

# Flint Data Summit 2

Analysis of Lead Data Sets

David A. Cornwell

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PART OF THE ARCADIS FLINT DISTRIBUTION ASSESSMENT TEAM

# Pb Databases

- 1) EPA Sequential Database—Combined
- 2) MDEQ Sentinel Database
- 3) MDEQ Residential Database
- 4) Not showing Spatial/GIS Data
- 5) Not showing Individual Data Base Analysis
- 6) Not Discussing WQP Data
- 7) Concentrating on Lead Data

# Pb Databases

- 1) EPA Sequential Database
  - 279 samples across 115 locations
  - Pb profile data
  - Samples span 1/28/2016 to 11/15/2016
- 2) MDEQ Sentinel Database
- 3) MDEQ Residential Database

# Pb Databases

1) EPA Sequential Database

2) MDEQ Sentinel Database

- 3,988 samples across 840 locations
- Pb first liter data
- Samples span 2/16/2016 to 9/27/2016
- Includes Rounds 1-5 and Extended Rounds 1-5

3) MDEQ Residential Database

# Pb Databases

- 1) EPA Sequential Database
- 2) MDEQ Sentinel Database
- 3) MDEQ Residential Database
  - 24,251 samples across 14,193 locations
  - Selected for locations in common with EPA Sequential or Sentinel databases
    - 4,361 samples across 801 locations in common with those databases
  - Pb first liter data
  - Samples span 9/15/2015 to 9/27/2016

**FROM THE 3 DATA SETS WE  
CREATED A  
COMMON Pb DATABASE**

# Pb Analysis – Common Database

The first three databases were combined based on sample location:

- 1) **All** EPA Sequential database locations were included
  - 2) **All** MDEQ Sentinel database locations were included
  - 3) Only includes those MDEQ Residential database locations where **either** EPA Sequential or MDEQ Sentinel data were available
    - This decision was made to target “higher risk” sites
- Result is a common database with **8,596** data across **904** locations.

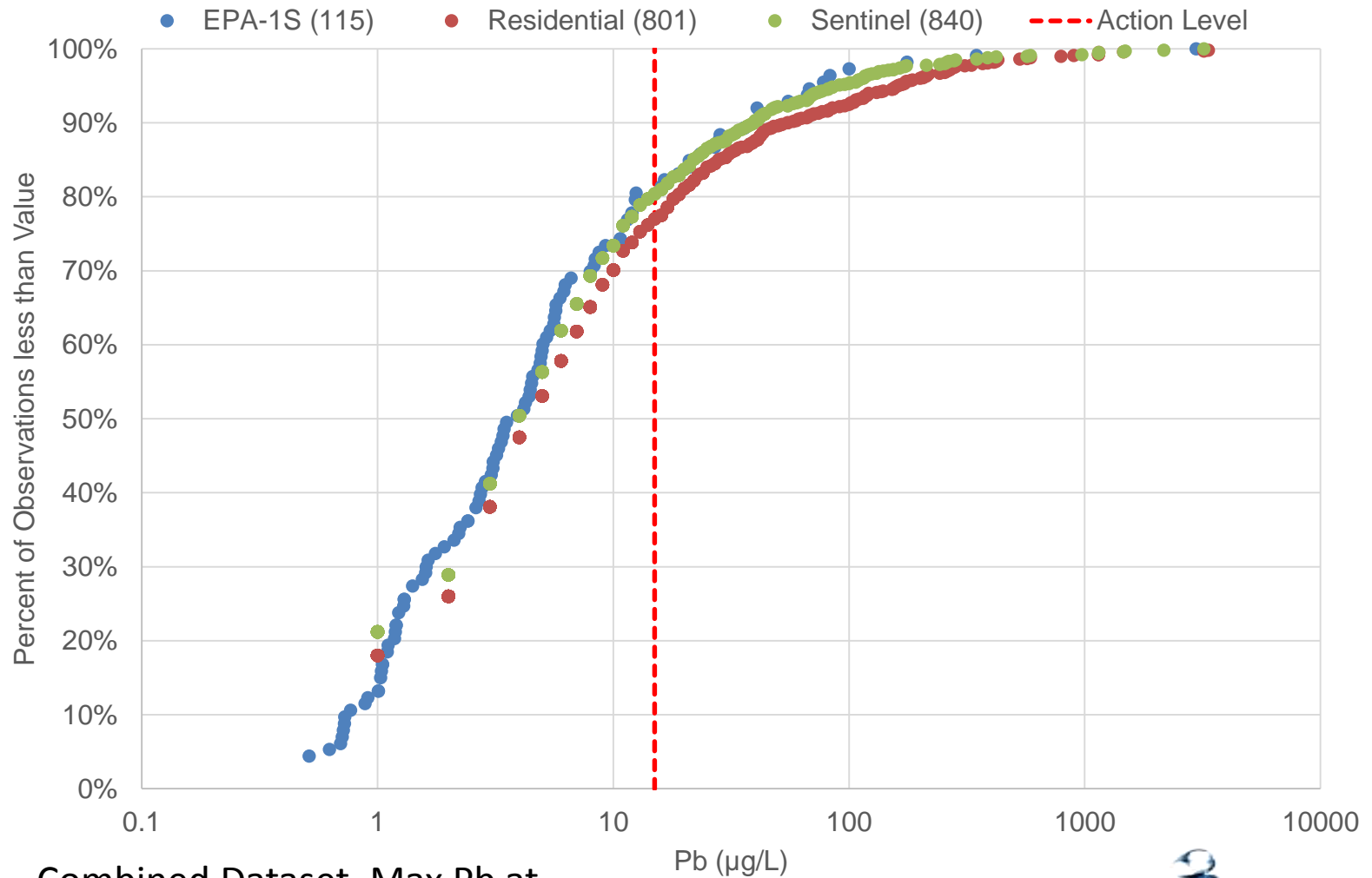


# Common Pb Database

- Analysis of the common database is dependent on the Pb value used for the EPA Sequential sampling
- For consistency with MDEQ Sentinel and Residential data, we used the Pb level in the **first EPA sample (125 mL)**
- However using the peak Pb level from the EPA Pb profiles will change maximum Pb distribution
- **Analysis based on location-specific maximum Pb values**

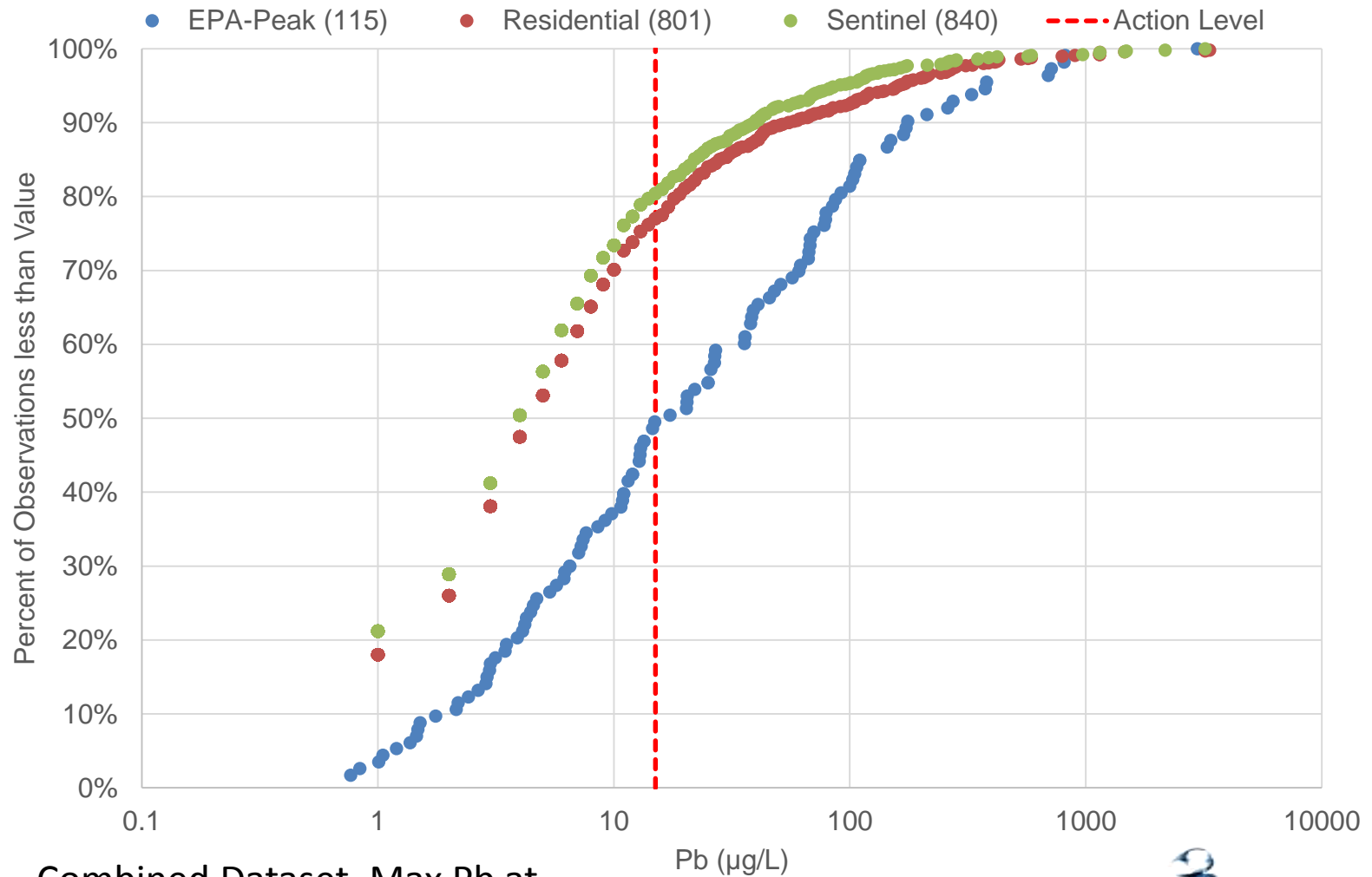


## Maximum Pb Distribution by Database (# of Locations)



Combined Dataset, Max Pb at  
Each Location in 2016, **EPA 1<sup>st</sup> Sample Pb Values**

