Public Comment Release
Evaluation of Indoor Environmental Conditions and Potential Health Impacts
New Bedford High School
September 27, 2011

Massachusetts Department of Public Health
Bureau of Environmental Health

Suzanne K. Condon, Associate Commissioner
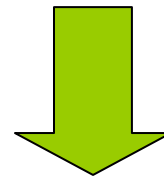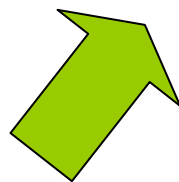**Director, Bureau of Environmental Health**

Presentation Outline

- **Introduction and Background**

- **IAQ Investigation**

- **PCB Exposure Assessment**

- **PCB Serum Testing Results**

- **Health Concerns and Cancer Incidence Evaluation**

- **Questions and Discussion**
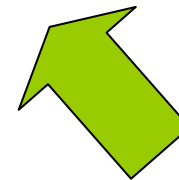
MDPH Bureau of Environmental Health

Indoor Air Quality
Program

NBHS Evaluation

Environmental Toxicology
Program

Community Assessment
Program

Scope of NBHS Evaluation

- Evaluation of indoor environmental conditions and health concerns

  - Comprehensive IAQ assessment

  - Interviews with staff regarding health and IAQ concerns

  - Evaluate health concerns and pattern of cancer among staff members diagnosed with cancer

  - Evaluation of indoor PCB sampling data collected at NBHS to estimate potential health risks

  - Blood serum PCB testing offered as a public service

Indoor Air Quality Program

Indoor Air Quality Evaluation

Methods – IAQ

Assessment Dates

- April 29-30, 2008 – General Indoor Air Quality Assessment

- July 9, 2008 – Assessment of moisture conditions after several days of wet weather

Methods – IAQ

- Visual inspection for water damage and/or microbial growth

- Measurements taken under normal operating conditions of:
  - Carbon dioxide (CO_2)
  - Ambient temperature
  - Relative Humidity
  - Particulates (2.5 micrometers and less)

- Surface temperature of walls, floors, univents

Results – IAQ

- Ventilation

  - On 4/29/2008, CO_2>800 ppm in over half (115) of the 223 areas surveyed – indicating lack of adequate air change

  - On 4/30/2008, no areas exceeded 800 ppm CO_2 – however, half of these areas (E and F Blocks) were empty or sparsely populated
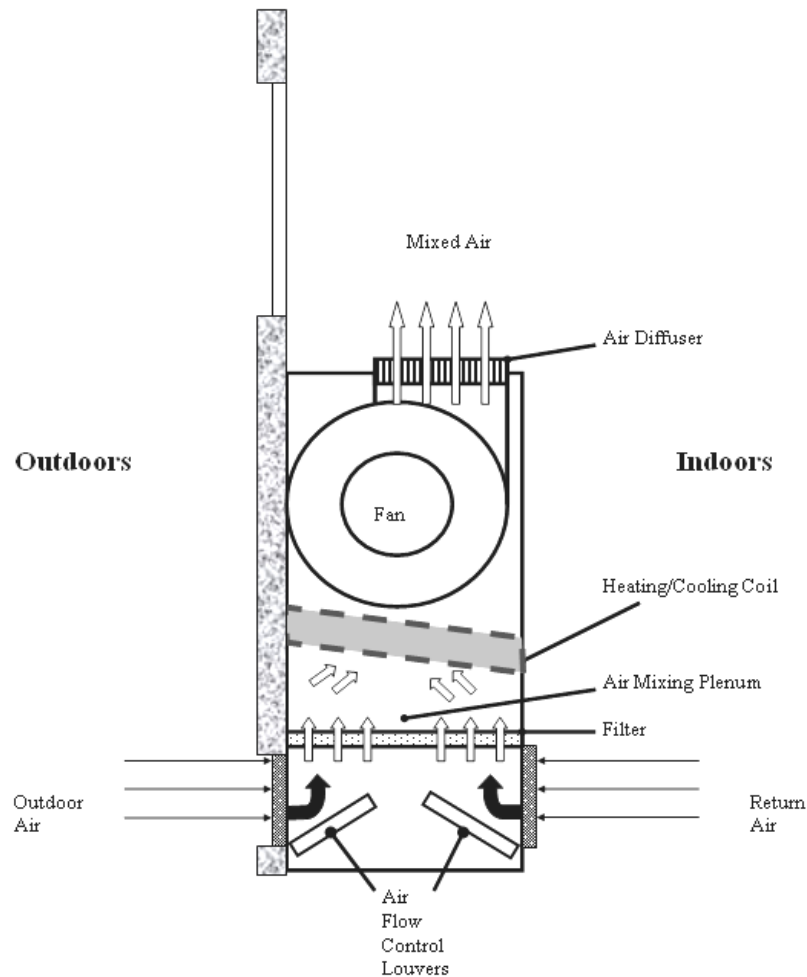
New Bedford High School Building Layout - HVAC system
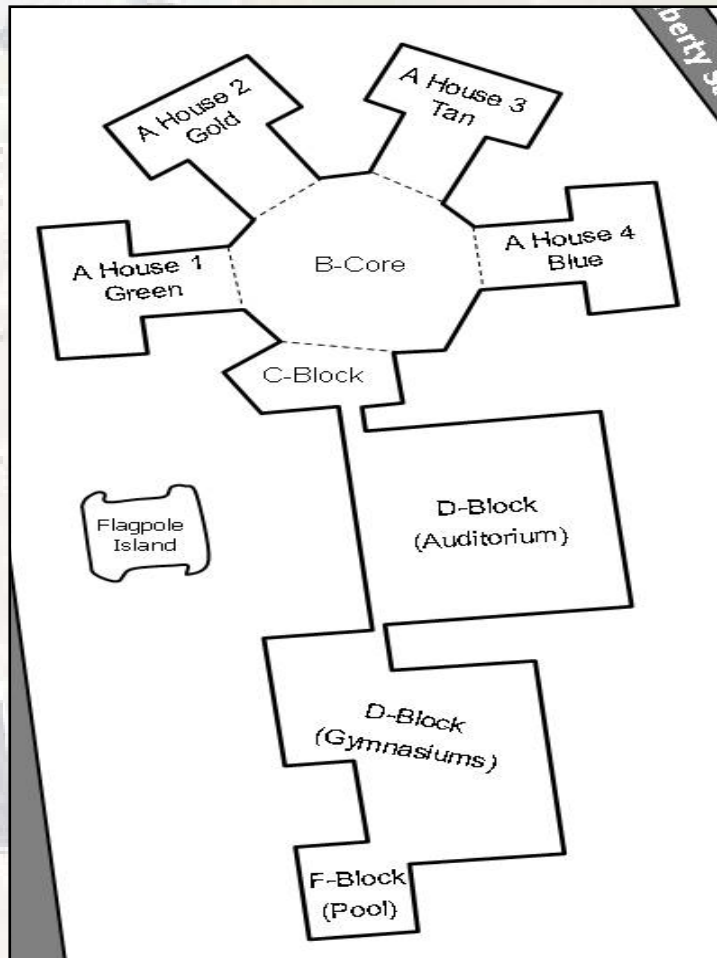
- Univents
  - A Houses
  - D-Block Classrooms on exterior walls
- Air Handling Units
  - B-Core
  - C-Block
  - D-Block
  - E-Block
  - F-Block

