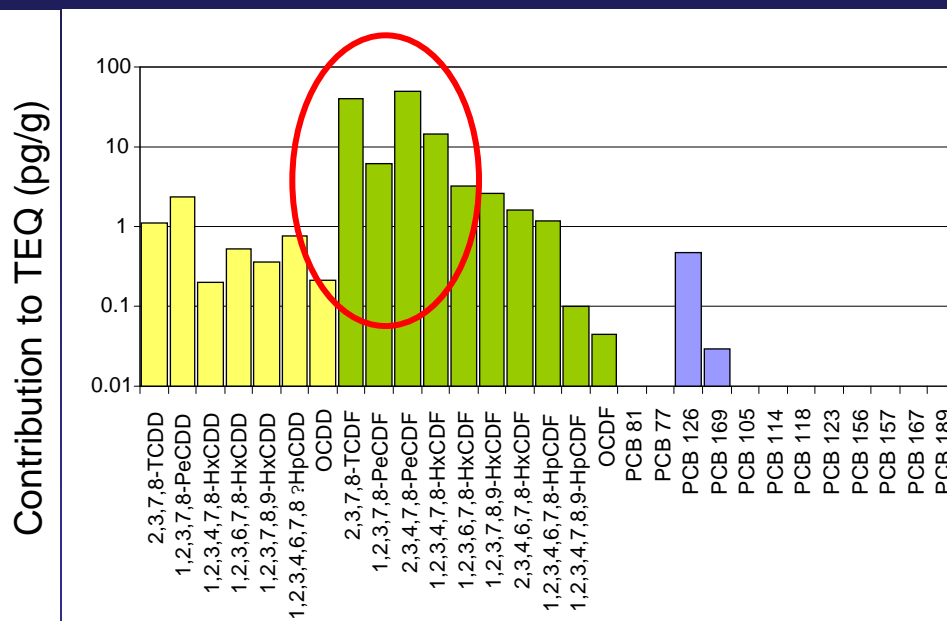
- House built in late 1960s; owner is original owner
- No fertilizers or pesticides in garden
- Mulch obtained from township composting facility located within Floodplain



