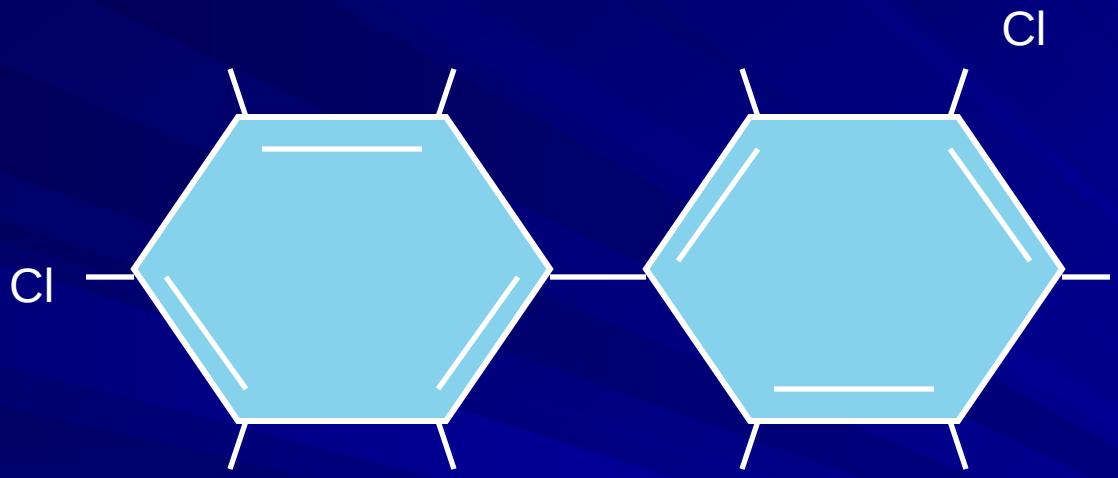
PCBs and TSCA



- Kim Tisa, PCB Coordinator
- US EPA Region 1

IMPORTANT DEFINITIONS

- **PCB Mixtures and Trade Names -** With few exceptions, PCBs were manufactured as a mixture of various PCB congeners. Target percentage of chlorine by weight was achieved through progressive chlorination of the biphenyl molecule.

- **Aroclor -** Monsanto's trade name for PCB mixtures. Each Aroclor was distinguished by degree of chlorination (i.e., last two digit = % Chlorine by mass)

DEFINITIONS, cont.

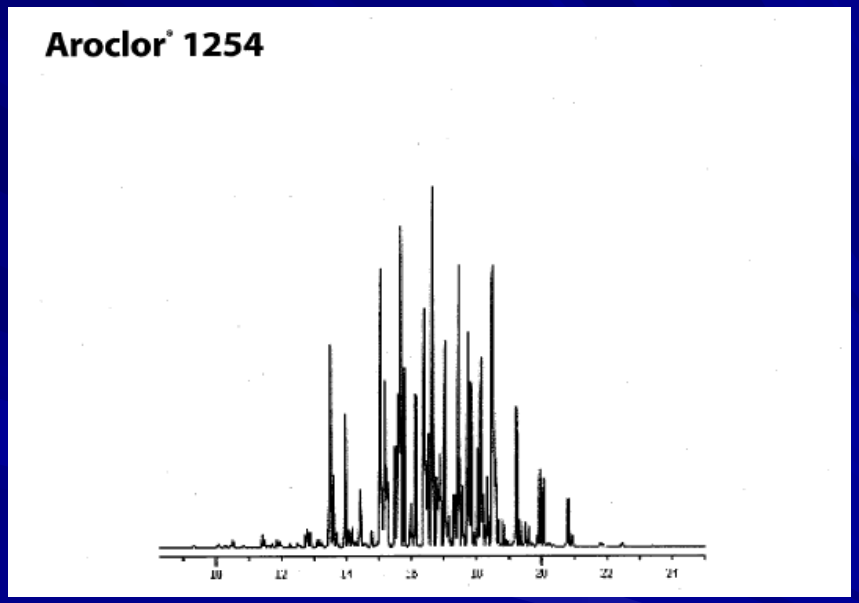
- **Congeners -** PCBs are a class of chemical compounds in which 1–10 chlorine atoms are attached to the biphenyl molecule. The 209 possible compounds are called congeners.

- **Homologs -** PCBs can be categorized by degree of chlorination. "Homolog" is used to refer to a group of PCB congeners with the same number of chlorines (e.g., tetrachlorobiphenyls). PCB compounds that have the same number of chlorine atoms are said to belong to the same "homolog" group.

Formulating PCBs into Aroclors

(1016, 1221, 1232, 1242, 1248, 1254, 1260, 1262, 1268)

- Monsanto was only US producer - 1.4 billion lbs
- Only about 130 of the 209 congeners were used in commercial formulations
- >50 different congeners were used in an Aroclor mixture
- Range from oily liquids to waxy solids at room temperature
- Last two digit = % Chlorine by mass



CHEMISTRY OF PCBs

- Attractive Properties to Industry
  - Low flammability
  - Fire resistant
  - Chemical stability
  - Electrical insulating properties
  - Durability
  - Resistant to degradation
  - Softener and plasticizer

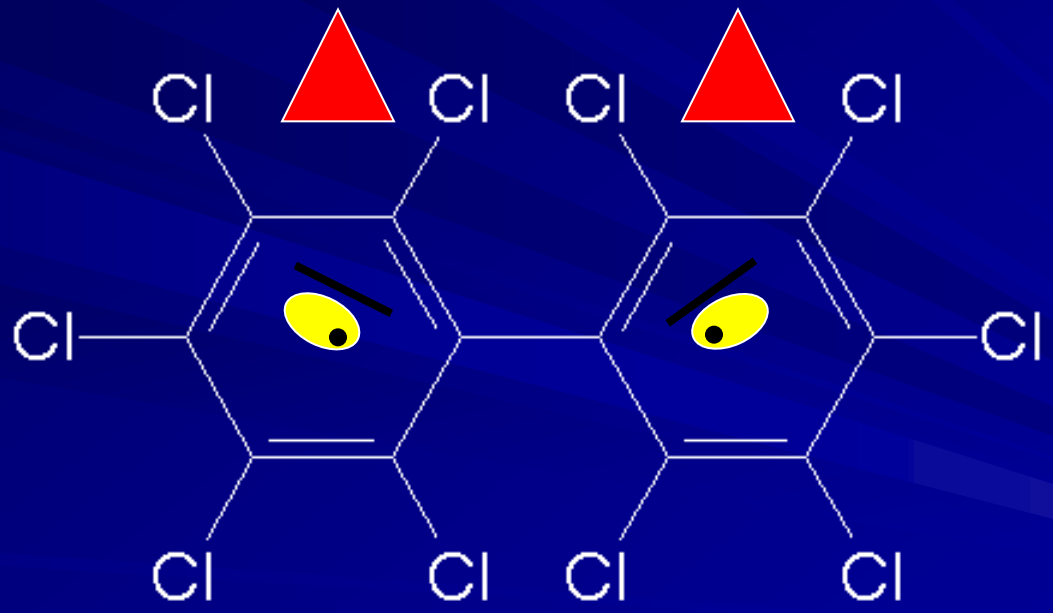
PCBs in Industrial Applications

- Transformers
- Capacitors
- Hydraulic fluids
- Oil-based paints
- Fluorescent light ballasts
- Lubricating & cutting oils
- Floor finishes
- Fire retardants
- Thermal Insulation materials (foam, felt)
- Caulking & grout
- PVC coatings for electrical wire & components
- Carbonless copy paper
- Inks and dyes
- Adhesives/mastic