Results – IAQ

Typical Unit Ventilator (Univent) Installation

Mixed Air

Air Diffuser

Outdoors

Indoors

Fan

Heating/Cooling Coil

Air Mixing Plenum

Filter

Outdoor Air

Return Air

Air Flow Control Louvers

- General Observations

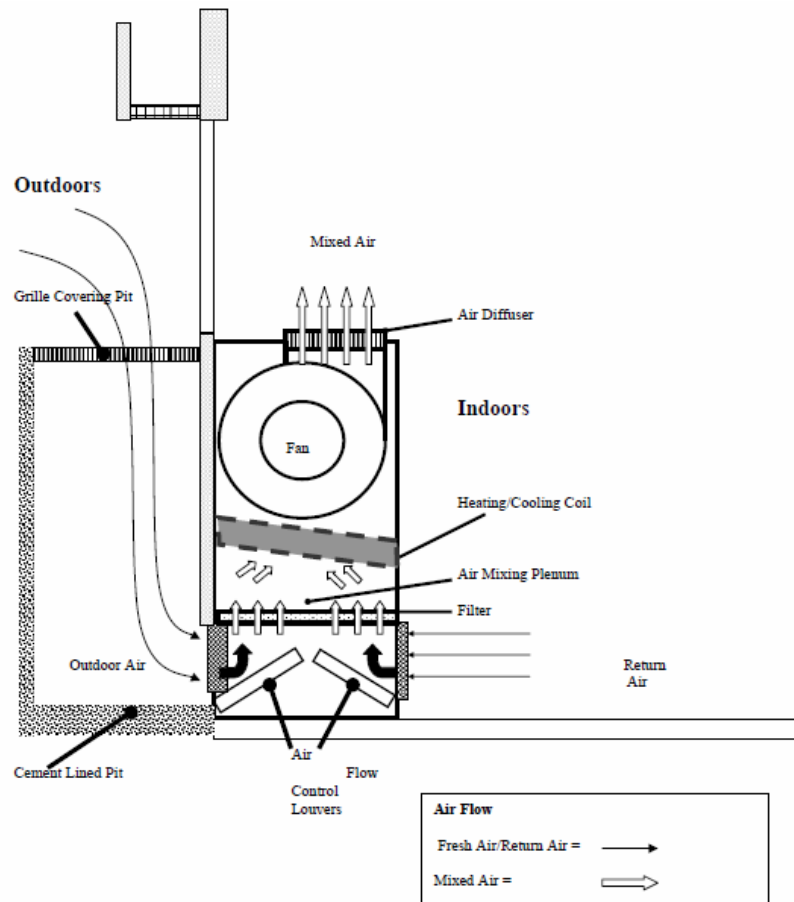 - Unit ventilators supply fresh air in A-Block classrooms and outer core of B-Block

  - Univents were deactivated in many areas

  - Obstructions to airflow observed in may areas

Results – IAQ

Ground Floor Unit Univent Configuration
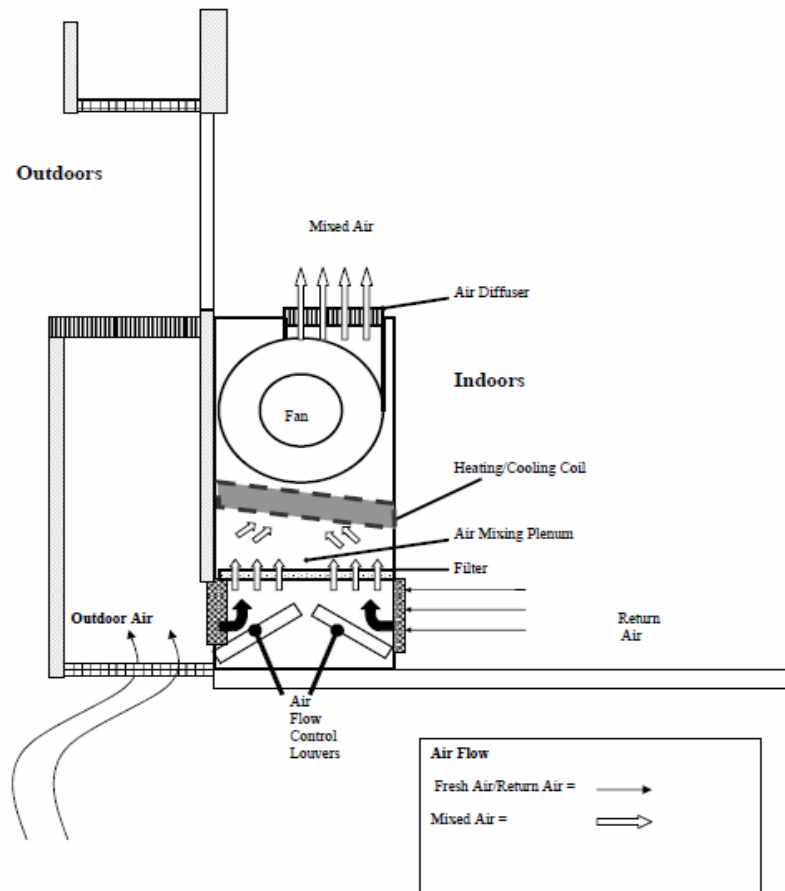

- Ground floor fresh air intakes in cement-lined pits

- Bird screens covering pits often covered with thick layer of pine needles

- Debris often observed in pits

Results – IAQ

2nd and 3rd Floor Unit Univent Configuration

- Fresh air intakes behind spandrel panel

- Cement windowsill caps space between exterior wall and spandrel

- Metal grate located at bottom of spandrel

Results – IAQ

- **Air intake grates were damaged and missing**

- **Bird nesting behind the spandrels**

- **Bird Waste**
  - **Diseases associated with exposure**
    - **May affect both healthy and immune compromised people**
    - **Hypersensitivity pneumonitis**
    - **Psittacosis**

- **Grate repair**
- **Cleaning & disinfection**

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Results – IAQ

Other HVAC Mechanical Systems

- Air-handling units (AHUs) provide ventilation in large areas and some offices and classrooms

- No airflow detected in many areas at time of assessment

- Specialized Exhaust Ventilation

  - Restroom exhaust fans were off at the time of assessment

  - Auto shop exhaust ventilation not operating during assessment

Results – IAQ

Pool odors

- **HVAC in pool area not exhausting air**

- **Pool odors observed ~500 ft from pool**

- **Relative humidity**
  - **In pool = 60%**
  - **In hall = 70% (10% > than pool)**

- **Evidence of water damage observed on wall above doorway to pool stairwell and ceiling in hallway**

- **Efflorescence observed on both the interior and exterior walls of the pool**
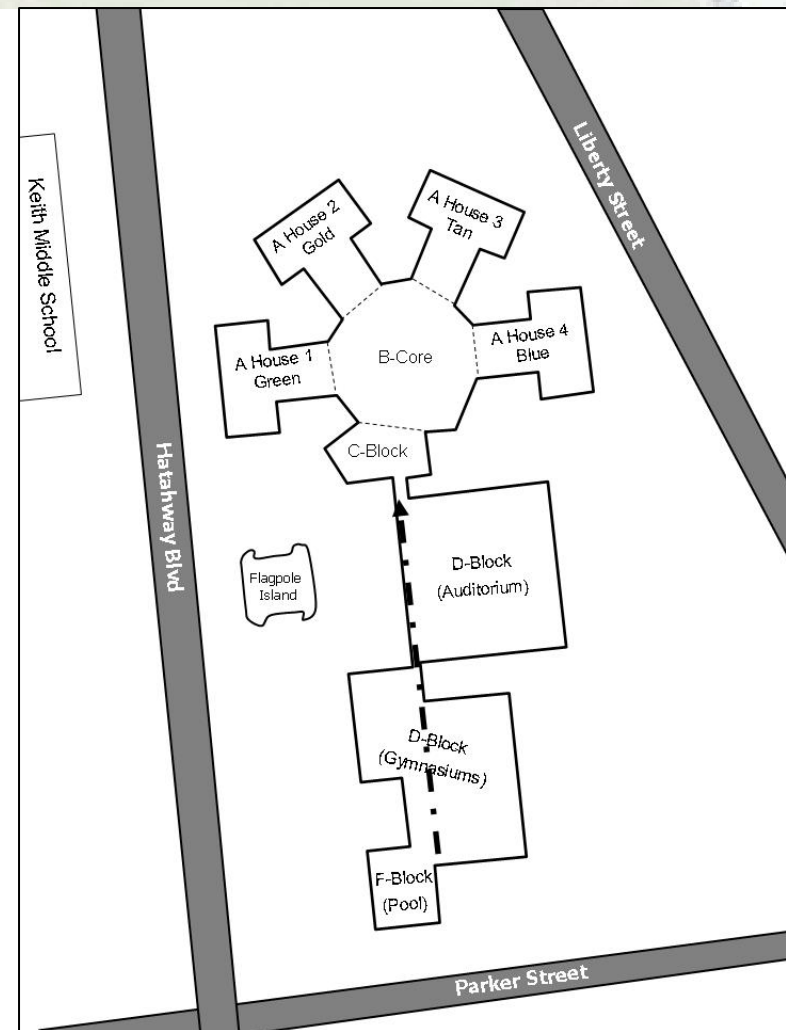
Results – IAQ