## Maximum Pb Distribution by Database (# of Location)



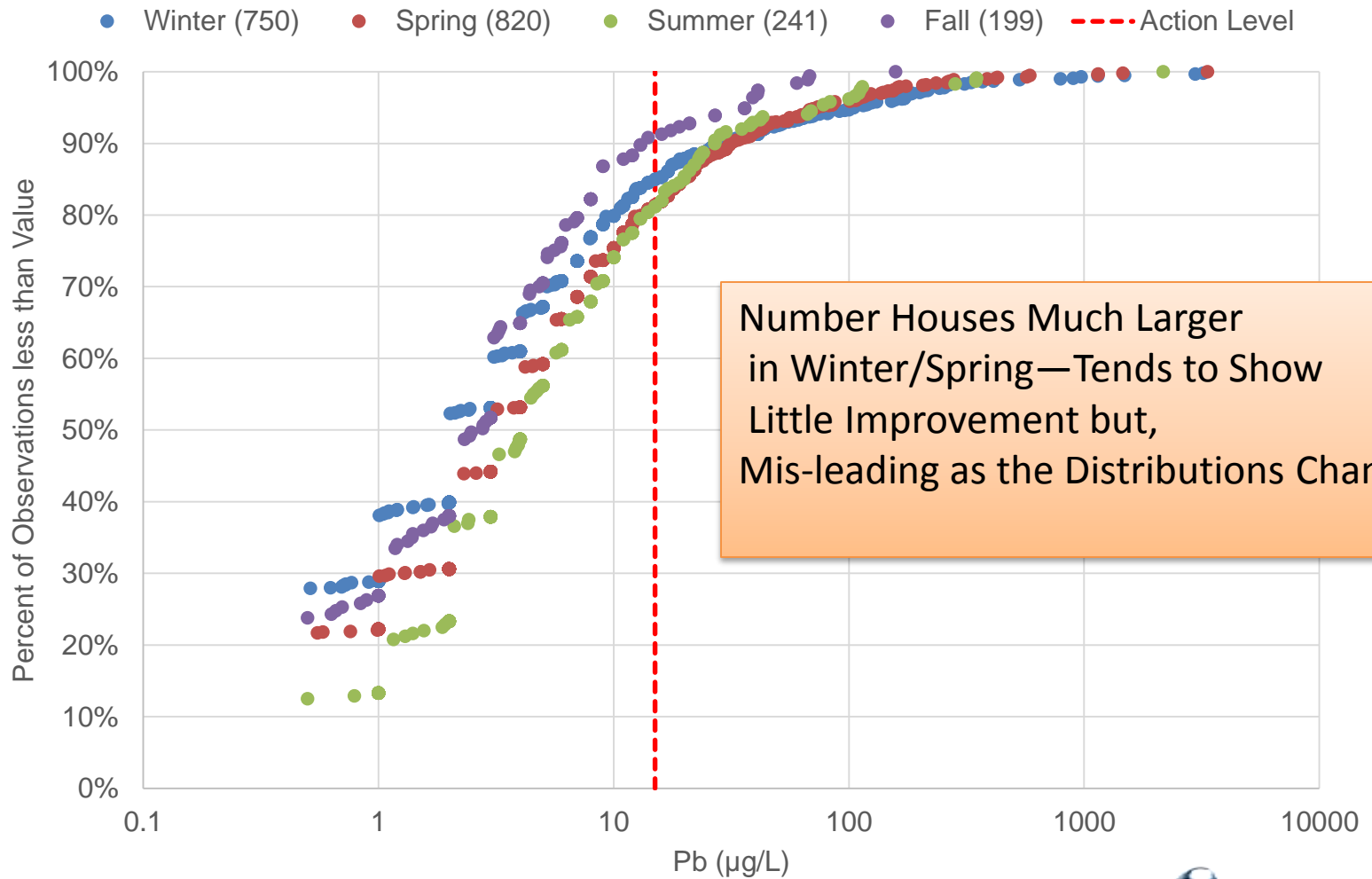
Combined Dataset, Max Pb at  
Each Location in 2016, **EPA Peak Pb Values**

# Common Pb Database

The following analysis looks at the maximum Pb level at each location (regardless of database source), distributed by:

- Season
  - Winter (Jan/Feb)
  - Spring (Mar-May)
  - Summer (Jun-Aug)
  - Fall (Sept-Nov)
- All plots are presented using EPA-1S data unless otherwise specified

## Max Pb Level for each Location, by Season (# of Locations)

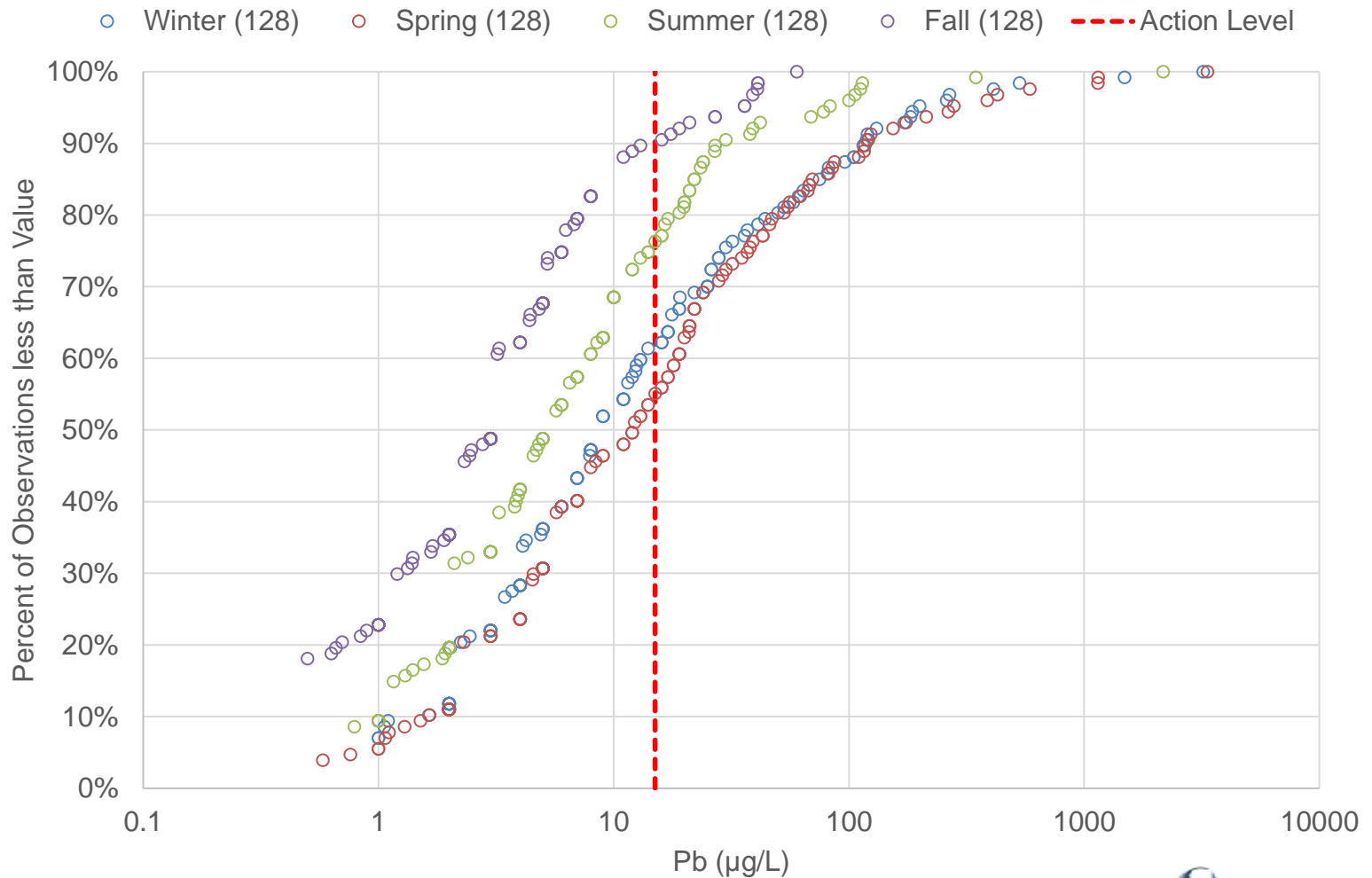


Combined Dataset, Max Pb at Each Location in Season, EPA 1<sup>st</sup> Sample Pb Values

