Case Study: Substitutions for Non-Detects

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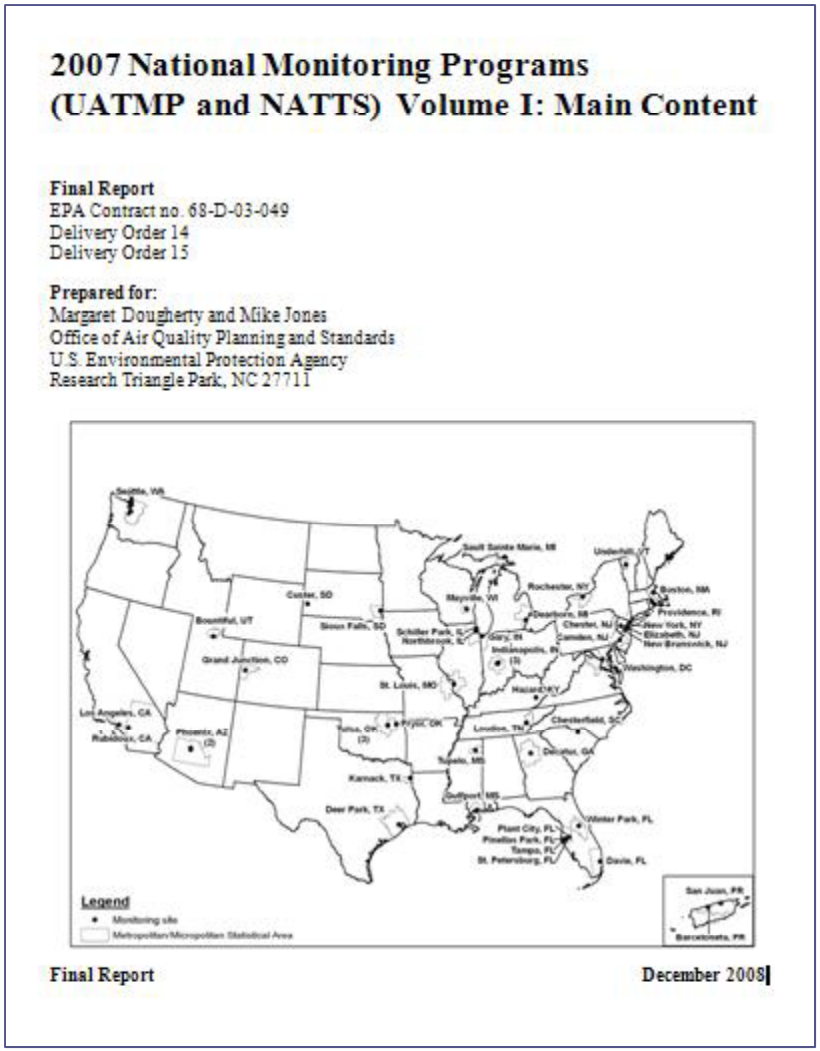
Disclaimer

- These substitutions are only used for performing statistical calculations on a data set.
- In addition, these substitutions are not used for measurements below the MDL. Measurements below the MDL are valid and should be used.
- Per the NATTS TAD, "**EPA policy dictates that all data, to include values below MDL, shall be reported to AQS…Do not report 1/2 MDL or any integer of the MDL…**"

Background

- ½ MDL substitution?
  - Past NMP reports
  - 1999, 2002 NATA Model-to-Monitor Comparison
  - MDLs differ among labs, change over time
- 0 substitution?
  - 2008-2009 NMP report
  - School Air Toxics
  - 2005 NATA Model-to-Monitor Comparison
  - Consistent, 0 is always 0
- Exclude altogether?

National Monitoring Programs Annual Report



2007 National Monitoring Programs (UATMP and NATTS) Volume I: Main Content

Final Report
EPA Contract no. 68-D-03-049
Delivery Order 14
Delivery Order 15

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Final Report **December 2008**

- Past reports used ½ MDL substitutions for risk-based data analyses;
- The 2008-2009 combined report is using 0 substitutions;
- Perfect set up to allow for the comparison of both approaches.