# Other Midland/Saginaw 2: Initial Data

HP 0-1 Inch Composite  
 $TEQ_{DFP-2005} = 125 \text{ pg/g}$

HP 1-6 Inch Composite  
 $TEQ_{DFP-2005} = 64.6 \text{ pg/g}$



- Similar congener patterns in both samples
- High in PCDFs



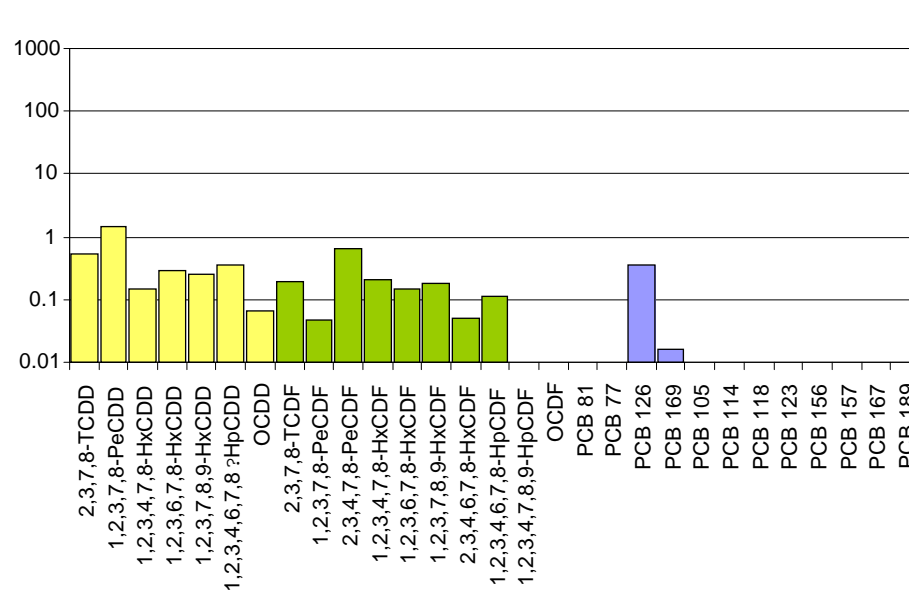
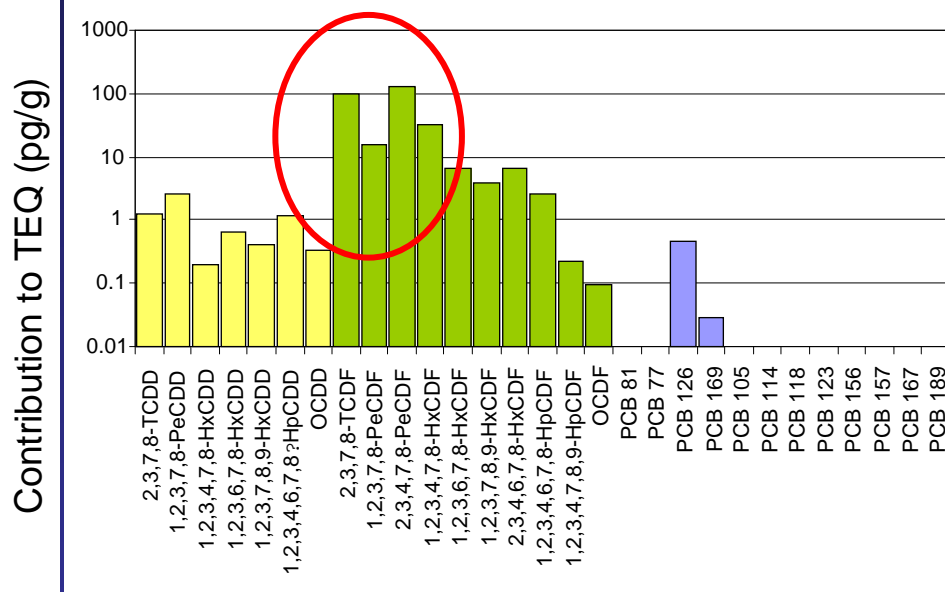
# Other MS 2: Uncomposited Samples