# Seasonal Pb Distribution – Paired Data

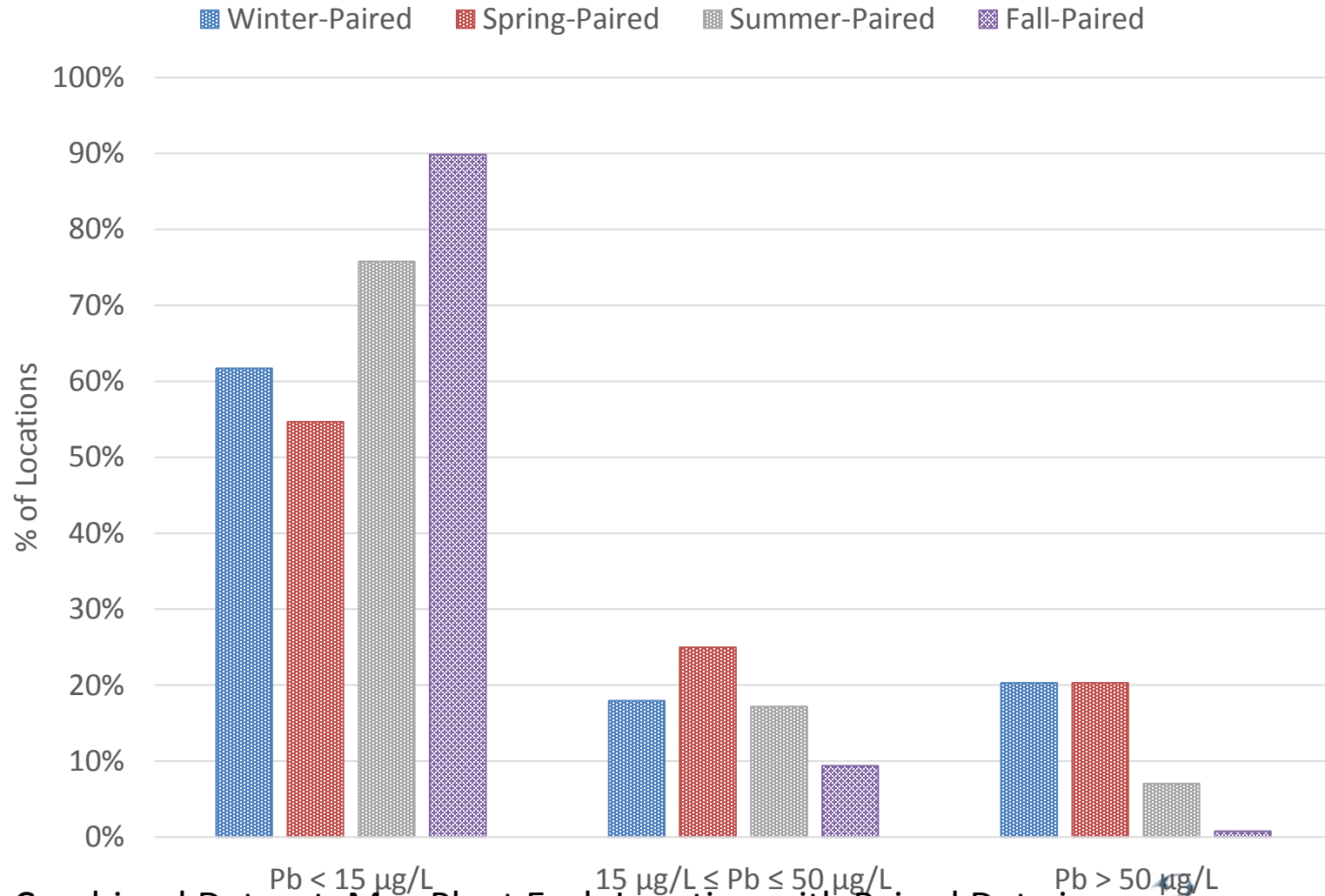
- To better understand how Pb changed at specific locations over time, a subset was created from only those **sites with Pb samples collected during all four seasons**
- Winter: 750 locations → 128 locations
- Spring: 820 locations → 128 locations
- Summer: 241 locations → 128 locations
- Fall: 199 locations → 128 locations
- Referred to a Paired Data
- Summer and Fall data distributions were less affected because a smaller proportion of data were removed
- Unpaired data removed from the Winter and Spring subsets tended to be low Pb

## Max Pb Level for Locations with Paired Data, by Season (# of Locations)



Combined Dataset, Max Pb at Each Location with Paired Data in All Four Seasons, EPA 1<sup>st</sup> Sample Pb Values

## Binned Distribution of Seasonal Max Pb - Paired Data



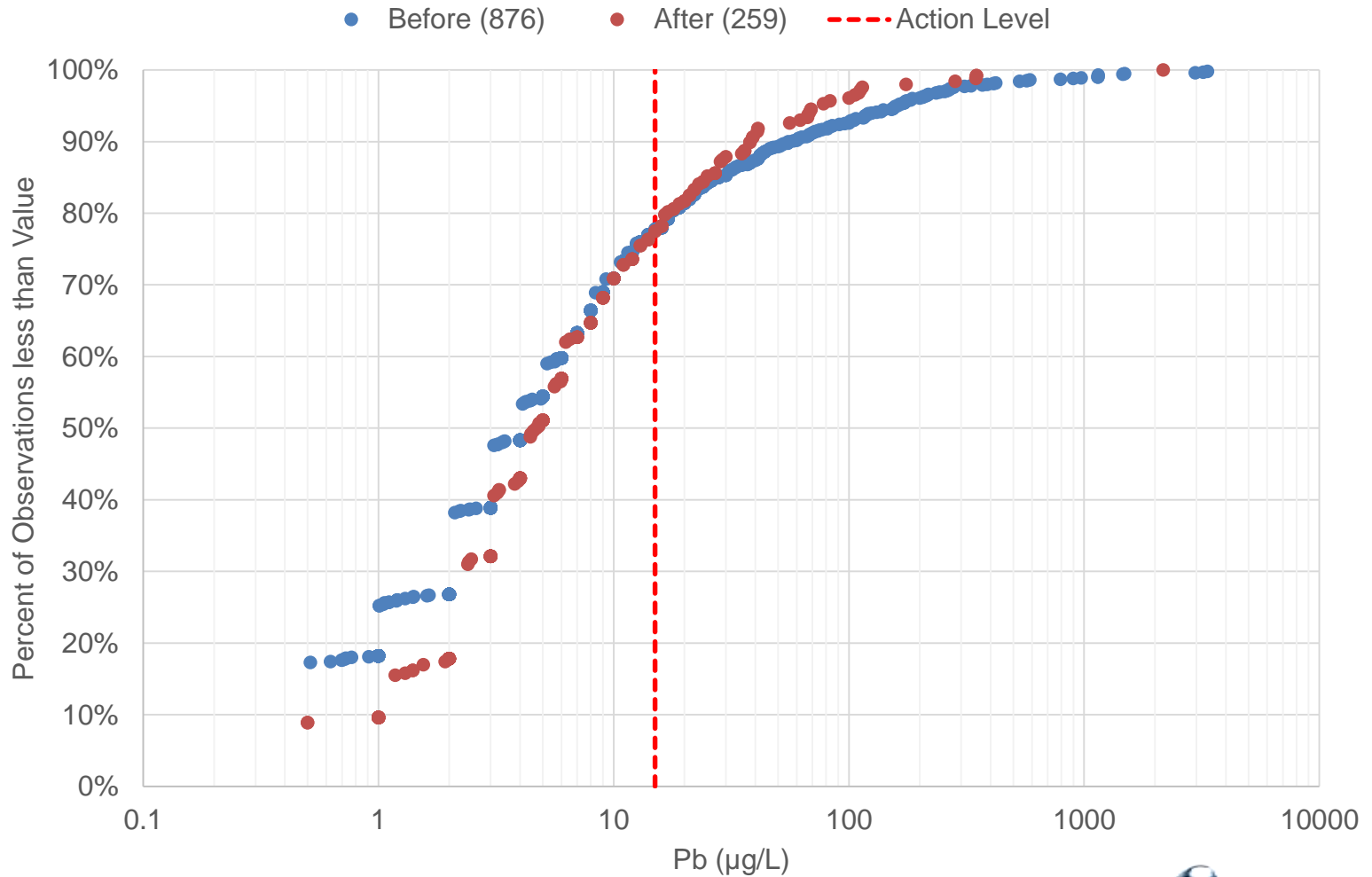
Combined Dataset, Max Pb at Each Location with Paired Data in All Four Seasons, EPA 1<sup>st</sup> Sample Pb Values



# Before/After May Flush Data

- Instead of grouping by season, data were grouped by occurrence before or after May Flushing (defined as 5/15/2016)
- Again, significantly more data prior to May Flushing than after
- Comparing these raw data show the distributions before/after the May Flushing are similar