National Monitoring Programs Annual Report

- Data from 2008-2009 Sample Years
- Measurements from NATTS/UATMP/CSATAM sites
- Focus is on the NATTS MQO Core Analytes
- Data generated by the National Contract Laboratory

NATTS MQO Core Analytes

- Formaldehyde
- Acetaldehyde
- Benzene
- 1,3-Butadiene 94%
- Carbon Tetrachloride
- Chloroform 94%
- Tetrachloroethylene 88%
- Trichloroethylene 35%
- Vinyl Chloride 16%
- Hexavalent Chromium 52%
- Naphthalene
- Benzo (a) pyrene 62%
- Arsenic
- Beryllium 77%
- Cadmium
- Manganese
- Lead
- Nickel 96%

*Acrolein is a NATTS MQO Core Analyte, but was excluded from this data analysis

Calculations Presented

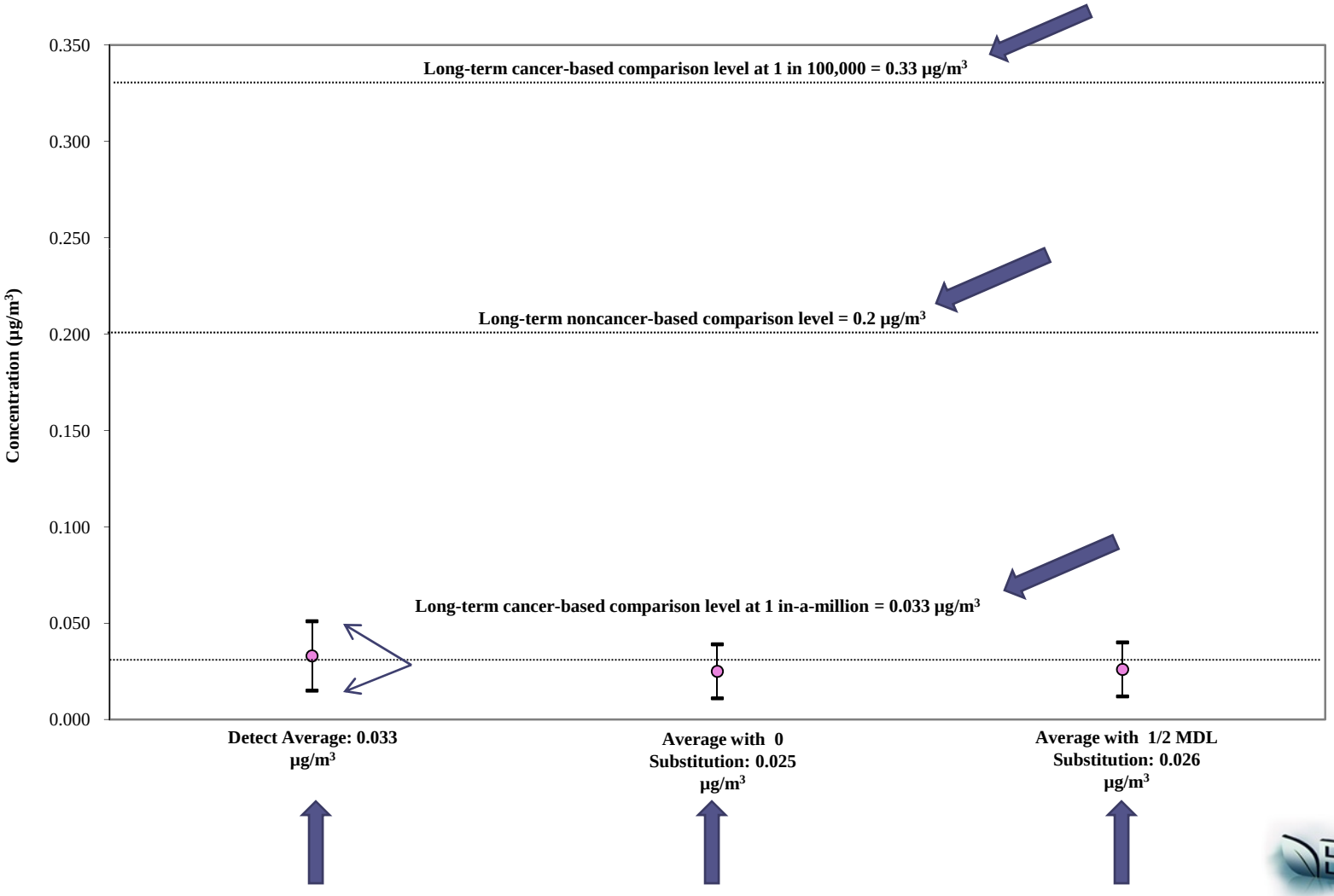
- "Detect" Average for a given year – Average of all "hits"
- "Annual" Average for a given year – Average with Surrogates
  - "1/2 MDL Substitution" Annual Average – Average of all "hits" and ½ MDL subbed in for non-detects
  - "0 Substitution" Annual Average – Average of all "hits" and 0 subbed in for non-detects
- 95% Confidence Interval is provided for each