Uses of Aroclor by Type

Current Uses (since 1970)	1221	1232	1242	1248	1254	1260	1268
Capacitors	X		X		X		
Transformers			X			X	
Heat transfer			X				
Hydraulic/lubricants • Hydraulic fluids		X	X	X	X	X	
• Vacuum pumps				X	X		
• Gas-transmission turbines	X		X				
Plasticizers • Rubbers	X	X	X	X	X		X
• Synthetic resins				X	X	X	X
• Carbonless paper	X		X				
Miscellaneous • Adhesives	X	X	X	X	X		X
• Wax extenders			X		X		
• Dedusting agents					X		
• Inks					X	X	
• Cutting oils					X		
• Pesticide extenders					X		
• Sealants and caulking compounds					X		

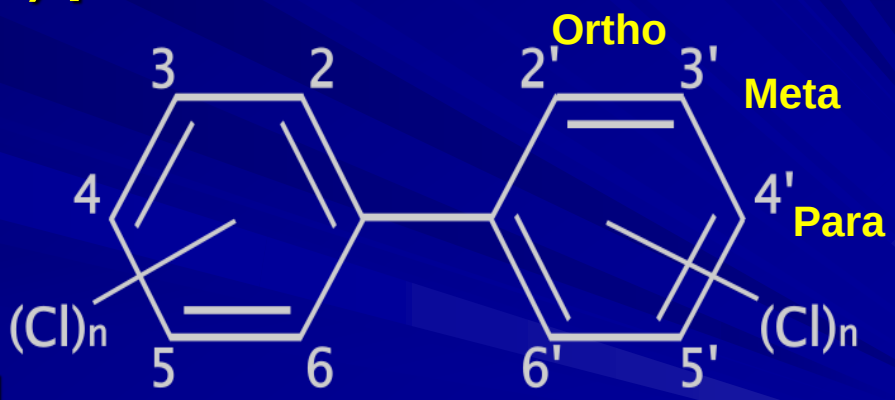
Why the Concern - Regulatory



Courtesy of Weston & Sampson

Toxicity vs. Chemical Structure

- **Number and position of chlorines dictates toxicity**
  - Chlorinated meta (3, 3', 5, 5') and para (4, 4') positions
  - Planar configuration, greater cellular response, higher order of toxicity
- **Chlorinated ortho (2, 2', 6, 6') positions**
  - Inversely related to toxicity
- **12 Coplanar PCBs**
  - At least 4 chlorines
  - Both para positions occupied
  - At least 2 meta positions occupied
  - 0 or 1 ortho positions occupied
  - "Dioxin-like" toxicity



Why should we care about PCBs?

- **There is significant background exposure**
  - **Total background exposure to pre-school children is approximately 12 ng/kg-day**

- **They are persistent / biocumulative in the body**
  - **Easily absorbed**
  - **Stored in fat**
  - **Slowly excreted**
  - **Lead to high "body burdens"**
  - **Produce long-lasting effects**

- **The "Safe" level of exposure is low and uncertain**
  - **Difficult to characterize toxicity due to chemical variability and complexity**

HEALTH EFFECTS

- **Developmental effects**
  - Impaired learning and motor function
  - Delays in organ system development
  - Possible related to endocrine disruption
- **Reproductive effects**
  - Increase in spontaneous abortion
  - Low birth weight/increased infant mortality
- **Immune system suppression**
  - Decreased antibody production
  - Increased susceptibility to disease
- **Liver damage**
  - Microscopic changes
  - Not strongly correlated with changes in function
- **Skin effects**
  - Chloracne rash/nail deformities

EPA Public Health Levels for School Indoor Air

Age group	Public Health Level (ng/m^3)	Total Background Exposure (ng/kg-day)
Daycare/Pre-School	70 to 100	12 to 14
Elementary	300	6
Middle School	450	5
High School	600	4
Adult Staff	450	3

- Factor in "background" exposure to PCBs so a 20 ng/kg-day ("safe" level) of exposure is unlikely to be exceeded considering total PCB exposure
- Assumes that PCB dust concentrations inside school are at "background" levels
- Site-specific information can be used to "refine" Public Health Levels

The Demise Begins

- In 1976, over concerns about the toxicity and persistence in the environment of PCBs, Congress enacted Section 6(e) of the Toxic Substances Control Act (TSCA)

- In 1979, PCBs were banned for all uses except “totally enclosed uses”, such as transformers, capacitors, vacuum pumps and hydraulic fluids

- In 1998, PCB Disposal Amendments

Where does that leave us today?

- The TSCA PCB regulations (40 CFR Part 761) place prohibitions on the use (manufacture), processing, and distribution in commerce and specify storage and disposal requirements for PCBs and PCB items
- PCB regulations may govern owners, operators, and/or persons conducting cleanup of PCB-contaminated property where the PCB contamination exceeds allowable concentrations under the regulations
- TSCA authority is not delegated to the states; therefore both TSCA and state regulations will apply

PROJECT GENERAL STEPS
Site Characterization, Cleanup and Disposal

- Investigate
- Delineate
- Determine cleanup criteria and develop cleanup plan
- Perform cleanup and verify
- Dispose of waste according to regulations
- Document

PROJECT CONSIDERATIONS

- Do I need to look for PCBs
- If I find PCBs, is my site regulated under TSCA
- What are my cleanup options

PCBs in Industrial Applications

- Transformers
- Capacitors
- Hydraulic fluids
- Oil-based paints
- Fluorescent light ballasts
- Lubricating & cutting oils
- Floor finishes
- Fire retardants
- Thermal Insulation materials (foam, felt)
- Caulking & grout
- PVC coatings for electrical wire & components
- Carbonless copy paper
- Inks and dyes
- Adhesives/mastic

PCB USES – CAULKS & LIGHT BALLASTS

U.S. Production of Aroclors as a plasticizer ingredient (mostly Aroclor 1254)

- 1958 - 4 million pounds
- 1969 - 19 million pounds
- 1971 - 0 pounds produced in U.S. (imports?)

Fluorescent light ballast capacitors (mostly Aroclor 1242)

- Prior to 1977 - Many (most?) ballasts contain PCBs
- 1977 – 1978 - Some new ballasts contain PCBs
- After 1978 - No new ballasts manufactured w/ PCBs
- Some ballasts remain in place; some have leaked/failed