## Locational Pb Levels Before/After May Flush (# of Locations)

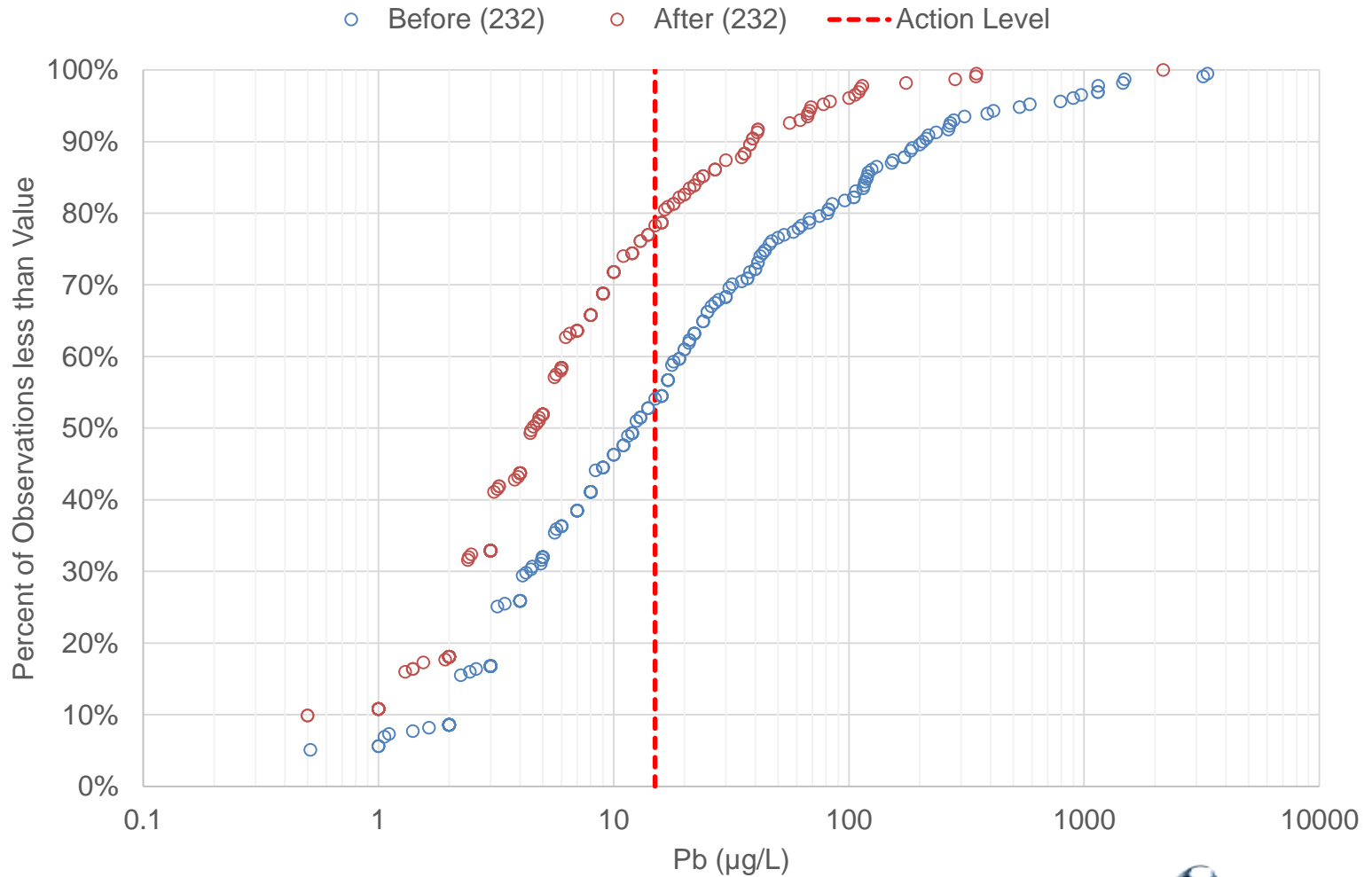


Combined Dataset, Max Pb at Each Location in 2016,  
EPA 1<sup>st</sup> Sample Pb Values

# Before/After May Flush – Paired Data

- Again, to better understand how Pb changed at specific locations over time, a subset was created from only those sites with Pb samples collected both prior to and after the May Flush Event
- Before: 876 locations → 232 locations
- After: 259 locations → 232 locations
- Removing non-paired data significantly changed the percentile distribution for the Before data
- After data distributions was less affected because a smaller proportion of data were removed
- Unpaired data removed from the Before subset tended to be low Pb

# Locational Pb Levels Before/After May Flush at Paired Locations (# of Locations)

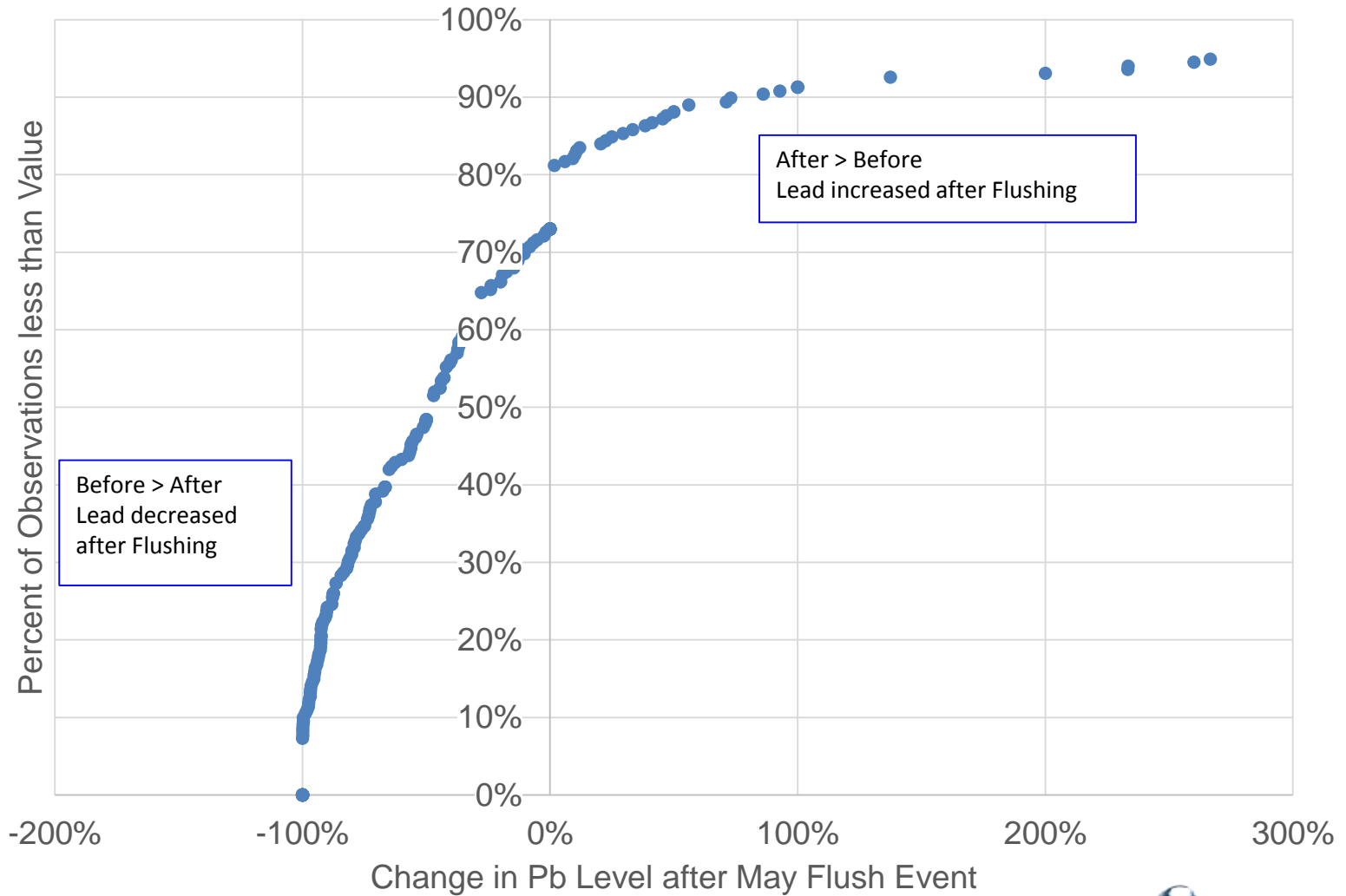


Combined Dataset, Max Pb at Each Location with Paired Data  
Before/After May 15, 2106, EPA 1<sup>st</sup> Sample Pb Values

# Before/After May Flush – Change at Specific Locations

- Paired data distributions don't show what happened at specific locations over time
- This shows how each individual house changed