- Pool Odors

Results – IAQ

Condensation in lower level of NBHS

- **Staff reported water on floors in ground level throughout building**

- **Univent intakes covered with pine needles from trees adjacent to the A Houses, holding moisture inside air intake pit**

- **Floor temperatures in 42 of 51 rooms at or below dew point**

- **Observed swollen floor glue**

- **Evidence of chronic condensation problem near freezer in kitchen, cold air leaking from freezer door**

Results – IAQ

Building-wide Issues
- Leaks
  - Roof
  - Windows
  - Observed area of visible mold
- Breaches exterior walls
- Plants

Results – IAQ

Building-wide Issues (continued)

- Plant and moss growth

- Shrubs/trees close to building

- Breaches in exterior of building

Results – IAQ

Other IAQ Concerns

■ No measurable levels of carbon monoxide detected

■ PM 2.5 below NAAQS, except for in restrooms due to smoking and deactivated exhaust ventilation

Results – IAQ

Other IAQ Concerns

- Observed sources of VOCs in some classrooms
  - Air fresheners and reed diffusers
  - Cleaning products
  - Dry erase boards and markers
- Accumulated dust
  - On air diffusers and exhaust vents
  - On personal fans
  - On items stored in classrooms
  - Chalk dust and pencil shavings

Results - IAQ

- Recommendations will be made in several areas:
 - Pool area
  - HVAC system
  - Mold and moisture issues

Environmental Toxicology Program

Evaluation of Indoor Air Data
&
PCB Exposure Assessment

Introduction – Exposure Assessment

What are PCBs?

- Polychlorinated biphenyls (PCBs) refer to a class of chemical compounds with 209 possible congeners in which chlorine atoms have replaced some or all of the hydrogen atoms in the biphenyl molecule.

- Were historically used in electrical components (e.g. capacitors) and in building materials (e.g. caulking), among other uses

- PCBs were sold in the U.S. commercially as mixtures known by the trade name Aroclor (e.g. Aroclor 1254)
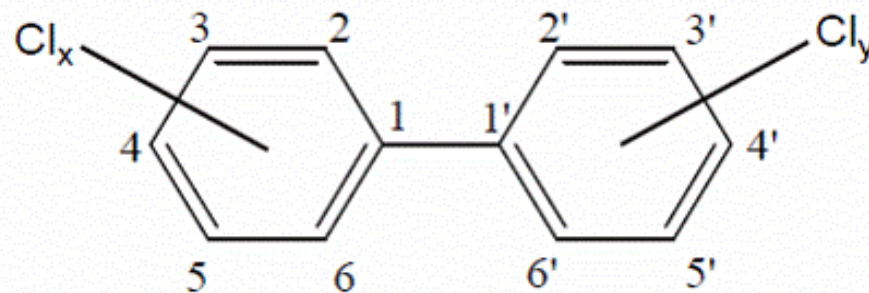
Introduction – Exposure Assessment

PCB exposure and cancer

- Although the epidemiological evidence is sometimes conflicting, most health agencies have concluded that PCBs may reasonably be anticipated to cause cancer.

Methods – Exposure Assessment

- Environmental Toxicology Program (ETP) staff evaluated indoor PCBs testing data from 2006 through Feb 2011

  - Air, wipe, and bulk samples

    - Air samples most relevant for potential health impacts

  - Developed quantitative estimates of health risks associated with opportunities for PCB exposure

  - Reviewed indoor air results by floor/wing

  - Evaluated across sample types in areas where multi-media samples collected

  - Compared PCB levels to results of the IAQ evaluation (e.g., rooms with poor ventilation may have higher levels of PCBs)

Methods – Exposure Assessment

Health-Based Screening Values

- Used to determine whether chemicals found at a location need further evaluation

- Specific to each chemical and each environmental medium (i.e., air)

- Generated by U.S. ATSDR, U.S. EPA, etc

- Based on scientifically peer-reviewed values

- Available for PCBs in air: ATSDR Cancer Risk Evaluation Guide (CREG) = 0.01 μg/m^3
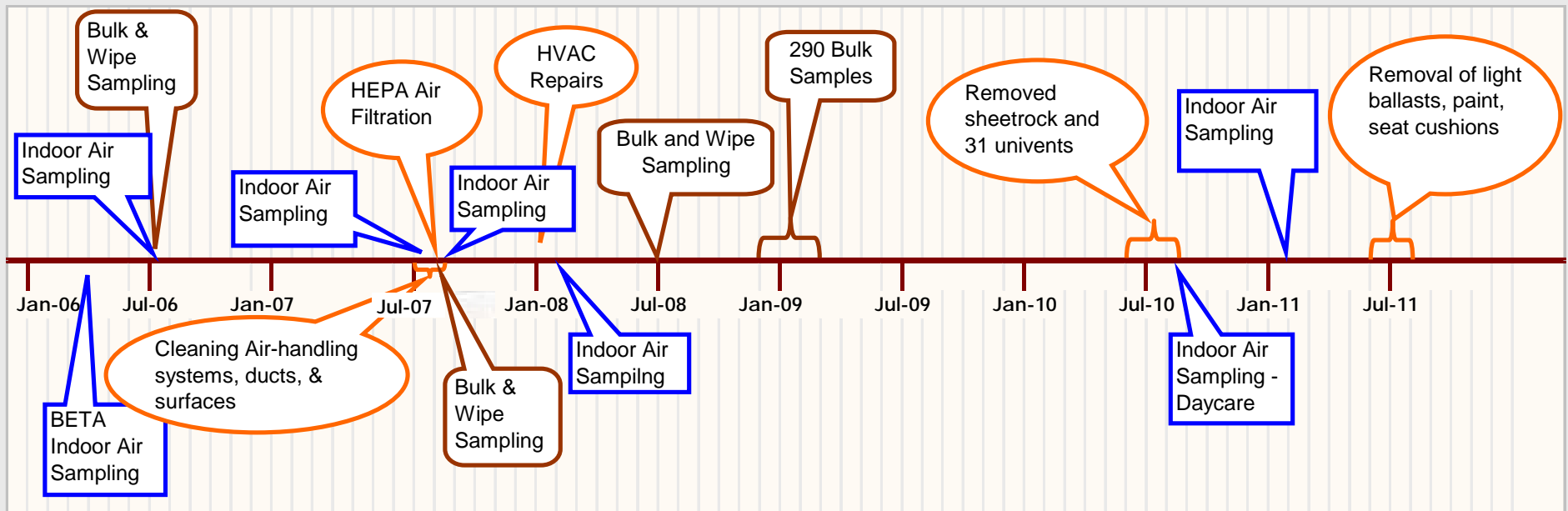
Methods – Exposure Assessment