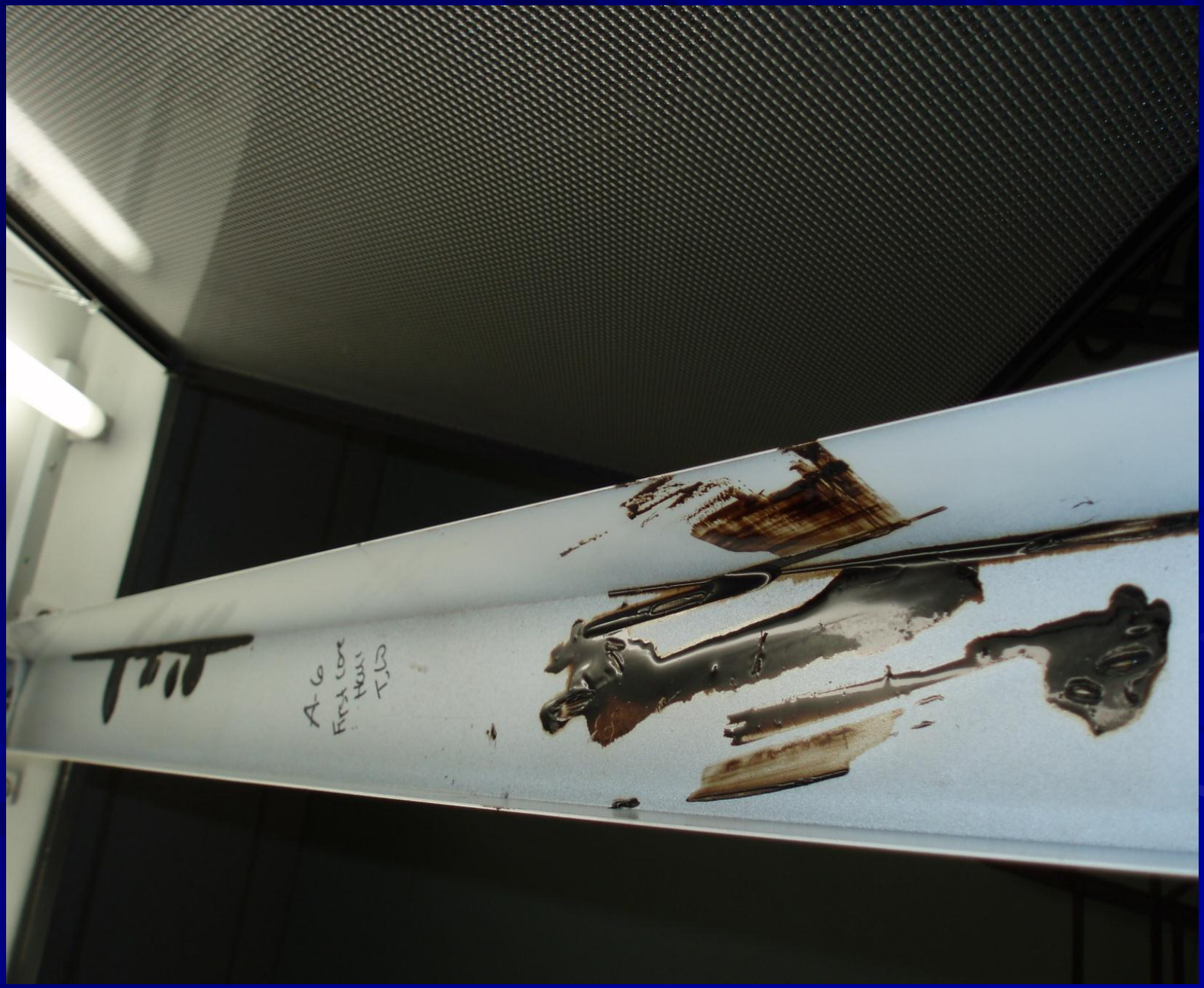
In fluorescent light ballasts

- PCB Small Capacitor of the type that can be found in clock systems. Trade Name is indicative of PCB content as well as the absence of the statement “No PCBs”

- Small Capacitor which does not contain PCBs of the type that can be found in clock systems. Marking “No PCBs” indicates that it was manufactured without PCBs.

- Transformer Spill and Weepage


NO
KEEP



DEFINITIONS: 40 CFR § 761.3

- PCB remediation waste
- PCB bulk product waste
- Excluded PCB product

PCB Remediation Waste - Important Dates and Concentrations*

- Material is considered a TSCA *PCB Remediation waste* if:
  - Disposed prior to April 18, 1978 and is currently at ≥ 50 ppm
  - Original PCB source ≥ 500 ppm beginning on April 18, 1978 and currently any concentration (≥ 1 ppm)
  - Original PCB source ≥ 50 ppm beginning on July 2, 1979 and currently any concentration (≥ 1 ppm)
  - Any concentration if from an unauthorized source
  - Burden of Proof and Presumption of no unreasonable risk

PCB Bulk Product Waste

Definition at § 761.3

> " Waste derived from manufactured products containing PCBs in a non-liquid state, at any concentration where the concentration at the time of designation for disposal was ≥ 50 ppm PCBs"

Issues

- The use of PCBs in non-liquid manufactured building products at >/= 50 ppm is prohibited under TSCA.
- Manufactured products containing PCBs have been found in many buildings and structures
- Caulk typically contains PCBs at very high levels - %
- The PCBs in the caulk migrate to a limited extent to surrounding materials (air, soil, masonry).
- Typical renovation procedures can increase exposures to workers and building residents, including children.

PCBs in Building Materials

- Considerations
  - PCB Bulk Product Waste § 761.62
    - Caulk, paint, mastic, laminates, adhesives
  - PCB Remediation Waste § 761.61
    - Concrete, masonry, brick, window frames, exterior soils, furniture
  - Demolition or Renovation
    - PCB bulk product waste and Reinterpretation Impact

PCB Bulk Product Waste Disposal

Bulk Product Waste (761.62)

examples: caulk, applied dried paints, varnishes, other similar coatings or sealants, Galbestos, building substrates (if disposal)

- Performance-based disposal
- Disposal in Solid Waste Landfill
- Risk-based Disposal Approval
- Daily Cover/Roadbed

Source Removal
PCB Bulk Product Waste

- Caulk removal
  - Strip out
- Paint removal
  - Abrasives
  - Chemicals
  - Hydroblast

761.62

Adjacent Surfaces and Surrounds
PCB Remediation Waste

- Grind/cut out areas of contamination beyond *PCB bulk product waste*
- Apply 761.61 options, as appropriate

Cleanup of *PCB Remediation Waste* – § 761.61

- Three options for Site cleanup
  - Self-implementing Approach
  - Performance-Based Approach
  - Risk-based Approach

Self-implementing Approach (SIP) § 761.61(a)

- Most appropriate for small-moderate sized sites (< 1-acre)
- Excludes certain sites (surface water/sediments)
- Notification/Certification requirements with USEPA, states, and local environmental agencies
  - 30-day default timeframe not applicable unless SIP requirements are followed in their entirety
- Prescriptive procedures for sampling and cleanup
  - Requires compliance with all sampling and analytical procedures
  - *In Situ* ("as found") sampling with no compositing for characterization
  - Subpart N or Subpart O

PCB Cleanup Levels 761.61(a)(4)

(bulk *PCB Remediation Waste/Porous Surfaces)*

- High Occupancy (> 6.7 hrs/week avg.)
  - ≤ 1 ppm
  - ≤ 10 ppm w/ cap*
- Low Occupancy (<6.7 hrs/week avg.)
  - ≤ 25 ppm
  - ≤ 50 ppm with fence and sign
  - < 100 ppm w/ cap*

* Cap: minimum 10” compacted soil, or minimum 6” asphalt or concrete

PCB Cleanup Levels 761.61(a)(4)

(*Non-Porous Surfaces*)

- High Occupancy (> 16.8 hrs/week avg.)
  - ≤ 10 ug/100 cm^2
- Low Occupancy (<16.8 hrs/week avg.)
  - < 100 ug/100 cm^2

PCB Remediation Waste Verification Sampling 761.61(a)(6)

Detailed and prescriptive methods for:

- Sample extraction and analyses
- Number of samples, depths, and locations
- Reporting
- Subpart O (*porous*) or Subpart P (*non-porous*)