## Impact of May Flushing on Pb Levels by Paired Location



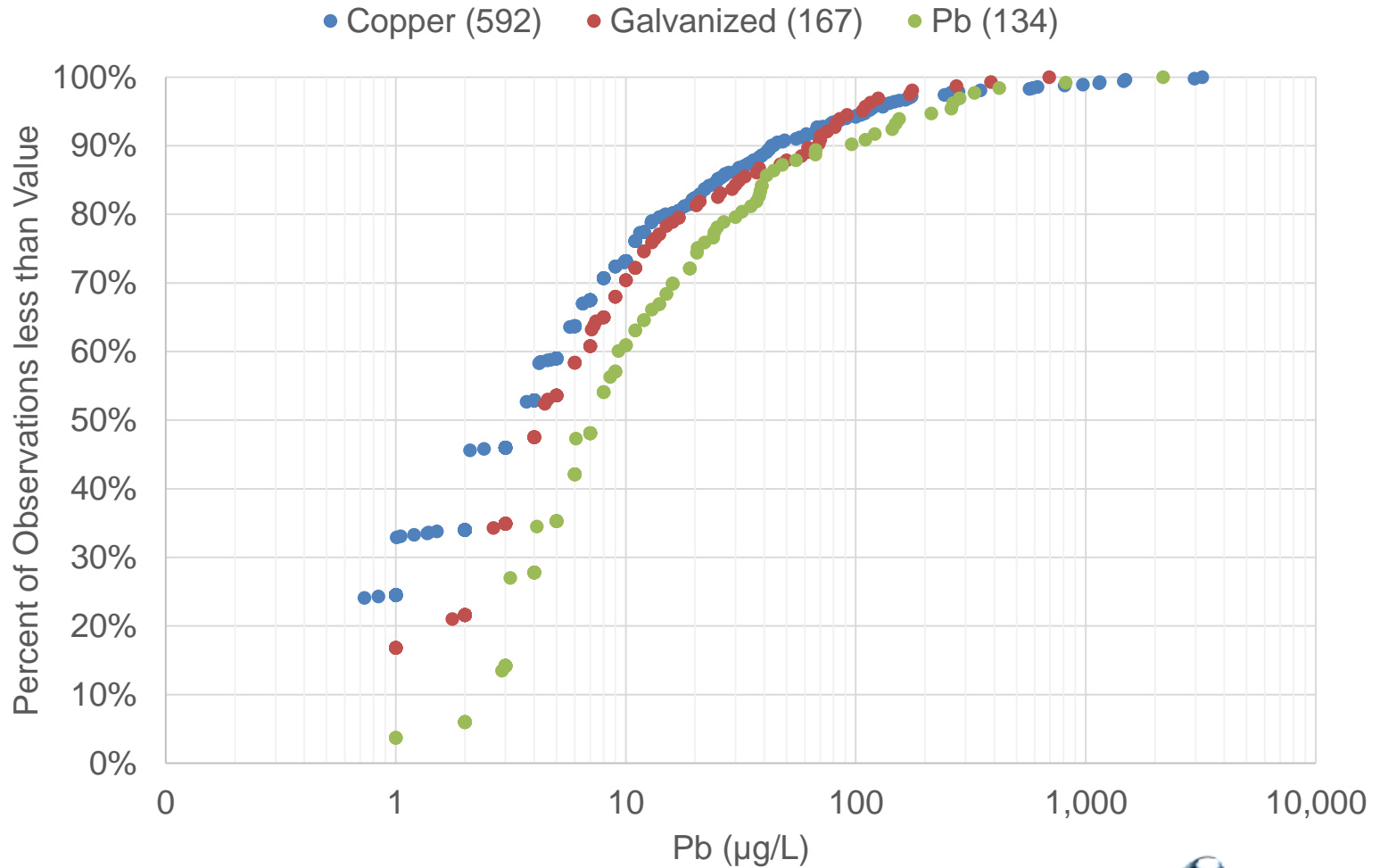
Combined Dataset, Ratio of Max Pb at Each Location with Paired Data Before/After May 15, 2106, EPA 1<sup>st</sup> Sample Pb Values

# Pb Levels by Service Line Type

- Maximum Pb levels were plotted based on service line material:
  - Copper
  - Pb
  - Galvanized
- Service line material is based on private-side of meter

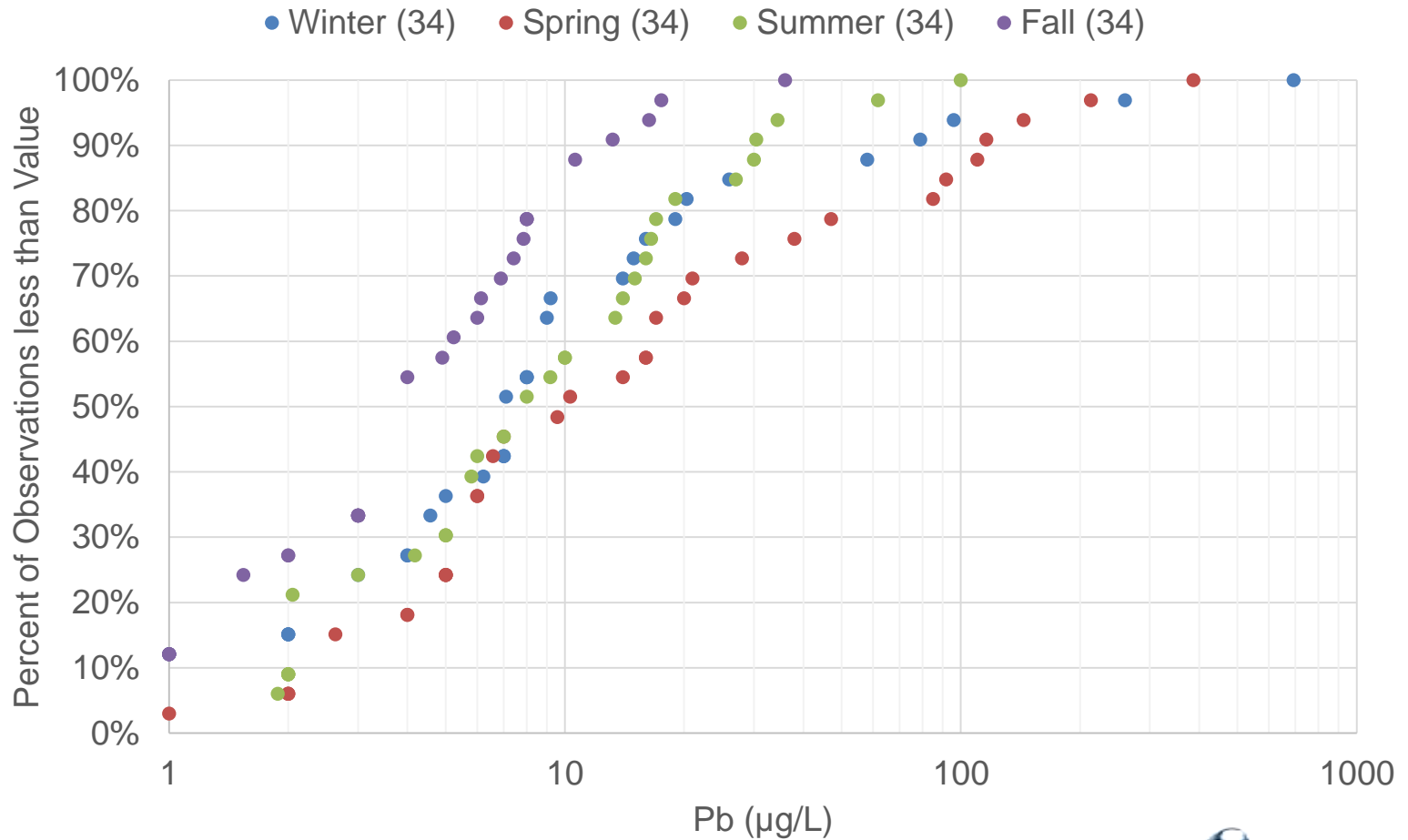


# Maximum Pb at Location by Service Line Type, All 2016 (# of Locations)



Combined Dataset, Max Pb at  
Each Location, EPA Peaks

# Maximum Pb Levels at Locations with Pb or Galvanized Service Lines, Paired by Season (# of Locations)



Combined Dataset, Paired Data Only, Only Galv. and Pb SLs,  
Max Pb at Each Location during Season, EPA Peaks