Clean-up Standards and Guidelines

- Used to determine whether chemicals need to be cleaned/removed
- Available for PCBs in surface wipes
  - CA clean up guidance (0.1 µg/100cm^2)
  - EPA regulatory clean up standard (10 µg/100cm^2) for residential settings

Results – Exposure Assessment

Timeline of Indoor Sampling for PCBs

Results – Exposure Assessment

- Overview of Indoor Air Sampling 2006-2008
  - 89 samples collected from 30 locations inside NBHS
    - 75 of 89 samples > CREG
    - 24 of 30 locations had CO_2 measurements
      - 20 of the 24 with CO_2 measurements > CREG
        - 9 locations > CREG had CO_2 levels > 800 ppm
        - 11 locations > CREG had CO_2 levels < 800 ppm <u>but had low to no occupancy</u>
        - 4 locations < CREG had CO_2 levels < 800 ppm
- Inadequate ventilation likely contributed to higher PCB levels in indoor air

Results – Exposure Assessment

Environmental Testing

- A comparison of PCB and CO2 levels suggests that when ventilation is adequate, PCB levels are lower

CO_2

PCBs

Results – Exposure Assessment

- **Overview of Indoor Air Sampling (continued)**
  - Daycare sampled in Aug 2010 and Feb 2011
    - < CREG and ND
  - Feb 2011 48 samples collected
    - 25 of 48 samples had detectable levels of PCBs
    - 17 of 25 detects > CREG
    - 3 classrooms closed, PCB residue leaking from fluorescent light ballasts in these rooms
      - Residue removed and air retested (results pending)

Results – Exposure Assessment

- **Overview of Indoor Air Sampling (continued)**

  - **20 of the 48 locations sampled in 2011 had been sampled previously in 2008**

  - **15 new locations sampled**

    - 2 classrooms had highest levels detected at school to date

      - These 2 were among the 3 classrooms closed and PCB residue on light fixtures removed

      - High CO_2 levels in these rooms and IAQ inspection noted sub-optimal ventilation

Results – Exposure Assessment

Cancer Risk Evaluation – Worst Case Scenario

- MDPH/BEH cancer risk estimates assume worst case scenario
  - Adults exposed to max concentration for 8 hours per day, 180 days per year, for 37 years
  - Students exposed to max concentration for 8 hours per day, 180 days per year for 4 years
- Adults: 5-6 excess cancers in a population of 100,000
- Students: 6-7 excess cancers in a population 1,000,000
- Based on federal health agency guidance, the exposure opportunities that resulted in these risk estimates are not expected to result in unusual cancer risk.

Community Assessment Program

PCB Blood Serum Testing

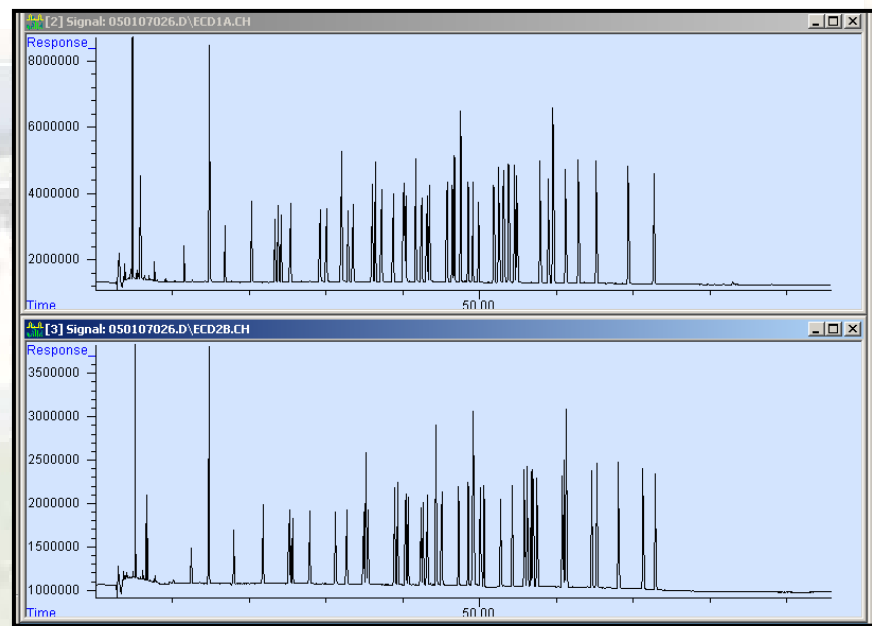# Methods – Serum PCBs Testing

- **Phase I**
  - Outreach activities
  - Exposure assessment questionnaire
- **Phase II**
  - Blood testing offer letters sent
  - Blood sample collection
  - Sample analysis

Methods – Serum PCBs Testing

- Analyzed by MDPH's William A. Hinton State Laboratory Institute

- Results reported as whole weight and lipid-adjusted (adjusted for fat content of serum)

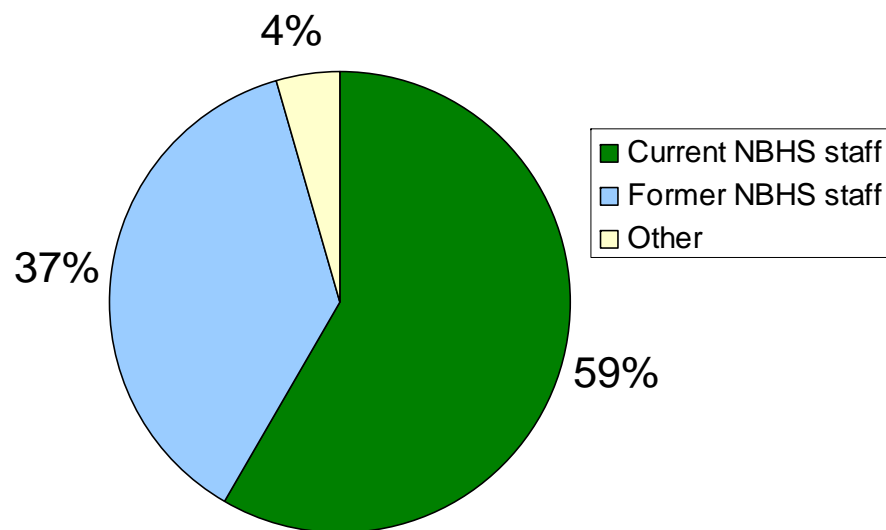# Methods – Serum PCB Testing

- Results compared with U.S. Centers for Disease Control's National Health and Nutrition Examination Survey

- Comparisons based on age group: 12-19 years, 20-39 years, 40-59 years, and 60+ years

- According to the CDC, the 95th percentile is useful for determining whether serum PCB levels are unusual