** Compositing provided adequate delineation

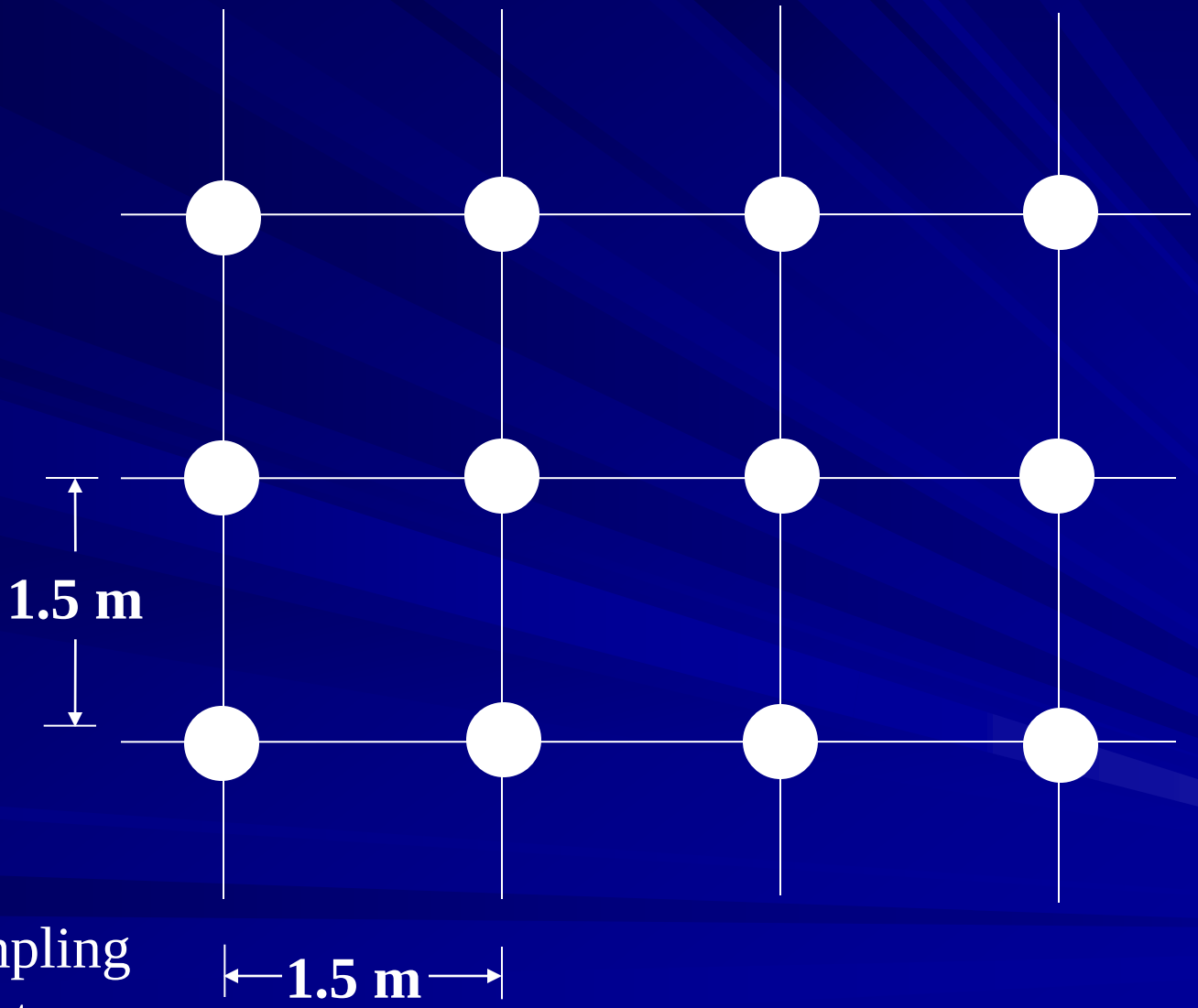
PCB Remediation Waste Verification Sampling 761.61(a)(6)

- Field screening methods may be used in a dynamic sampling approach for initial verification
- Final verification sampling uses a 5’ x 5’ sampling grid over remediated area (minimum 3 samples) and definitive laboratory analysis methods but may use Subpart Q
- Cleanup continues until established cleanup levels are reached

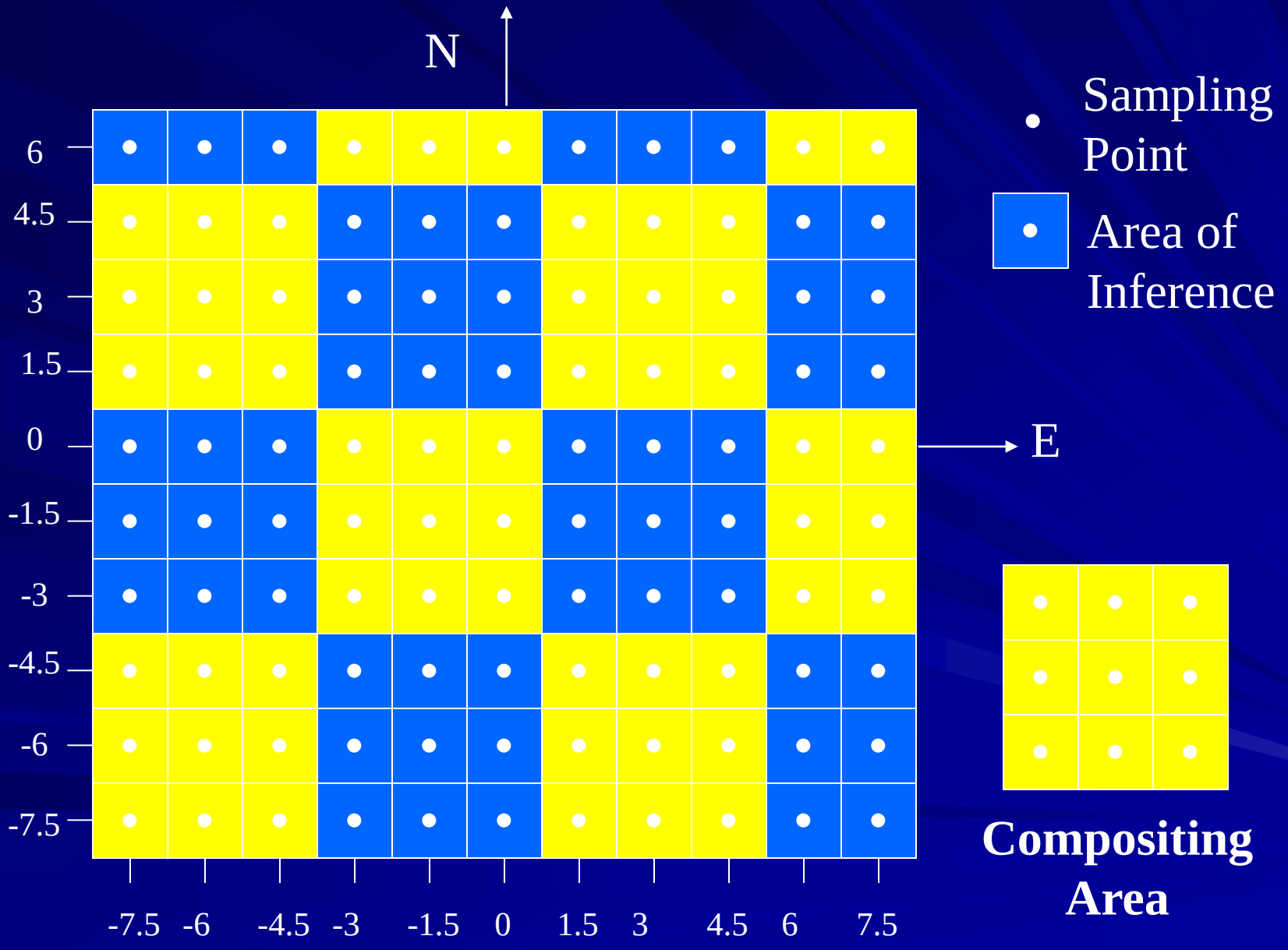
Subpart O -Composite Sampling

- Allowed provided adequate characterization
- Consider whether point-source or non-point source
- 9-sample max per composite