HP 0-1 Inch West Side

TEQ<sub>DFP-2005</sub> = 305 pg/g

HP 0-1 Inch Backyard

TEQ<sub>DFP-2005</sub> = 5.0 pg/g



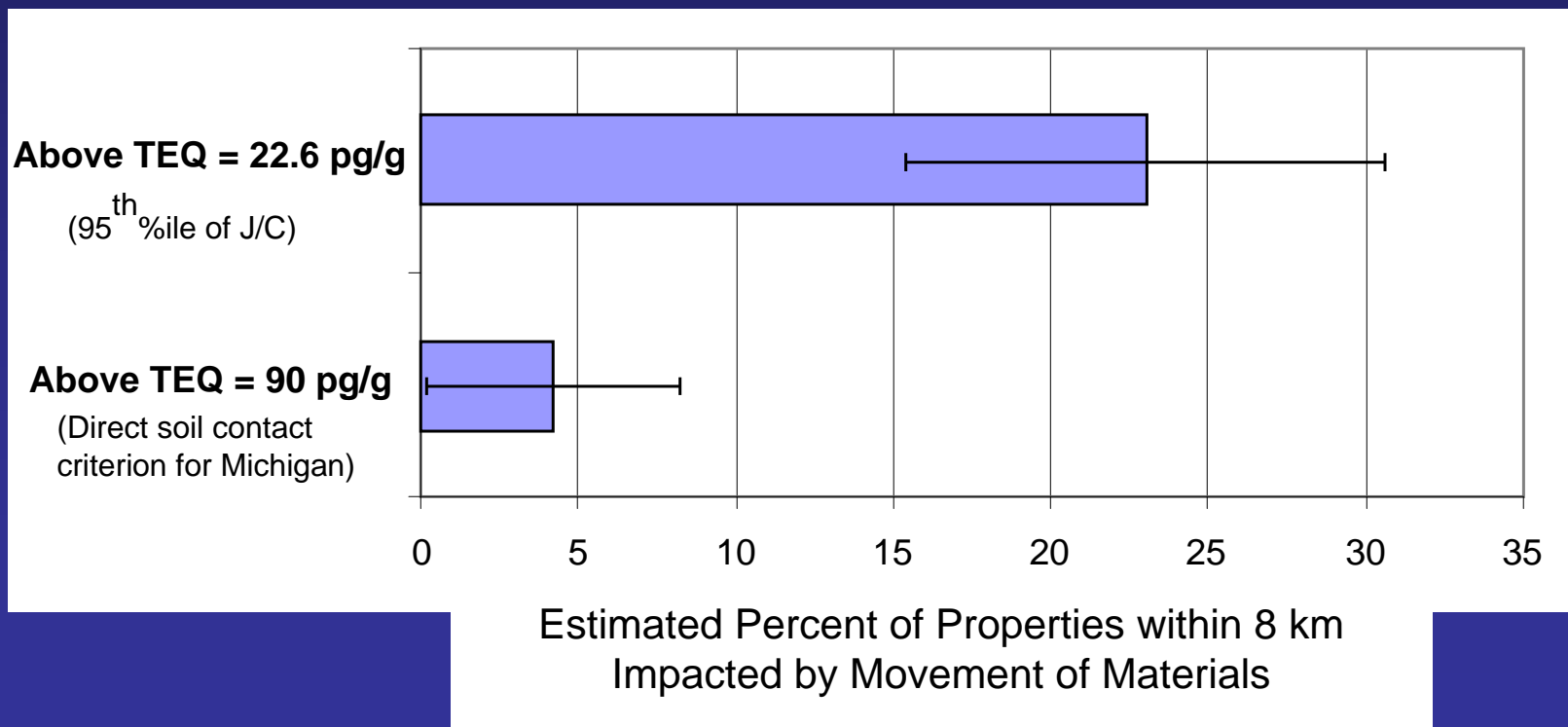
- House built in mid 1970s; current owners owned house since mid 1980s
- Trucked in soil placed in backyard
- Congener pattern of west side different than backyard
- Topography of site suggested leveling by building up of west side



# Movement of Materials from Floodplain

## Estimation of extent of movement of materials

- Focused on properties
  - Within 8 km of Tittabawassee and Saginaw River Floodplains
  - With at least 50% of TEQ attributable to PCDFs