2009

Fourth National Report on Human Exposure to Environmental Chemicals

Results – Serum PCB Testing

- This report summarizes the results for 67 people

School Affiliation

4%

37%

59%

- Current NBHS staff
- Former NBHS staff
- Other

Participant Age Groups

1% 7%

33%

59%

- 12-19 years
- 20-39 years
- 40-59 years
- 60+ years
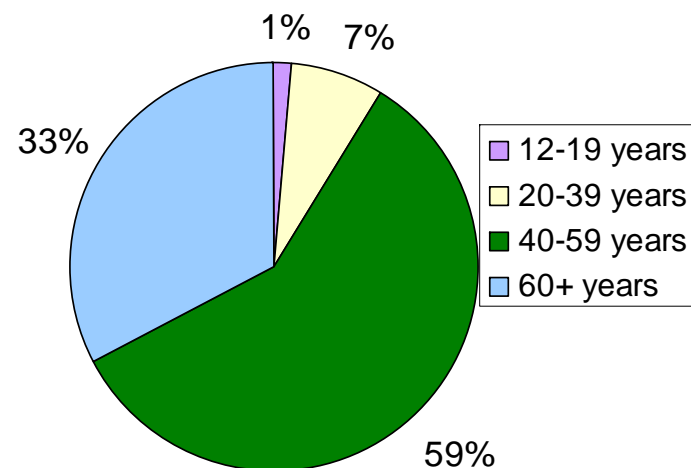
Results - Serum PCB Concentrations (Whole Weight)
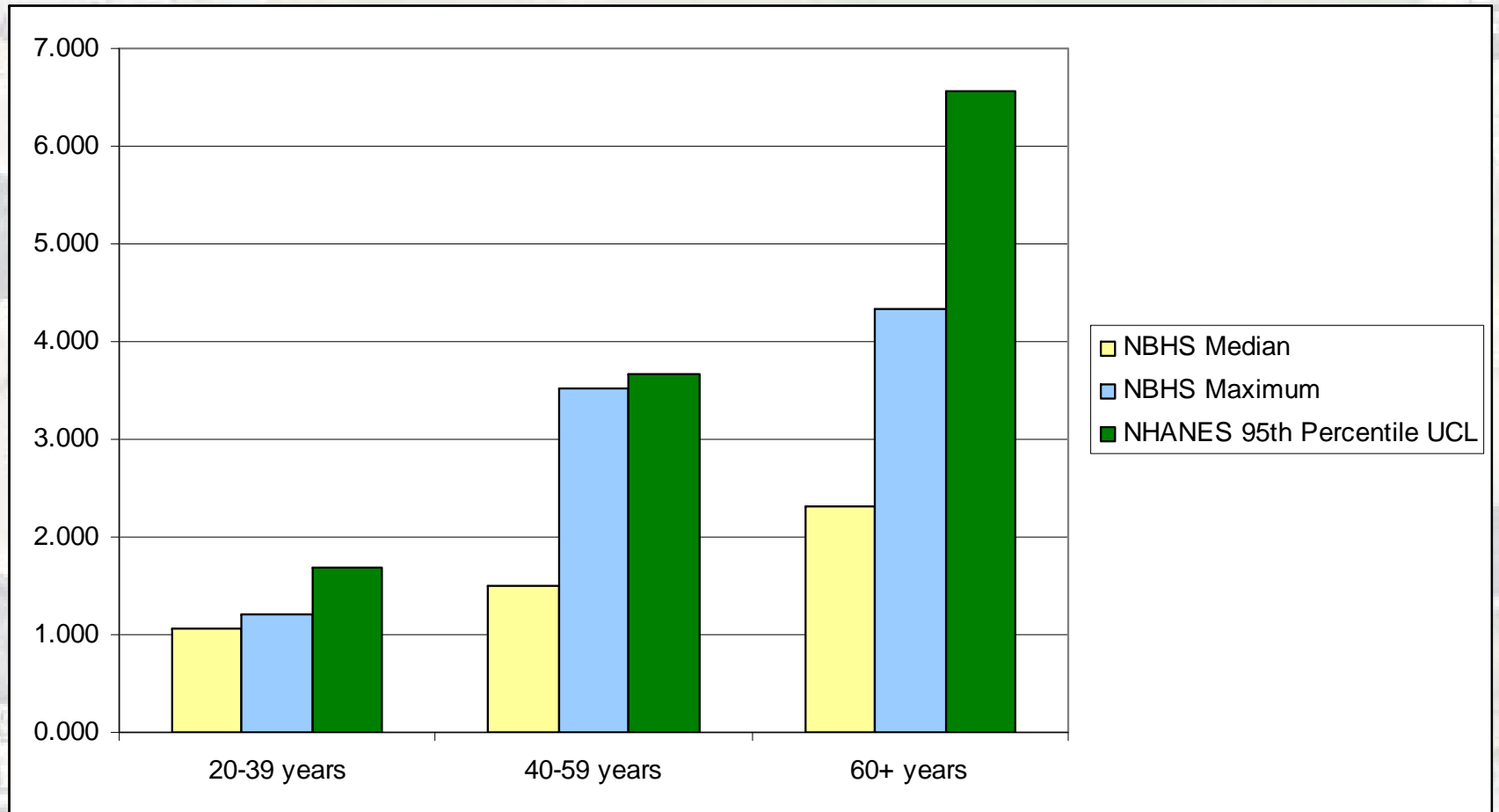
Results - Serum PCB Concentrations (Lipid-Adjusted)
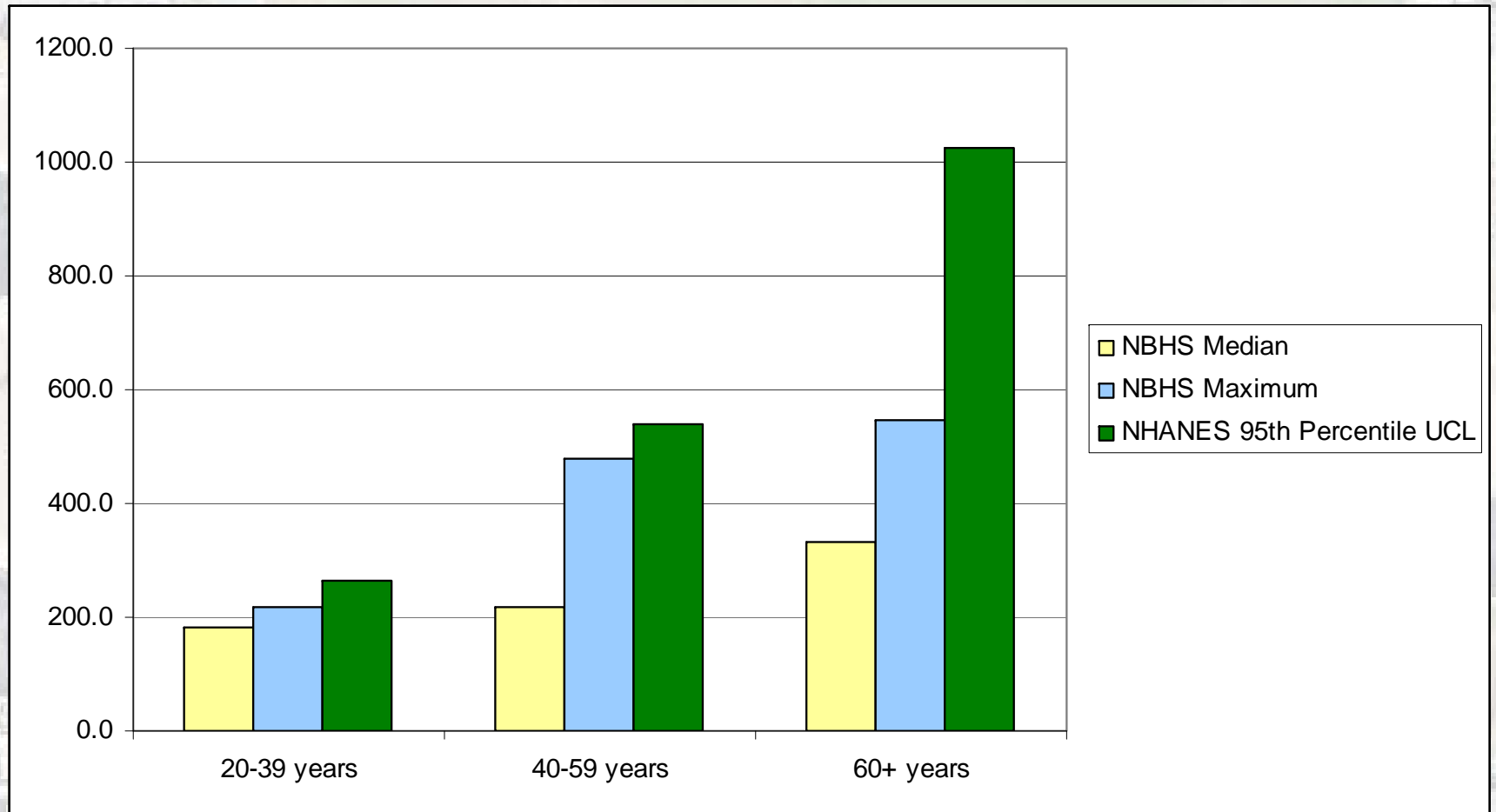
Results –
Geometric Mean Whole Weight Serum PCB Levels (ppb) by Years Worked at NBHS