Mark Sampling Points at Intersection of Grid Lines



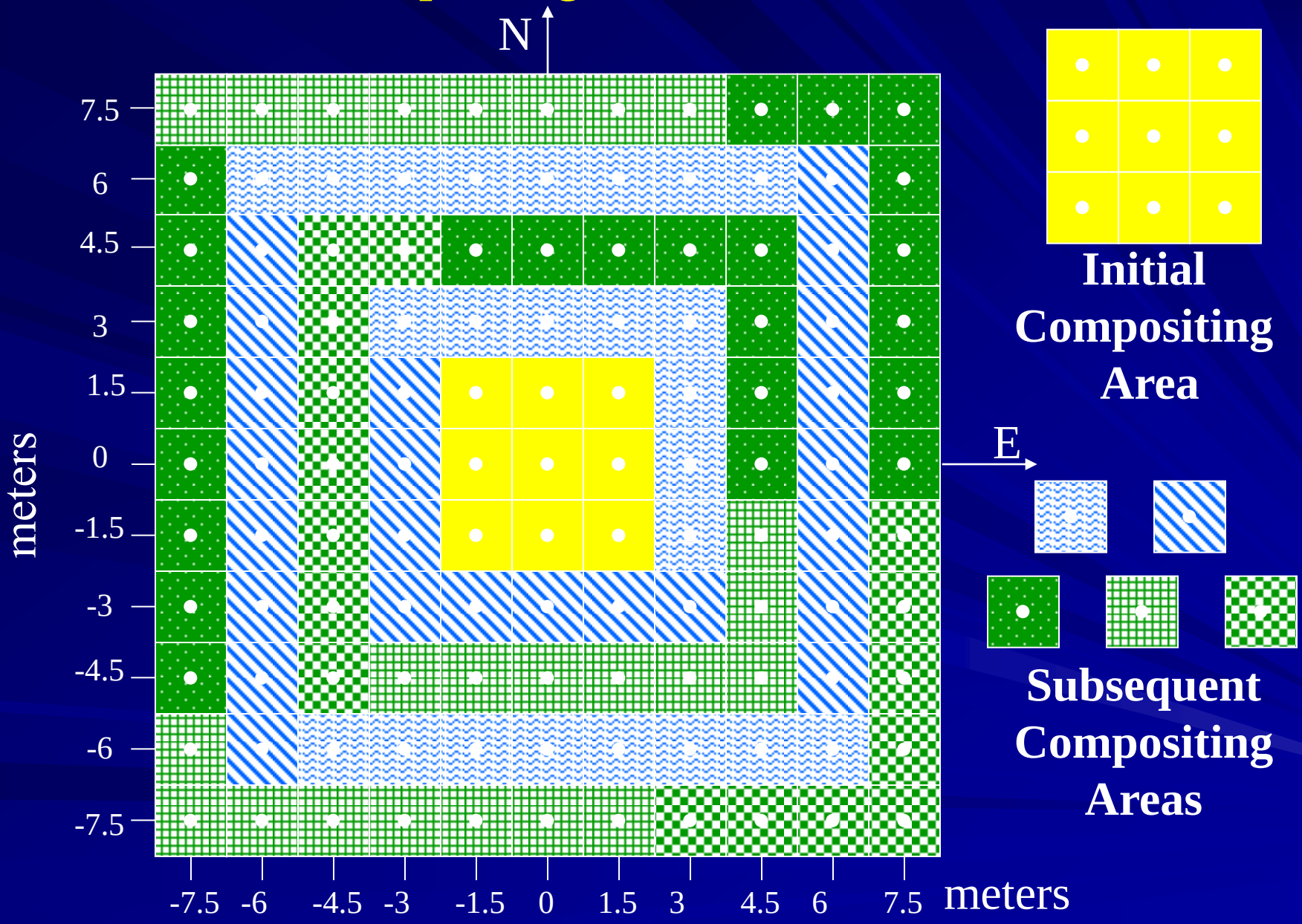
Compositing Areas: Non-point Source



Preamble page 35409

Codified 63 FR 35466

Compositing Areas: Point Source



PCB Remediation Waste Disposal § 761.61(a)(5)

- Liquids § 761.60(a)

- ≥ 50 ppm (dewatered waste)
  - Existing TSCA Facilities
  - RCRA §3004 or §3006 hazardous waste landfill

- < 50 ppm (dewatered waste)
  - Existing TSCA Facilities
  - RCRA §3004 or §3006 hazardous waste landfill
  - State approved solid waste landfill

Risk Based Option 40 CFR § 761.61(c)

- Deviation from decontamination, storage, and disposal requirements under 761.61(a)
- Recommended for complex or large sites and all media types
- Requires EPA approval
- Public notification process may be required
- Risk Assessment: state vs. federal
- Possible Long-Term O&M / Financial Assurance

Management in Place

- Not acceptable for *PCB bulk product waste* (§ 761.62)
- May be acceptable for surrounding materials (§ 761.61)
- *Possible* short-term interim measure
  - Consultation with EPA
  - Sampling may be required

Performance Based Option 40 CFR § 761.61(b)

- Notification not required to perform removal work
- Cleanup to less than 1 mg/kg total PCBs - Subpart O
- Dispose of all waste at TSCA-approved facility
- Document cleanup and keep records on file
- Submit § 761.61(a) Notification to EPA

Excluded PCB Products

- Must meet all criteria under § 761.3
  - ✓ concentration
  - ✓ sold/distributed in commerce prior to 1984
  - ✓ no dilution
- May be left in place without further restrictions/requirements
- State Requirements may require removal