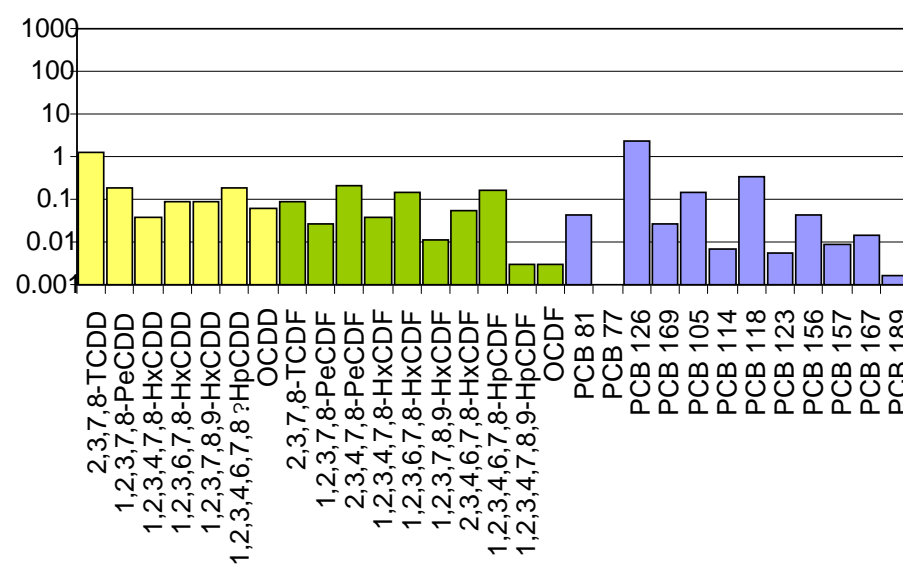
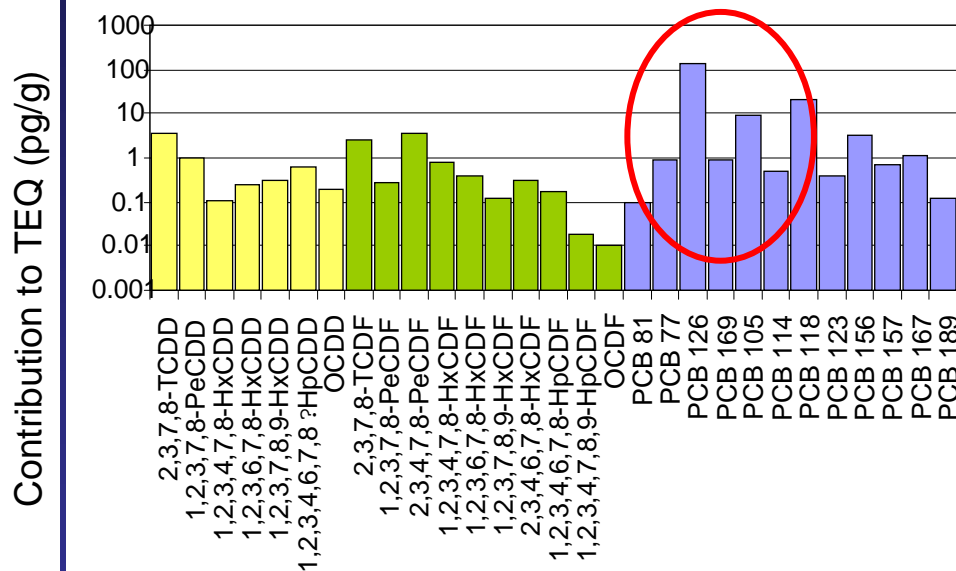
# Jackson/Calhoun: Initial Data

HP 0-1 Inch Composite

TEQ<sub>DFP-2005</sub> = 186 pg/g

HP 1-6 Inch Composite

TEQ<sub>DFP-2005</sub> = 5.7 pg/g



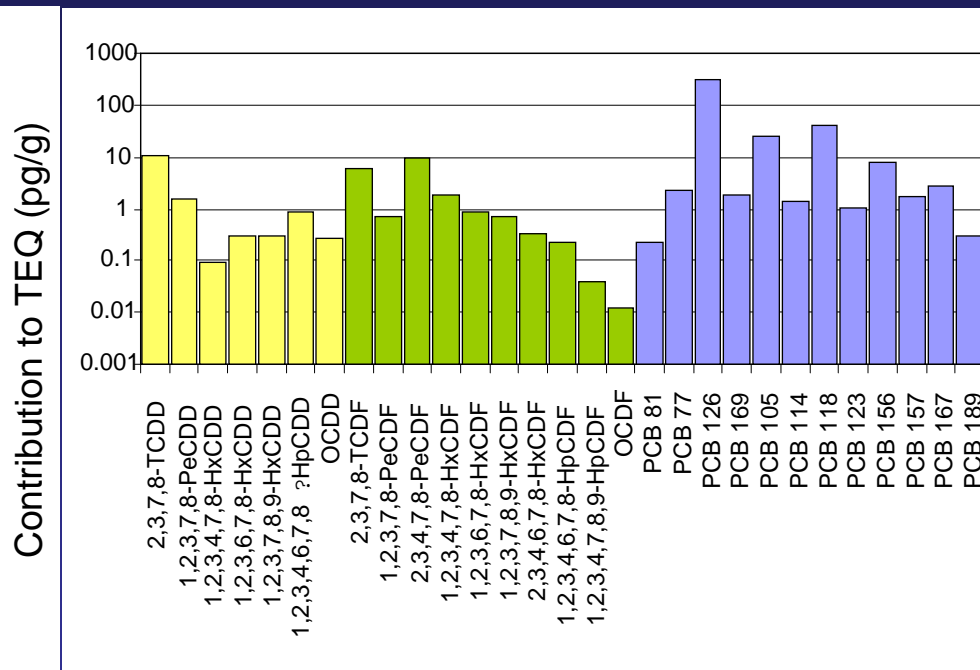
- TEQ of HP 0-1 Inch highest value measured in Jackson/Calhoun
- TEQ of HP 1-6 Inch below mean
- TEQ dominated by PCB 126 (3,3',4,4',5 PeCB) and PCB 118 (2,3',4,4',5-PeCB)
  - not weighted by TEFs, dominated by PCB 118 and PCB 105 (2,3,3',4,4'-PeCB)