Whole Weight

Legend:
- ☐ Worked 0-14 years
- ■ Worked 15-37 years

Categories:
- 40-59 years Current & Former Staff
- 60+ years Current & Former Staff
- 40-59 years Current Staff Only
- 60+ years Former Staff Only
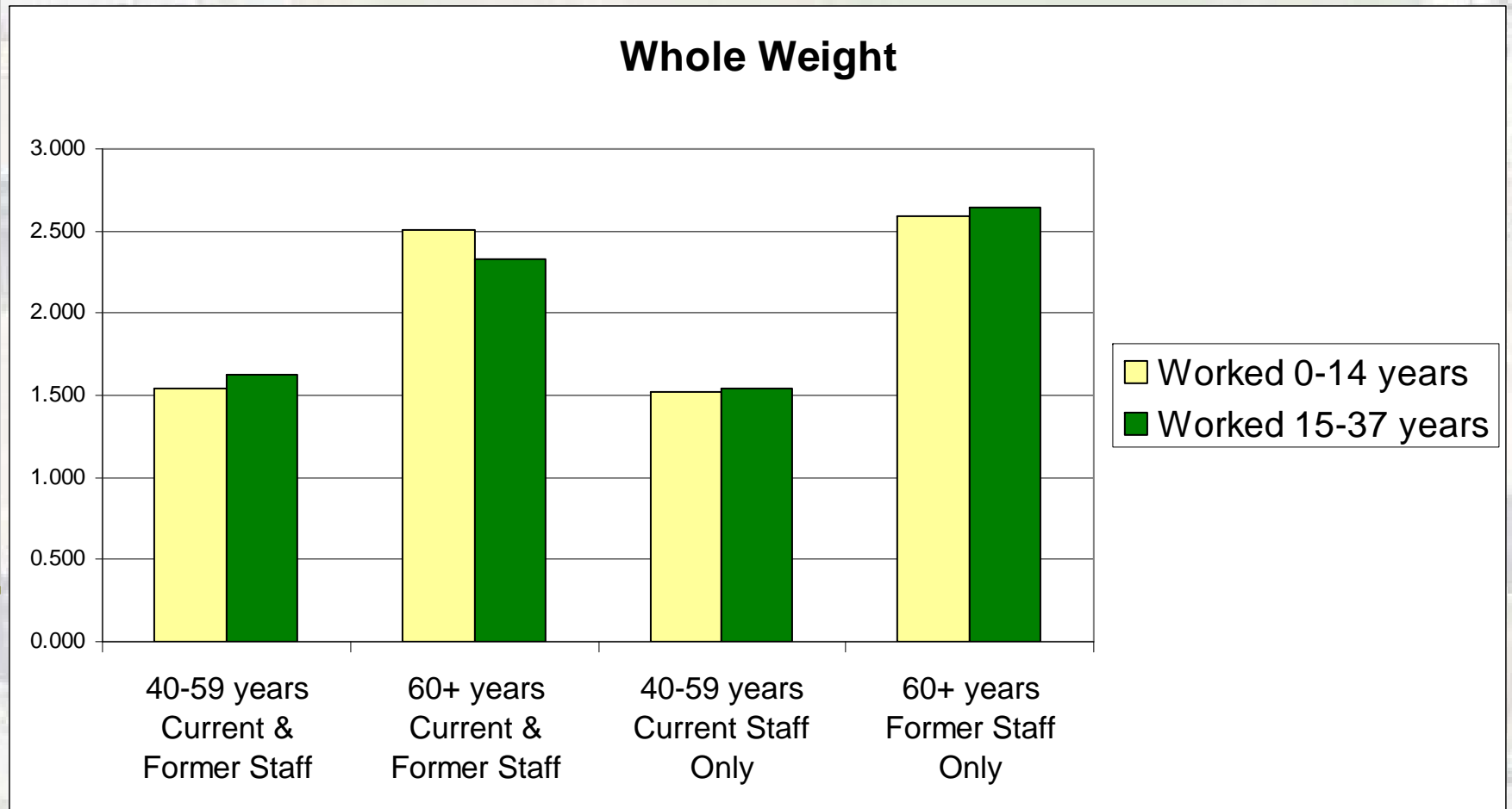
Results –
Geometric Mean Lipid-Adjusted Serum PCB Levels (ppb) by Years Worked at NBHS

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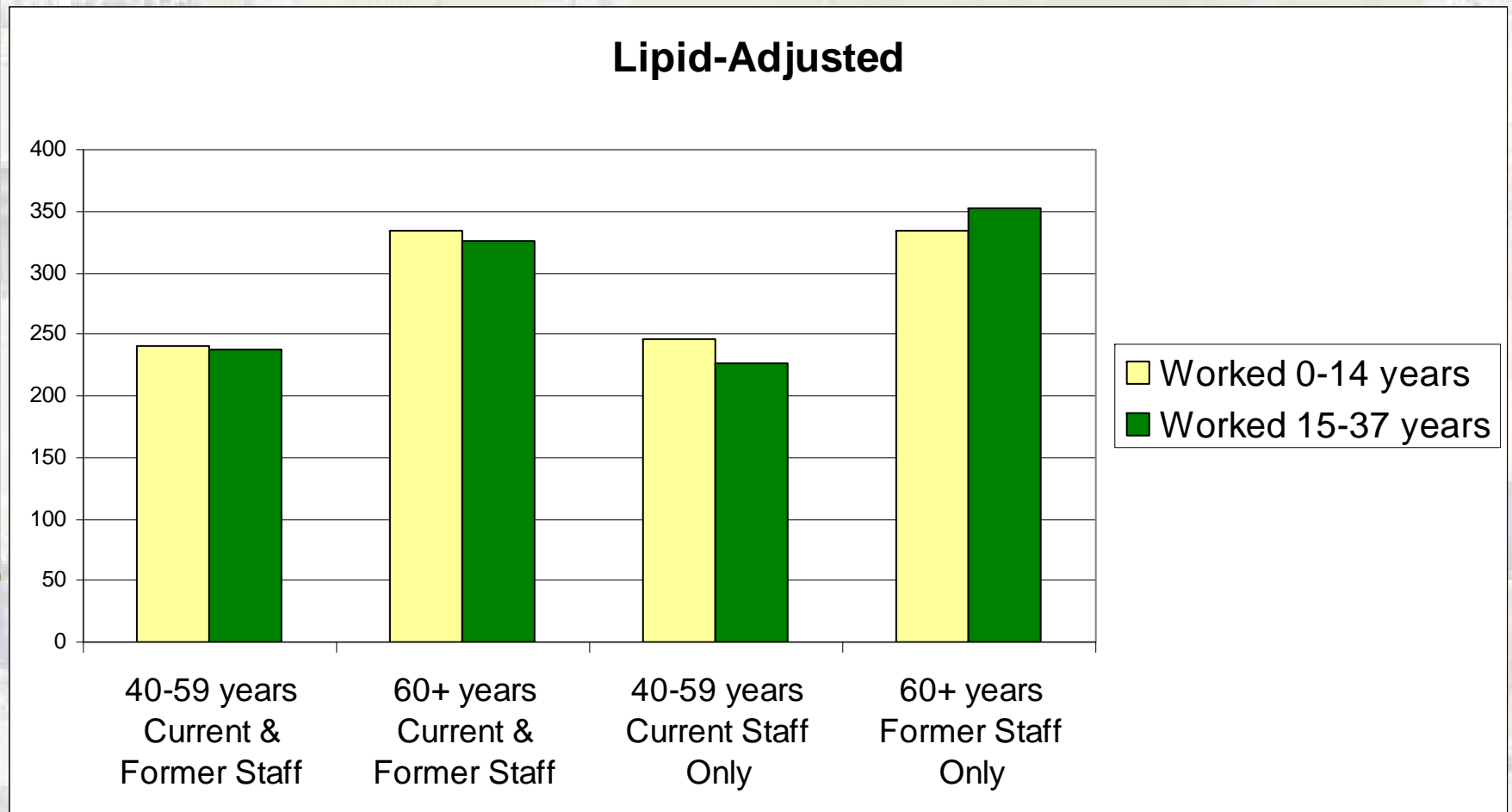
Results – Serum PCB Levels Compared with Building Location