Non-Liquid Region 1 Sites

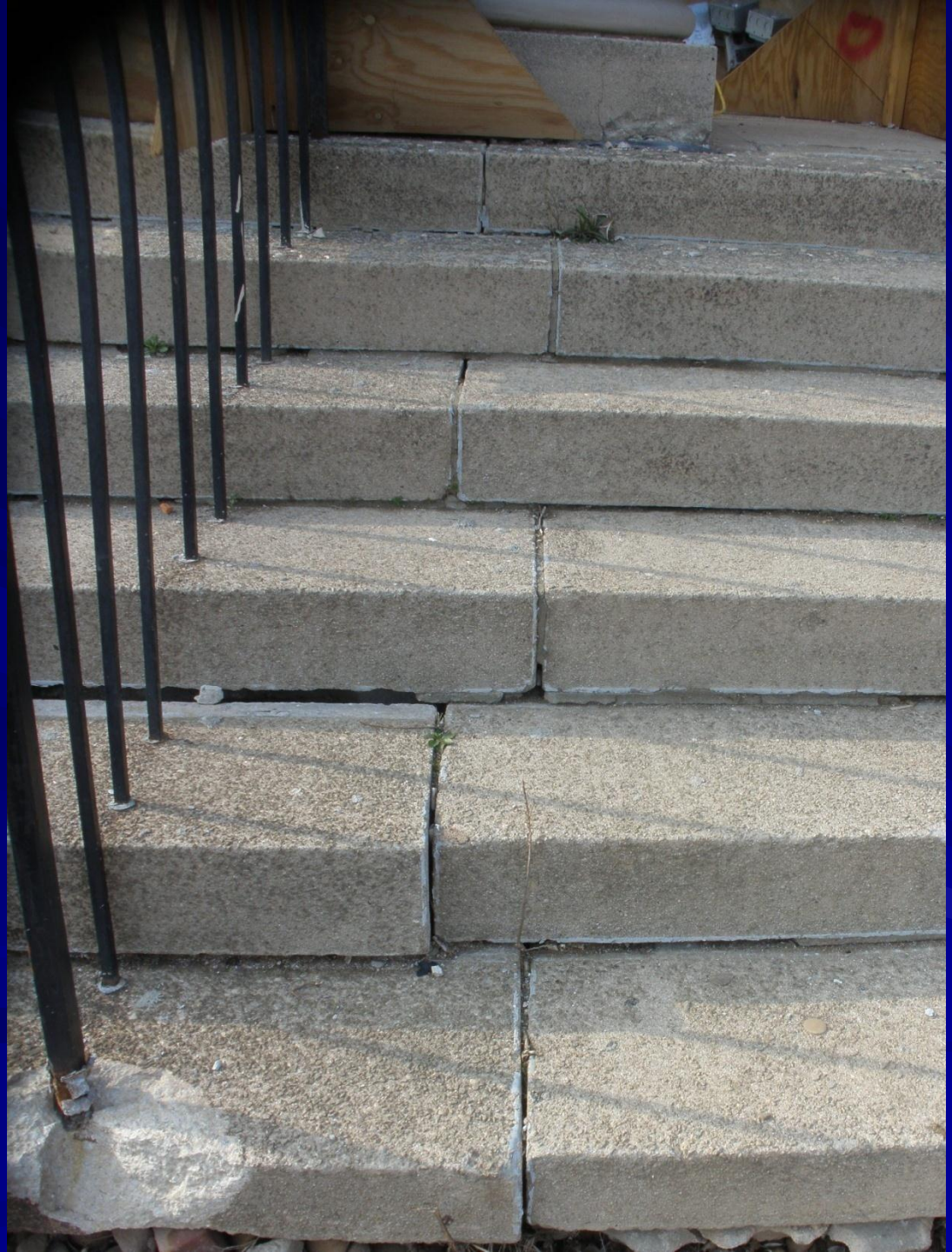
- Universities, Schools and Daycare Centers
- Pools
- Federal Government Buildings
- State/Local Govt. Buildings
- Water Systems
- Commercial Buildings
- BFs
- Nuclear Power Plants


EXIT
EXIT


CAULK AROUND WINDOWS
16,000 - 40,000 PPM
CAULK BETWEEN
METAL LINTEL &
METAL WINDOW
FRAME
8.0 - 48 PPM
CAULK BETWEEN
METAL LINTEL &
WOOD SOFFIT
4.1 - 45 PPM
GLAZING
COMPOUND
1,700 PPM


CAULK
BETWEEN WINDOW
& INTERIOR SILL
164 PPM


ASPHALTIC FELT & MASTIC
UNDER WOOD GYM FLOOR
9.6 - 10.9 PPM



- 2005 Transformer spill – van hit pole and PCB contaminated van, newly-paved state road, lawn, and catchbasin
- Van was sent to a PCB landfill
- ~ $80,000 in cleanup and disposal costs
- 761.61(b) disposal

Photos

November 2006

- Spill from a pole-top transformer

- Bank closed 4 days
- 4 dogs decontaminated
- ~ $150,000 cleanup cost


ADLER

Which PCB cleanup option is best for my site?

Consider:

- Schedule
- Site size and End Use
- Contamination type and extent
- Special removal requirements
- Verification sampling
- Public involvement & LT requirements

Other Project Considerations

- Excavation/Decon set-up
- Storage limitations (lined roll-offs, containment areas, time restrictions)
- Transportation requirements (vehicles, manifests, PCB activity notification)
- Field Screening and Laboratory TAT
- Waste management / disposal
- Other federal/state/local permits/certs

PCB Project Dos and Don'ts

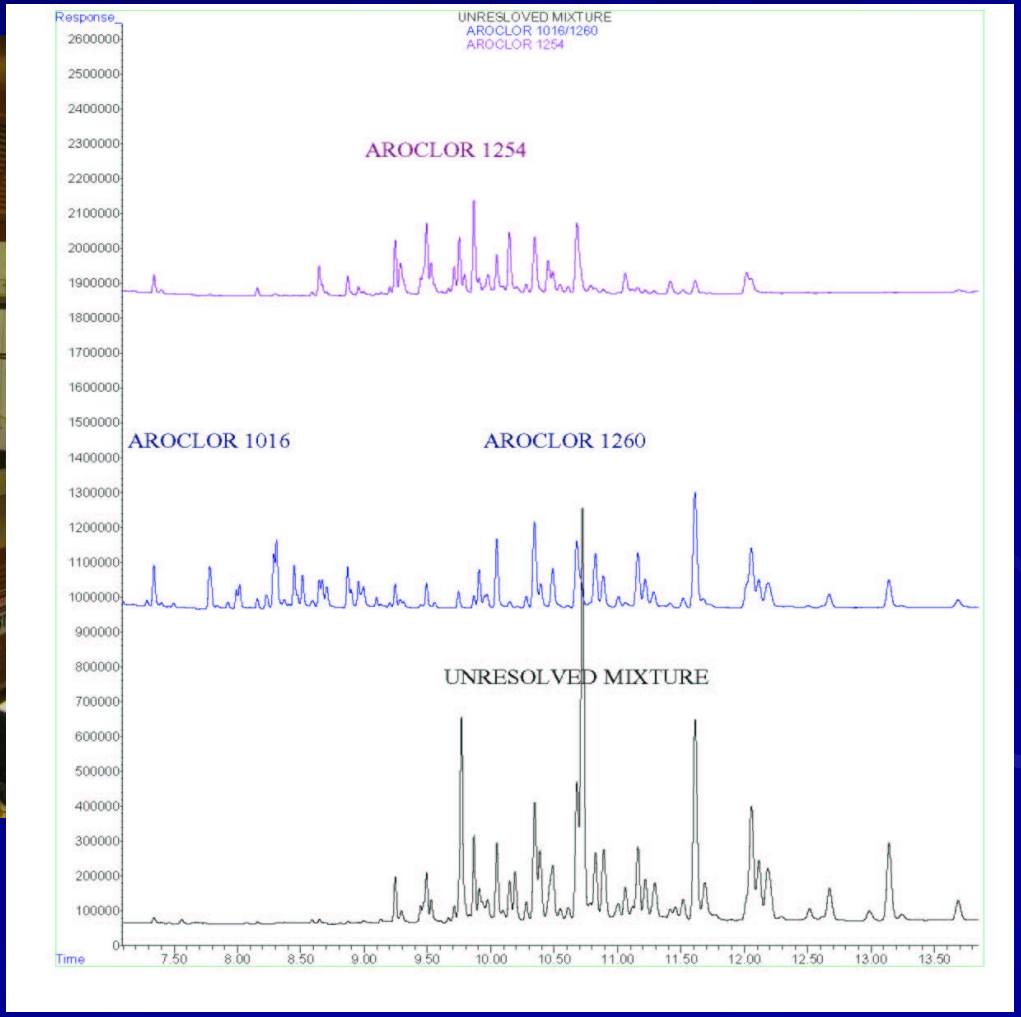
- DO:
  - Know your Site
  - Delineate nature/extent
  - Appropriate and Representative Sampling
  - Appropriate analytical data
  - Contractor Plans consistent with remediation
  - Consider waste management/storage
  - Count on the unexpected

PCB Project Dos and Don'ts

- DON'T:
  - Forget your Lab
  - Mishandle Waste
  - Re-contaminate cleaned areas
  - Improperly Decontaminate
  - Collect Samples while still conducting cleaning