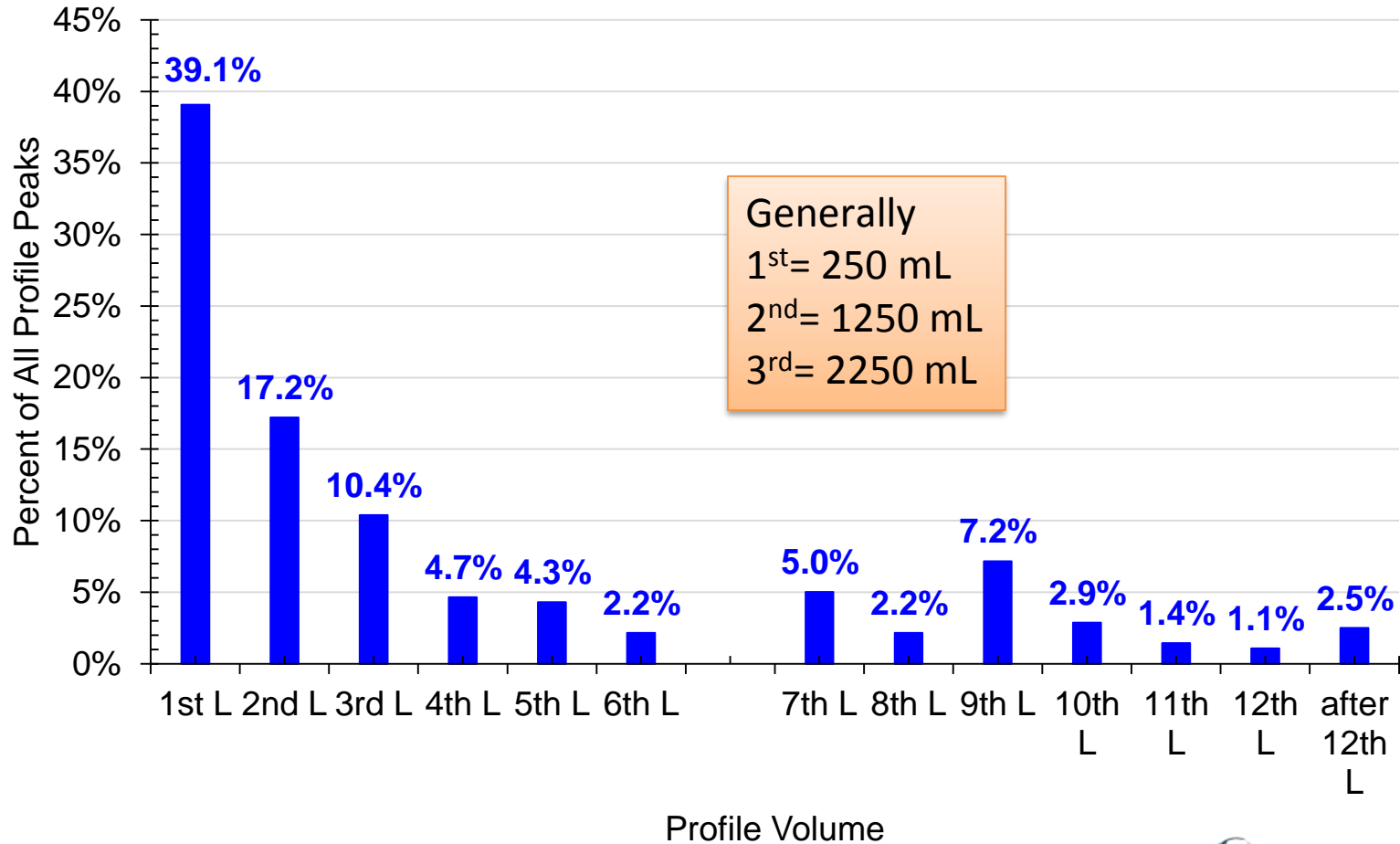
# OCCURRENCE OF PEAK LEAD

EPA Sequential Data - Profile volume where peak Pb occurs

# EPA Sequential Data Evaluated

Sampling Round	Sample Dates	Number of Profiles	Number of Houses
Sequential 1	February 2016	94	94
Sequential 2	May 2016	42	41
Sequential 3	July 2016	47	47
Sequential 4	September 2016	51	51
Sequential 5	November 2016	45	45
Total		279	115

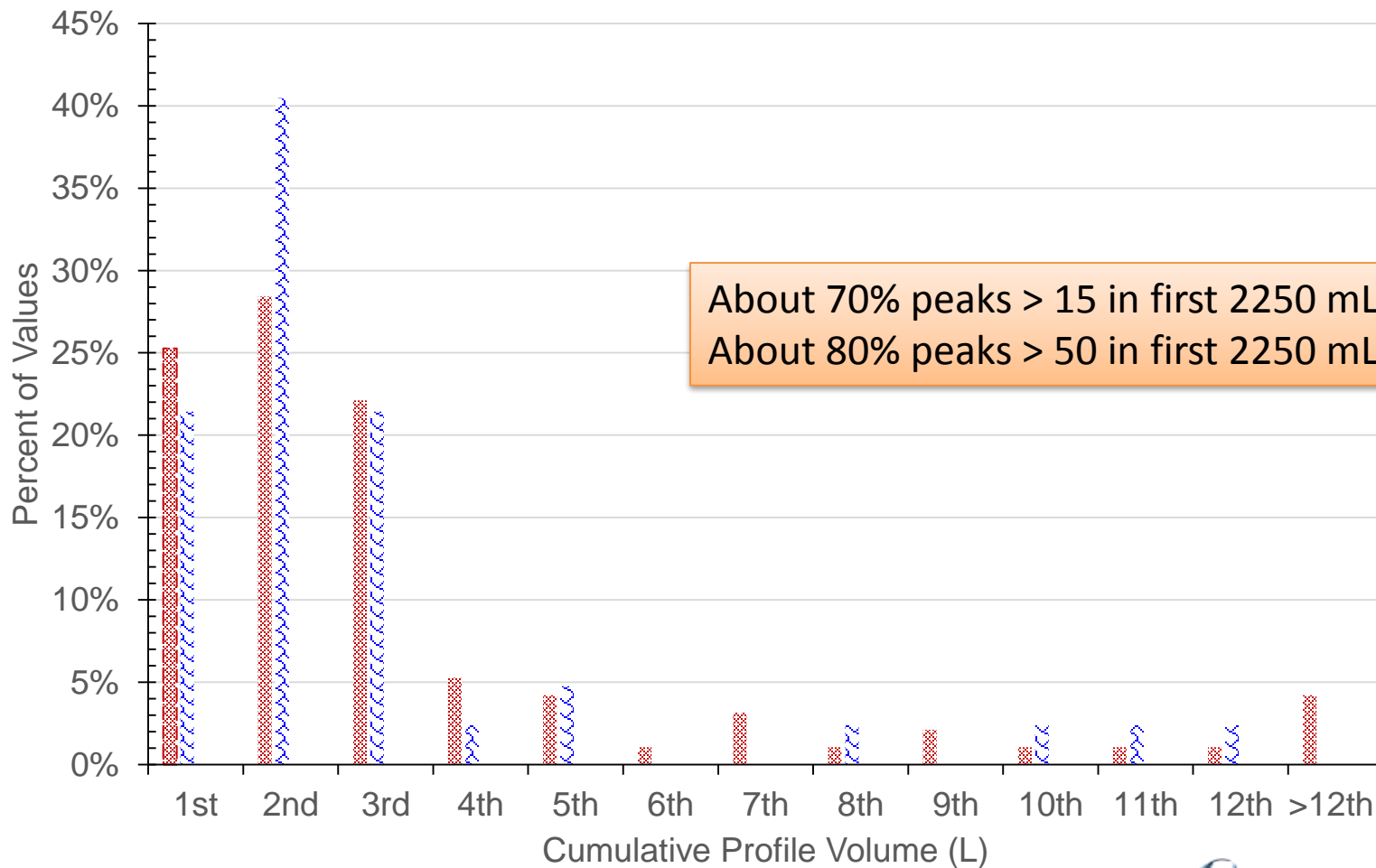
EPA Sequential Data  
Profile Volume where peak occurred  
"2nd L" means peak occurred >1,000 but ≤2,000 mL



**OCCURRENCE OF ANY HIGH LEAD  
VALUES (>15 OR >50 µg/L)**

## EPA Sequential - >15 vs >50 $\mu\text{g/L}$ - Peak

■ Peak >15  $\mu\text{g/L}$  95 samples    ■ Peak >50  $\mu\text{g/L}$  42 samples