- Asked where staff spent the majority of their time inside NBHS

- Most participants indicated that they work or worked in various locations throughout NBHS

- 10 participants identified specific rooms

- 21 reported spending most of their time in one block or house

- No consistent pattern of higher serum PCB levels with higher indoor air levels

Results – Serum PCB Level in Participants Diagnosed with Cancer

- 6 participants diagnosed with cancer in the last 20 years

- 1 of these 6 reported working in one of the rooms where indoor air samples were collected for PCB analysis

- Detected indoor air concentrations were among the lowest detected in the school

- The serum PCB concentrations for all six participants are within the range of levels measured in the NHANES 2003-2004 survey

Results – Serum PCB Levels Compared with Years Worked at KMS

- 14 of the 67 participants work or worked at KMS for 1 to 3 years

- PCB concentrations in air consistently below health-based comparison values

- Remedial work prior to construction has eliminated the potential for contact with contaminated soil on the KMS property

- Qualitative review found no clear pattern of higher serum PCB levels with more years worked at KMS

Results – Serum PCB Levels Compared with Years Worked at the Former Keith Middle School

- 26 of the 67 participants work or worked at KMS for 1 to 20 years

- Serum PCB levels (by age group) versus the number of years they reported working at the Former Keith Middle School were examined

- Qualitative review found no clear pattern of high serum PCB levels with more years worked at KMS

Community Assessment Program

Health Concerns and Cancer Incidence

Methods – IAQ Health Concern Evaluation

Information regarding NBHS employee health concerns were gathered from the following sources:

- BEH conducted interviews with NBHS staff at the time of the IAQ inspections at the school (April 29 and 30, 2008);

- An MDPH contractor conducted exposure assessment interviews with some current and former NBHS staff as part of the PCB blood serum testing program;

- A petition, signed by NBHS staff, requesting a health assessment and medical testing was sent to the former Director of the NBHD, and forwarded to MDPH;

- Supplemental information collected and distributed by a local advocacy group obtained via an email; the email distribution list included BEH.

Methods – IAQ Health Concern Evaluation

- All information was reviewed to identify:
  - the types of symptoms reported,
  - their frequency of occurrence,
  - any unusual patterns
- Analysis Response Classification
  - Asthma
  - Other Respiratory Symptoms
  - Allergy Symptoms
  - Central Nervous System Effects

Results – IAQ Health Concern Evaluation

IAQ Interview Results (n=42)

- Respiratory effects (n=33)
  - Sinus congestion
  - Upper respiratory infection
  - Colds
- Allergy symptoms (n=14)
- CNS symptom (n=23)
  - Headaches

Results – IAQ Health Concern Evaluation

Exposure Assessment Interview Results (n=67)

- Respiratory effects (n=9)
  - Sinus congestion
  - Runny nose
  - Sore throat
- Allergy symptoms (n=8)
- Asthma (n=3)
- CNS effects (n=6)
  - Fatigue and/or tiredness

Results – IAQ Health Concern Evaluation

Symptomology and building location

- 36 individuals reported working predominantly in one location during the work day

  - CO_2 levels were above the recommended 800 ppm in about half of these rooms

Results – IAQ Health Concern Evaluation

General Indoor Air Quality (n=109)

- 24 reported problems with the ventilation
- 13 reported concerns regarding the presence of mold/water damage in the school
- 13 reported the presence of excessive dust
- Indoor temperatures and concerns regarding pests were also mentioned

Results – Cancer Pattern Evaluation

Evaluating Cancer Patterns

- What types of cancer are involved?

- Do the cancer types share similar etiologies (i.e., causes/characteristics)?

- How does the relative frequency of the various types of cancer reported compare to what is known about the occurrence of cancers in the population of Massachusetts as a whole?

- Are there an unusual number of rare cancers?

Results – Cancer Pattern Evaluation

Facts About Cancer

- Cancer is not one disease but a group of different diseases

- There are more than 100 types of cancer, each with different risk factors

- One or several factors acting over time can cause cancer

Results – Cancer Pattern Evaluation

Facts About Cancer

- American Cancer Society estimates
  - 1 out of every 2 men
  - 1 out of every 3 women
  - 3 out of every 4 families
  - → Will develop cancer in their lifetime
- Cancer has a long development period (can range from 15 to 40 years)

Results – Cancer Pattern Evaluation

Cancers in the Community

- Calculate an expected rate, SIR and 95% CI
- Review individual diagnosis information
  - Age at diagnosis
  - Cancer sub-type
  - Tobacco use
- Review spatial pattern of address at diagnosis

Results – Cancer Pattern Evaluation

Cancers in the Workplace

- Types of cancer among staff
- Age and gender of staff in relation to cancer types
- Possible workplace exposure(s)
- Length of employment and work space within workplace
- Development (Latency) period
- Biological plausibility between exposure and disease

Results – Cancer Pattern Evaluation

The Massachusetts Cancer Registry (MCR)

- The MCR began collecting cancer incidence data in 1982

- The MCR collects data on all newly diagnosed cancer cases in the state by city or town

- Hospitals have 6 months to report a newly diagnosed cancer case to the MCR

- After receiving the data, the MCR performs extensive quality control, checking each case for errors and removing duplicates