# Jackson/Calhoun: Pattern Comparison

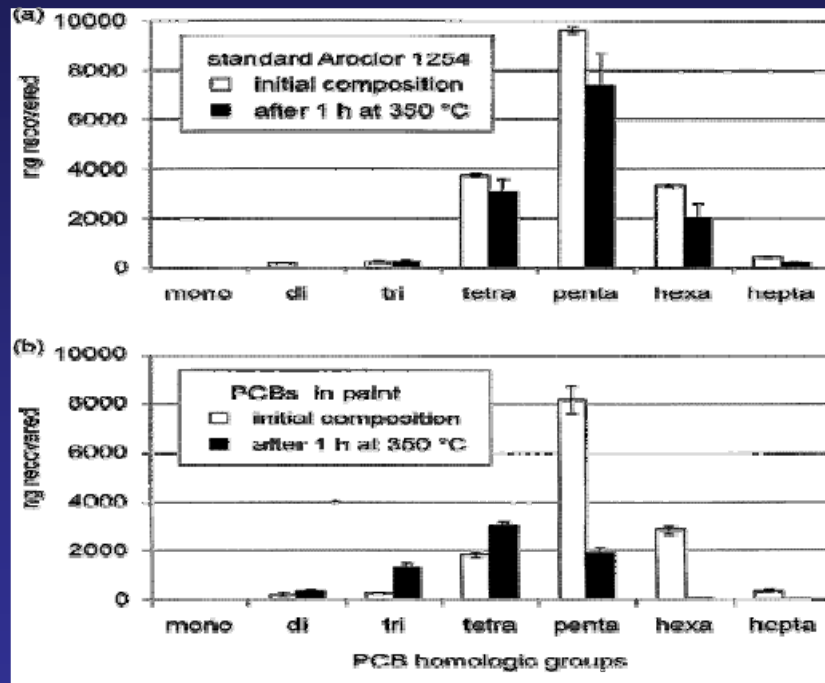
HP 0-1 Inch Backyard

TEQ<sub>DFP-2005</sub> = 448 pg/g



PCBs in Paint

(Kubatova et al., 2003)



- House built in mid 1960s on farmland; owner bought house from builder
- Installed pool in late 1960s in backyard
- Removed pool paint by sandblasting in mid 1990s
- Pool paint heavy in Aroclor 1254, predominantly pentachlorinated PCBs



# Conclusions

- Two mechanisms were identified by which properties outside zones impacted by industry can become contaminated:
- Other Midland/Saginaw: Movement of contaminated materials
  - 23.0% of properties within 8 km of Tittabawassee and Saginaw Floodplains were estimated to show evidence of contamination
  - 4.2% of properties were estimated to be above 90 pg/g
- Jackson/Calhoun: Sandblasting of paint
  - Recent research has focused on caulk as source of PCBs in soil
- Assumption that concentrations outside of industrially contaminated zones are at “background” levels may not be accurate



# Questions?

# [www.umdioxin.org](http://www.umdioxin.org)

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- David Garabrant, MD, MPH
- Alfred Franzblau, MD
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