# OCCURRENCE OF PEAK LEAD

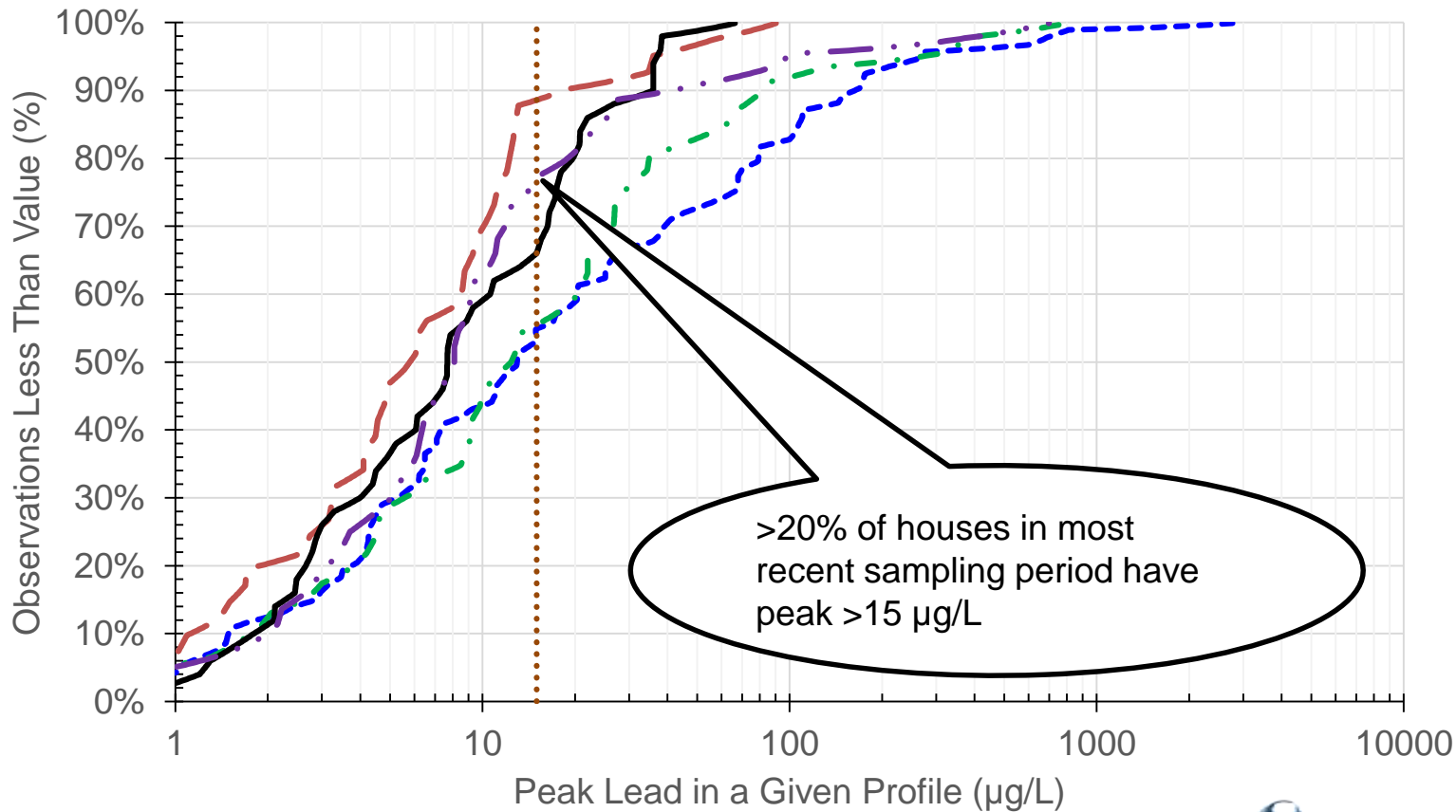
Peak Lead Values

# Peak Lead

- Improvement over time by house

# Comparison of Peak Lead in a House EPA Sequential - By Sample Period

--- Sequential    -.- Sequential\_2    -.- Sequential\_3  
— Sequential\_4    -.- Sequential\_5

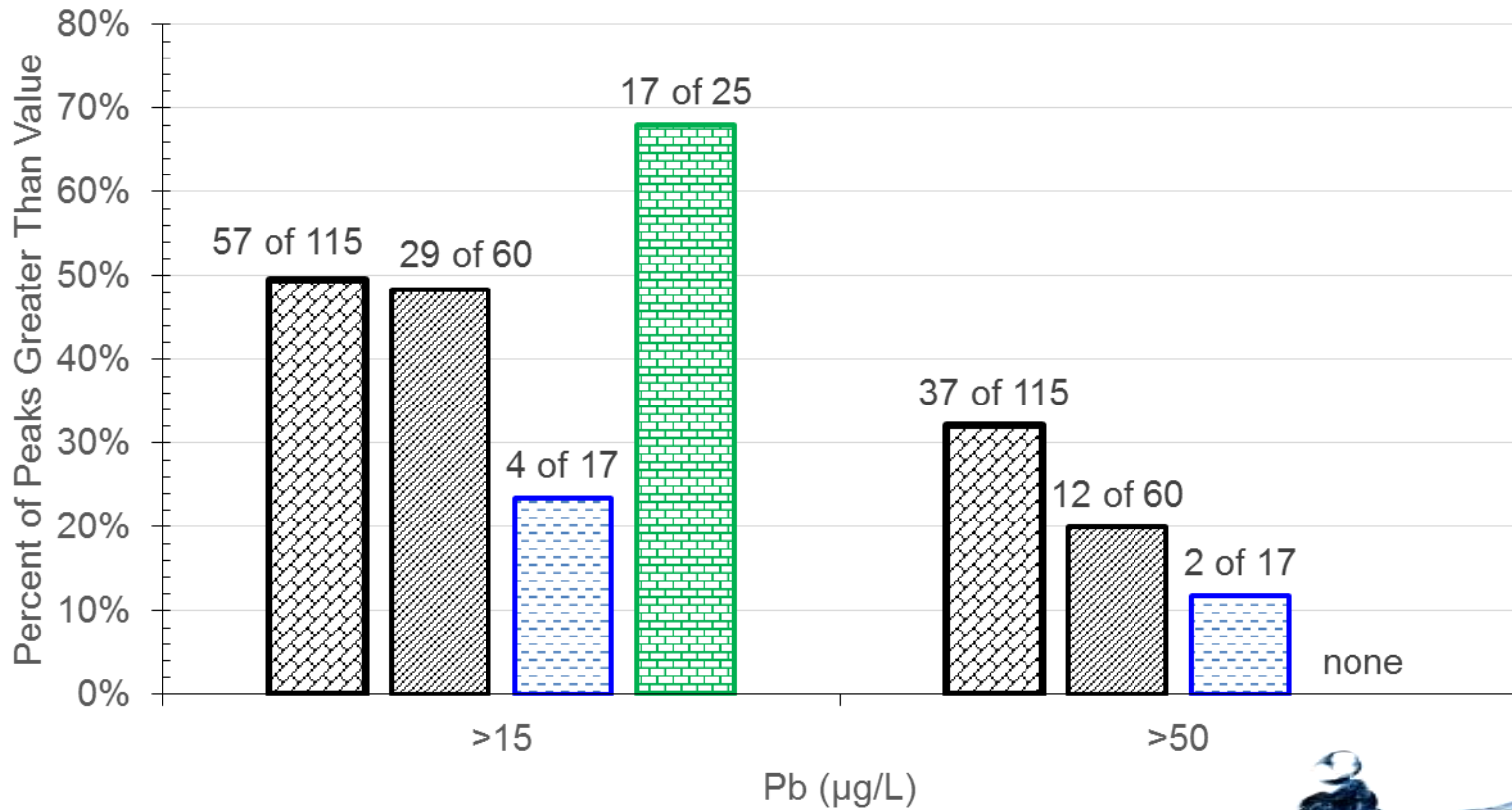


# HIGH LEVELS COMPARED TO OTHER DATABASES

- Compares peak lead from all samples in all profiles at a given house
- Black bar is from Flint EPA Sequential (115 houses)
- Blue bar is from Cornwell Engineering Group (CEG) national database (17-34 houses)
- Green bar is for 25 houses from Del Toral et al. 2013 (ES&T article)

# EPA Sequential (max values at house) versus Del Toral et al. 2013 and CEG National Database Percent of Peak Lead Values >15 or 50 µg/L

- ▣ highest value in profiles at a house
- ▣ EPA Rounds, 3, 4, & 5
- ▣ CEG Nat. database - houses
- ▣ Del Toral et al. 2013 - houses



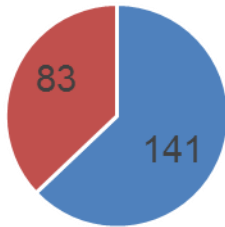
# Location of Profile Peaks Relative to Premise Plumbing

- EPA provided detailed plumbing breakdown of 77 residences, indicating all plumbing pipes, fixtures, etc. from tap to service line
- Premise plumbing was defined as plumbing from tap to meter
  - All locations in database have meters located inside of house
- Cumulative volume inside of house based on calculated volume of plumbing
- Analysis compared volume of premise plumbing to the sample volume where profile peak occurred.



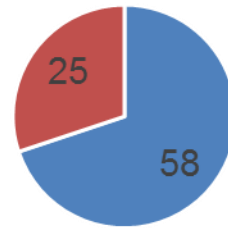
# Location of Profile Peaks Relative to Premise Plumbing

All Profiles  
(224 Profiles)



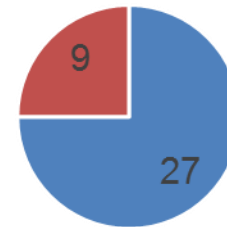
- Inside Premise Plumbing
- Outside of Premise Plumbing

Profiles with Peaks  $>15 \mu\text{g/L}$   
(83 Profiles)



- Inside Premise Plumbing
- Outside of Premise Plumbing

Profiles with Peaks  $>50 \mu\text{g/L}$   
(36 Profiles)