  - Time delays
  - *$$$*

ANALYTICAL CONSIDERATIONS AND PITFALLS



LAB COMMUNICATION ISSUES

- Discuss Project Requirements

  – Methods
    - Allowable extraction methods – Soxhlet extraction (3540) preferred
    - Extraction by sonication not preferred
      – Inefficient
      – Not applicable to all matrices
      – Not allowed under many state QA programs

    - Alternative techniques require correlation study
      – Subpart Q

  - Reporting limits

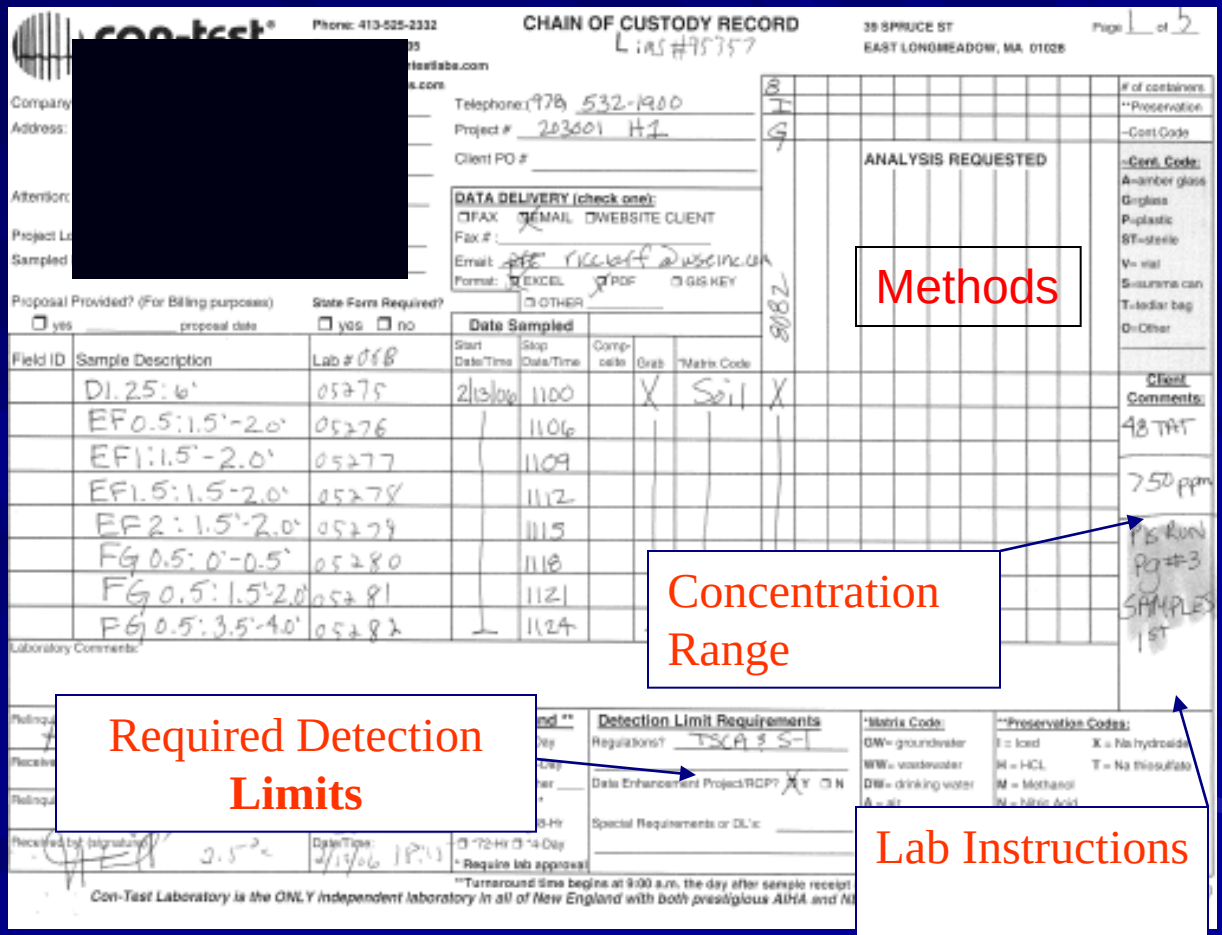
Incorrect / Incomplete COC Info.