Results – Cancer Pattern Evaluation

149 individuals reported to MDPH

71 unconfirmed

78 confirmed in MCR

6 from PCB Serum testing

72 from advocacy group list

39 no further information

32 reported as deceased

22 no further information

10 death records found

83 individuals with a confirmed cancer diagnosis

5 no mention of cancer on death record

5 cancer reported on death record
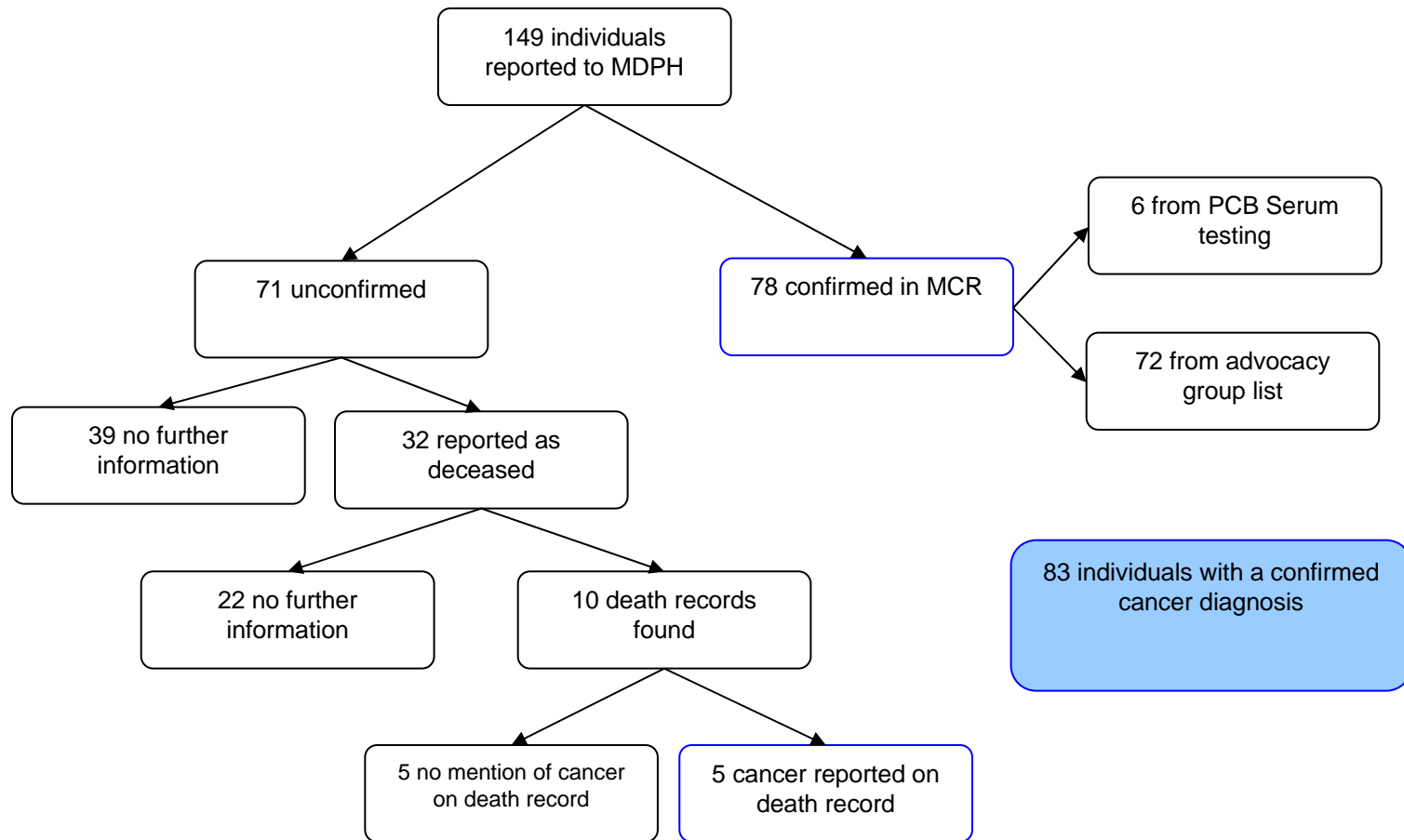
Results – Cancer Pattern Evaluation

Cancer Concerns

- 83 individuals identified as having a cancer diagnosis
  - 26 different cancer types
    - breast cancer (n=24),
    - colorectal cancer (n=7),
    - prostate cancer (n=6),
    - lung cancer (n=5)
  - Diagnoses occurred over a 29-year period (1982-2010)

Results – Cancer Pattern Evaluation

- MDPH received reports of 24 women diagnosed with breast cancer over about 30 years
  - Most common cancer among women
  - Women have a 1 in 8 chance of developing invasive breast cancer during their lifetime
  - Age is the strongest risk factor for breast cancer
    - About 1 in 8 invasive breast cancers in women younger than 45
    - 2 out of 3 invasive breast cancers are in women over 55 years of age
    - Average age at diagnosis for breast cancer diagnoses reported to MDPH is about 55 years of age

Results – Cancer Pattern Evaluation

- Risk factors
  - Age
  - Genetics and family history
  - Other breast conditions (e.g., dense breast tissue)
  - Alcohol consumption
  - Women who work in professional jobs, including teachers, tend to have an increased risk of developing breast cancer
    - Maternal age at first birth and low parity
    - Likely to have regular mammograms – increases chances of early detection
- Research into possible environmental factors ongoing
  - Compounds found to have estrogen-like properties are of special interest
  - To date, no clear link between breast cancer risk and exposure to these substances

Conclusions – Cancer and Other Related Health Concerns

- Breast cancer was the most common type of cancer reported among NBHS staff

  - Most commonly diagnosed cancer in Massachusetts

  - Affects 1 out of 8 women nationally

  - Schools' staff often made up predominantly of women – so not unusual for breast cancer to be the most frequently diagnosed

  - Pattern is likely to be consistent with other schools of similar size in Massachusetts and the population in general

    - If the 24 diagnoses represent all of the breast cancer diagnoses

    - Without more information, difficult to draw firm conclusions

Conclusions – Cancer and Other Related Health Concerns

- In general, the symptoms reported among staff are most commonly experienced in buildings with less than optimal indoor air quality

- Overall there does not appear to be an unusual pattern of cancer

  - Many different types of cancer diagnosed over more than 29 years,

  - Most frequent diagnoses among NBHS employees are the most common types of cancer diagnosed in the general population.

Conclusions – Serum PCB Testing

■ All individuals who were tested and are associated with the NBHS had serum PCB levels within typical range seen in the U.S. population

■ No consistent pattern of higher serum PCB levels with increasing years of employment or with building location

Conclusions – Exposure Assessment

- Based on federal health agency guidance, the exposure opportunities that resulted in these risk estimates are not expected to result in unusual cancer risk.

- However, MDPH recommends taking steps to reduce/eliminate opportunities for exposure to PCBs
  - Cleaning
  - Enhanced monitoring protocols (e.g. deteriorated caulking materials)
  - Regular maintenance

Conclusions – IAQ

- Deactivation of univents prevents adequate supply of fresh air to classrooms

- Deactivation of exhaust vents
  - Prevents removal of normally-occurring indoor pollutants
  - Prevents removal of other pollutants (pool odors, VOCs, shop pollutants)

- Source of moisture in ground floor areas is condensation resulting from humidification problems in pool area

Recommendations

- Additional bulk sampling not recommended because indoor levels of PCBs seem to be higher during bulk sampling

- Burned out bulbs should be replaced immediately in light fixtures that may contain PCBs

- MDPH understands that PCB containing light ballasts were removed this summer

- MDPH can work with NBHS to develop O&M plans to address cleaning and bulb replacement

Recommendations

- Operate all ventilation equipment when the building is occupied.

- Remove all blockages from univents, univent air intakes, and exhaust vents to ensure adequate airflow.
  - Inspect periodically
  - Consider installing wire mesh bird screens over air intakes to prevent further roosting
  - Clean intake vents with an appropriate antimicrobial or use a professional cleaning company.

Recommendations

- Consult a ventilation engineer

  - to ascertain the best method for increasing fresh air supply in classrooms

  - to plan for the repair and operation of the pool exhaust system

Recommendations

- Clean expanding mastic between tiles in below grade areas. Monitor for humidity, condensation and further expansion of tile mastic.

- Ensure roof/window leaks are repaired and replace water-damaged ceiling tiles. Examine the area above and around these areas for mold growth

Recommendations

- Additional information required to estimate the actual rate of breast cancer

- Information would be needed for all staff employed at NBHS starting at the first year of diagnosis through current year (i.e. 1982 -2011)

  - This is necessary because in order to calculate an accurate rate of breast cancer, an accurate population number is needed

  - Name, DOB, address, employment history, etc.

  - If this is something that people would want, follow-up meeting recommended with City (including the Health Department and School Dept.) and New Bedford Educator's Association

Q&A

…Questions?

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www.mass.gov/dph/environmental_health