- Inside Premise Plumbing
- Outside of Premise Plumbing

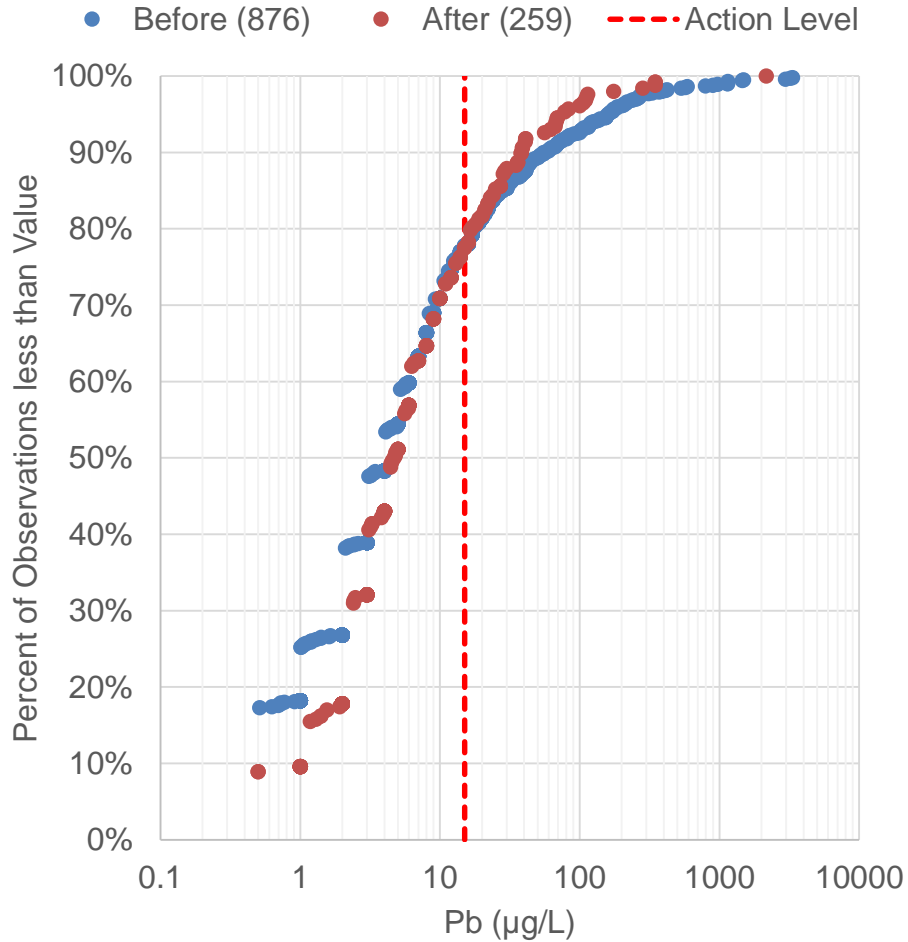


# TAKEAWAYS

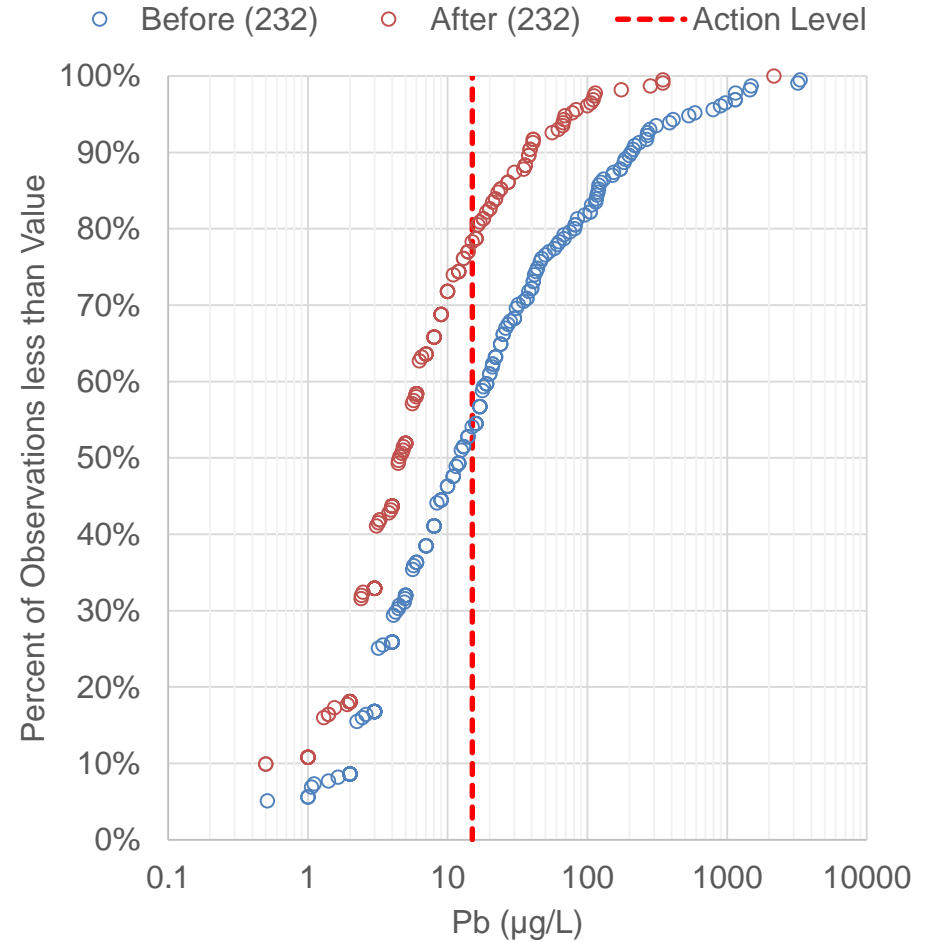
# Raw Data vs. Paired Data

- Raw data can mask extent of Pb levels at higher-risk sites
- Paired data tends to clearly show overall changes
- Removing unpaired data changes percentile distributions from earlier periods, increases median and 90<sup>th</sup> percentile Pb levels

Locational Pb Levels Before/After May  
Flush  
(# of Locations)



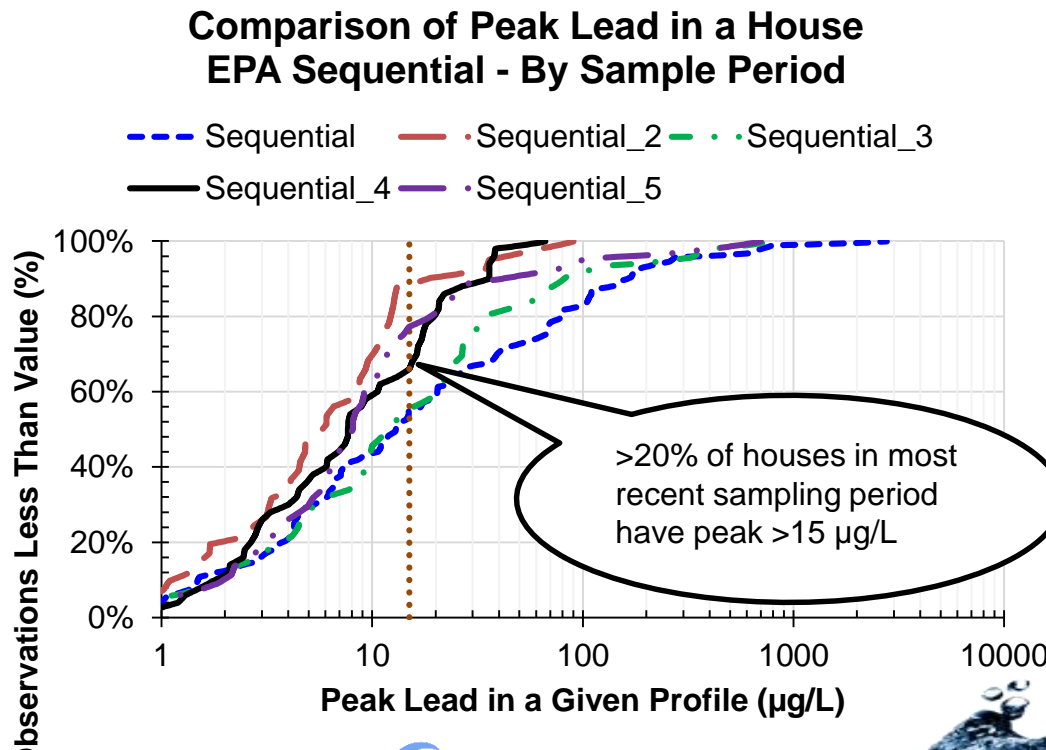
Locational Pb Levels Before/After May  
Flush at Paired Locations  
(# of Locations)



# Pb Levels Are Improving Over Time

## But Still high Peaks

- Pb levels in most locations are decreasing when comparing paired data



# SHORT-TERM RECOMMENDATIONS

# Whole-house Flushing

- EPA Sequential Pb profiles show “particulate” lead is likely now in household plumbing
- Whole-house flushing at individual residences could reduce Pb peaks
- Whole house flushing is like unidirectional flushing of a house---not just running a tap

# NEXT STEPS IN CCT AND SOURCE ISSUES

- Several water source changes could be made in the flint system in the next few years
- A plan to address future corrosion control (scope) is due by the City to EPA February 1, 2017
- Consent order requires CCT for any new source water



# SOURCE CHANGES CURRENTLY ENVISIONED (COULD CHANGE)

## Timeline for Flint Water Source Changes:

- Present to ~October 2017 supplied by DWSD
- ~October 2017 to mid- or late-2019 supplied by County water
- Mid- to late-2019 Flint WTP goes on-line
- After Flint WTP is operational there will be still be continual blending of County water into portions of Flint's distribution system

# 1. IMMEDIATE CCT PLANS

- Current source will be used through ~ October
- Current Orthophosphate requirement = minimum 3.1 mg/L
- Time remaining doesn't justify loop study
- Plan is to refine WQP and perhaps ortho dose
  - Primarily rely on coupon studies
  - **Whole house flushing**

## 2. TEMPORARY COUNTY WATER

- County is doing its own CCT
- City will assess their plan
  - Desktop study
  - Coupon study on impacts of changing to County CCT in Flint system
  - Address if County CCT needs to be supplemented prior to entering Flint System
  - Develop switch over plan

# 3. FLINT TREATMENT PLANT CCT

- Once treated water is available but before plant water entering distribution
  - Conduct pipe loop study of different orthophosphate doses

# 4. BLENDED WATER

- Takes into account all previous studies:
  - County alone
  - County + Flint distribution
  - Flint WTP
- Builds on that with coupon studies of different water blends with possible supplement to County Water