1) Analytical and extraction requirements

2) Expected concentration range

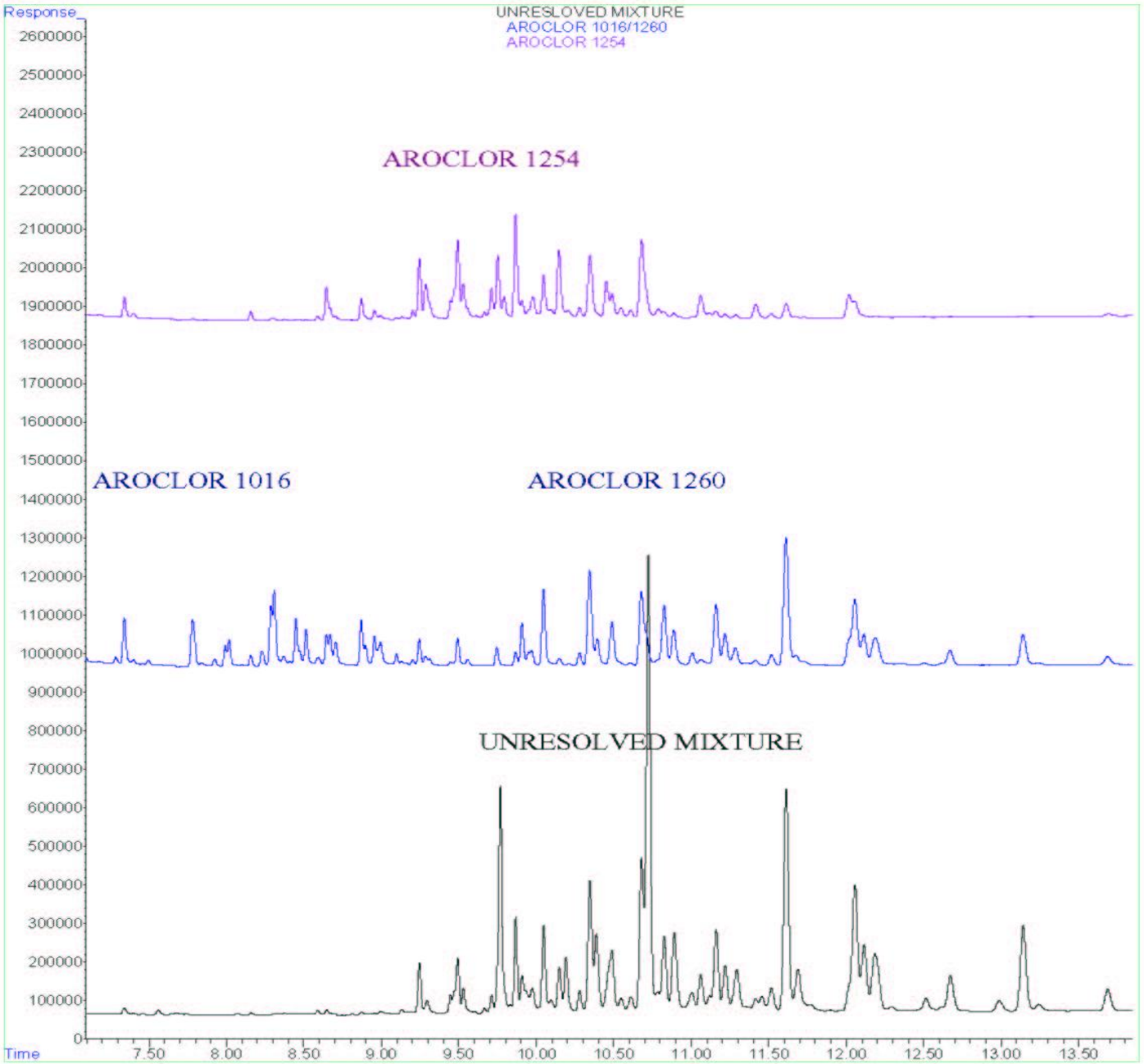
3) Required reporting limits

4) Special Instructions



Laboratory Analytical

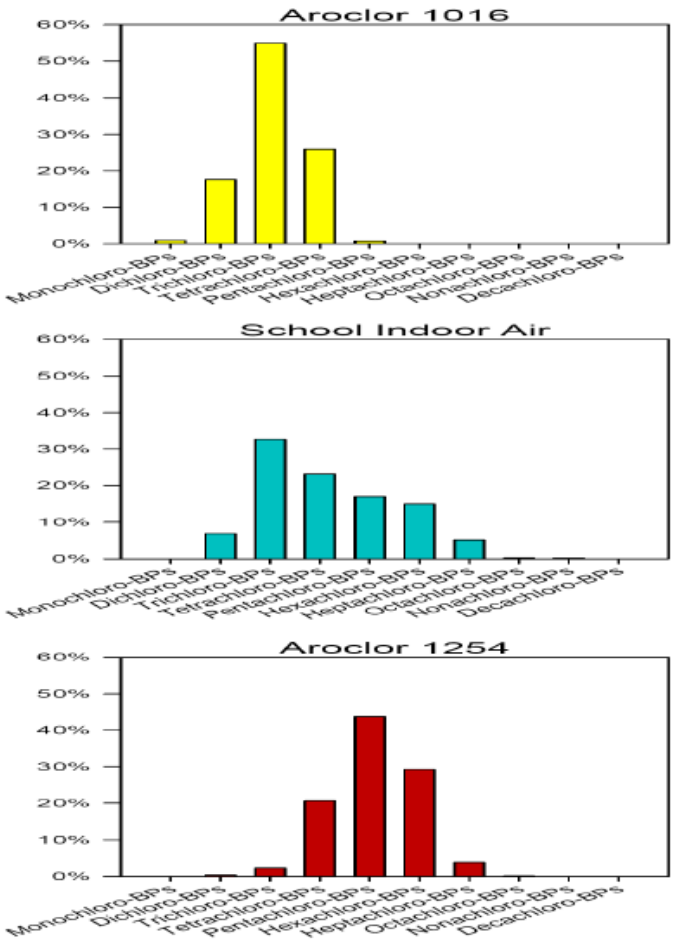
Aroclors (8082A)	Homologs (680)	Congeners (1668B)
Aroclor 1016 Aroclor 1221 Aroclor 1232 Aroclor 1242 Aroclor 1248 Aroclor 1254 Aroclor 1260 Aroclor 1262 Aroclor 1268 Total PCB Report organized and summed by Aroclor pattern.	Monochlorobiphenyls Dichlorobiphenyls Trichlorobiphenyls Tetrachlorobiphenyls Pentachlorobiphenyls Hexachlorobiphenyls Heptachlorobiphenyls Octachlorobiphenyls Nonachlorobiphenyls Decachlorobiphenyl Total PCBs Report organized by homolog group (by number of chlorine atoms) and summed.	A snipit from a wetland sediment sample round from a project. 81-TeCB - 3,4,4',5-Tetrachlorobiphenyl 77-TeCB - 3,3',4,4'-Tetrachlorobiphenyl 123-PeCB - 2',3,4,4',5-Pentachlorobiphenyl 118-PeCB - 2,3',4,4',5-Pentachlorobiphenyl 114-PeCB - 2,3,4,4',5-Pentachlorobiphenyl 105-PeCB - 2,3,3',4,4'-Pentachlorobiphenyl 126-PeCB - 3,3',4,4',5-Pentachlorobiphenyl 167-HxCB - 2,3',4,4',5,5'-Hexachlorobiphenyl 156,157-HxCB 2,3,3',4,4',5-Hexachlorobiphenyl + 2,3,3',4,4',5'-Hexachlorobiphenyl 169-HxCB - 3,3',4,4',5,5'-Hexachlorobiphenyl 189-HpCB - 2,3,3',4,4',5,5'-Heptachlorobiphenyl Individual congeners reported, except that


Response
UNRESLOVED MIXTURE
AROCLOR 1016/1260
AROCLOR 1254
2600000
2500000
2400000
2300000
2200000
2100000
2000000
1900000
1800000
1700000
1600000
1500000
1400000
1300000
1200000
1100000
1000000
900000
800000
700000
600000
500000
400000
300000
200000
100000
0
AROCLOR 1254
AROCLOR 1016
AROCLOR 1260
UNRESOLVED MIXTURE
Time
7.50
8.00
8.50
9.00
9.50
10.00
10.50
11.00
11.50
12.00
12.50
13.00
13.50

AROCHLOR VS HOMOLOGUE?

Estabrook School (Lexington MA) Investigation

- EH&E (2011) Report
- Site-specific risk assessment
- Homologue pattern (at right) used to justify alternate Aroclor 1016 RfD



Some Pros and Cons of the Analytical Methods

Method	Pro	Con
Aroclors (8082A)	▪ Relatively inexpensive (<$100/sample) ▪ Widely available analytical service	▪ Affected by weathering ▪ Although still used, it is not the best for air sampling
Homologs (680)	▪ Good estimate of total PCBs ▪ Overcomes weathering of Aroclors ▪ Good option for air analysis (Aroclors may not evaporate as tech. mixtures) ▪ More accurate-no human interpretation	▪ Expensive (~$300/sample) ▪ A service not offered by all laboratories
Congeners (1668B)	▪ Provides a breakout of all the individual PCB chemicals present ▪ Provides quantitation of the dioxin-like congeners ▪ Provides added flexibility in a risk assessment. More accurate (not dependent on human interpretation)	▪ Expensive (~$800/sample) ▪ Few laboratories offer the analysis (less than with homologs) ▪ Not all of the laboratories do it well (engage your QC chemist)
Screening kits (various)	▪ Cheap ▪ May help with faster delineation	▪ Subject to interferences ▪ Generally higher detection limits ▪ Not determinative ▪ No standing under the CAM in Massachusetts ▪ Not an option for risk assessment

Activities to Date

- September 2009 caulk guidance - fact sheets, Q & A's, Schools Information Kit
- *Steps to Safe Renovation and Abatement of Buildings that have PCB-Containing Caulk*
- Developed public health levels for PCBs in indoor air for schools
- ORD Research – PCB mitigation and exposures assessment in buildings
  - Papers to be published in near future
- December 2010 (ballast guidance)
- Ship Sampling Guidance
- *PCB bulk product waste* reinterpretation

http://www.epa.gov/epawaste/hazard/tsd/pcbs

PROPOSED / NEW CHANGES

- April 2010 ANPRM PCB Uses
- June 2011 – Disaster Debris Guidance
- September 2012 - Revisions to Manifesting Regulations (direct final)
- Upcoming – Ship Sampling Guidance

Contacts and PCB Info

- Kimberly Tisa – USEPA Region 1 PCB Coordinator

  617-918-1527 (direct)
  tisa.kimberly@epa.gov

  Katherine Woodward, Project Manager
  617-918-1353
  woodward.katherine@epa.gov

- Caulk Hotline: 888-835-5372

- *http://www.epa.gov/epawaste/hazard/tsd/pcbs*

- *http://www.epa.gov/region1/cleanup/pcbs/index.htm*

Questions and Discussion