Calculations Presented

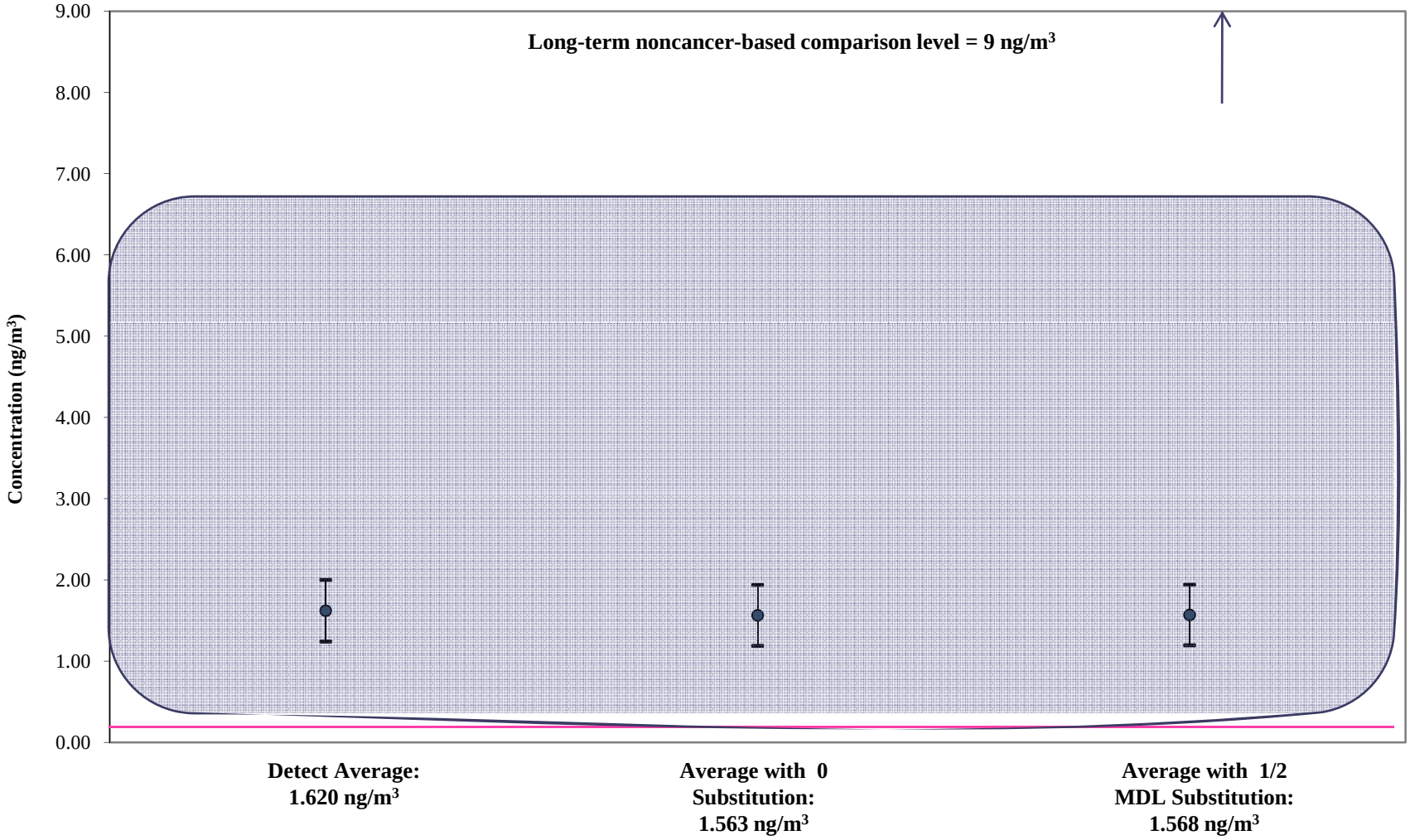
Annual Average Criteria:

- Designated as a “pollutant of interest”
- Completeness for the method must be at least 85%
- Must have at least 3 valid quarterly averages
  - Quarterly Average requires at least 7 detects within a given calendar quarter.
  - Thus, there must be a minimum of 21 detects (out of roughly 60 samples, or 35% detection rate)
- Annual Average is the average of all the detects plus substituted values for a given year

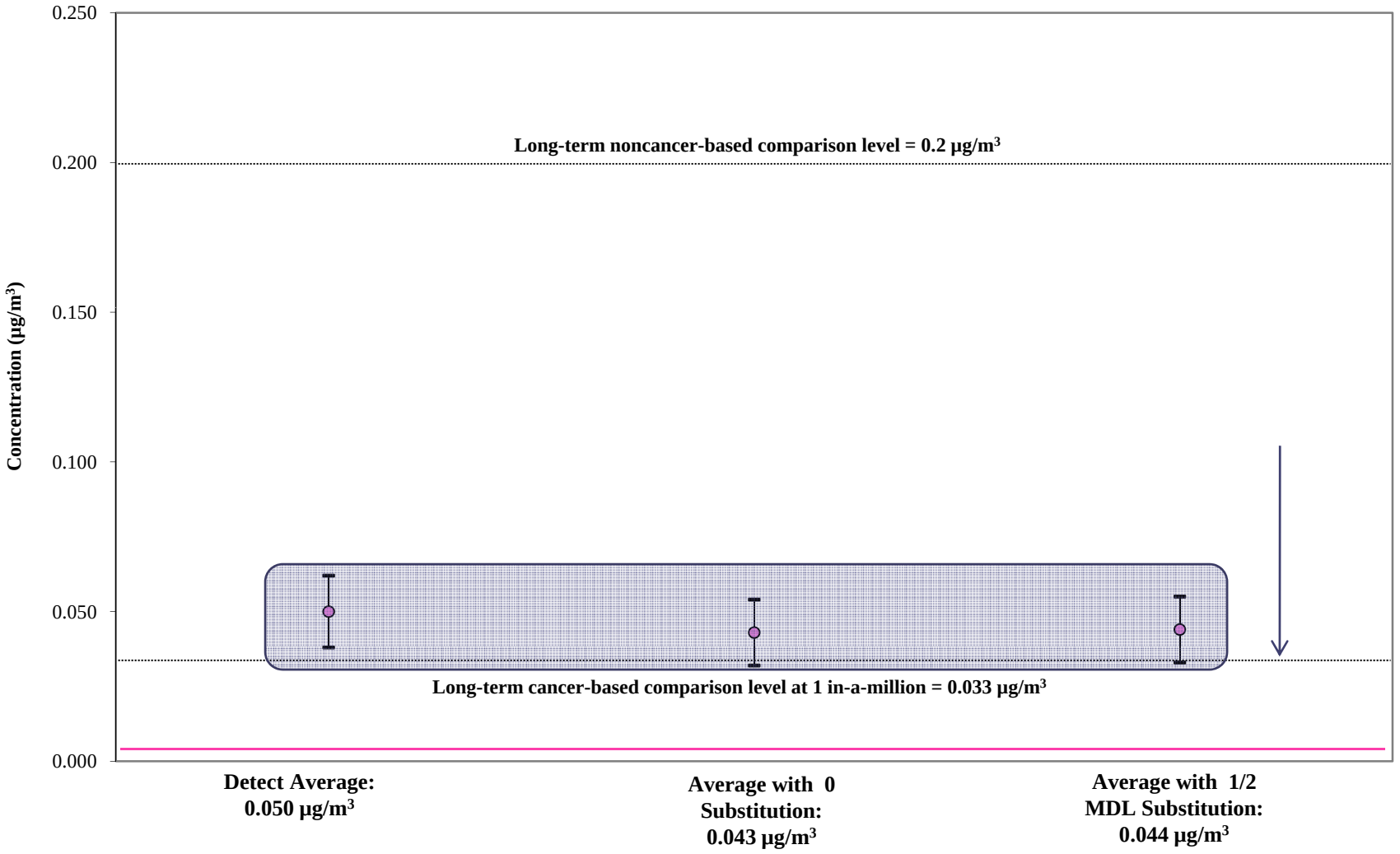
Example Graph



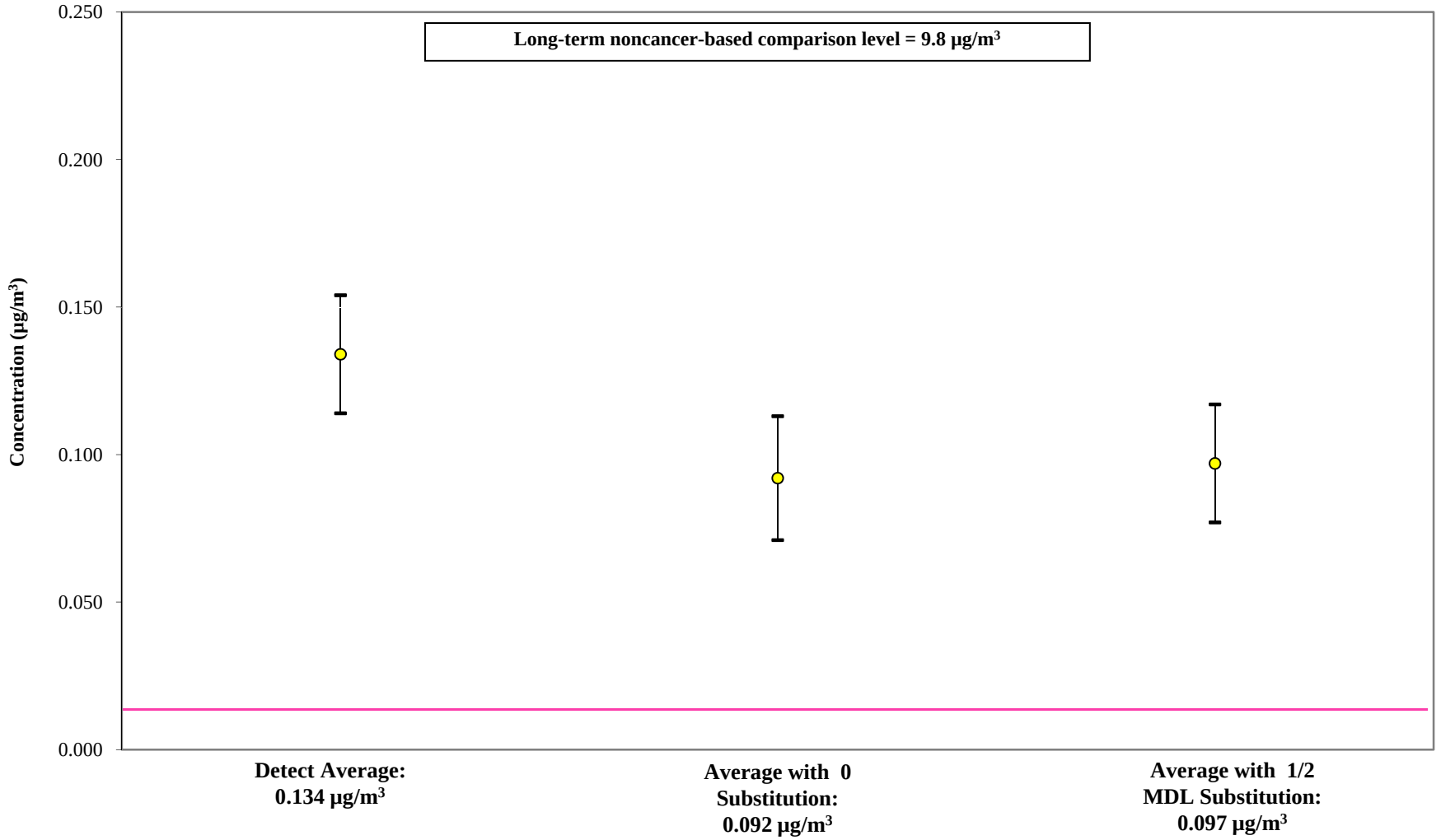
PXSS 2008 Nickel Averages



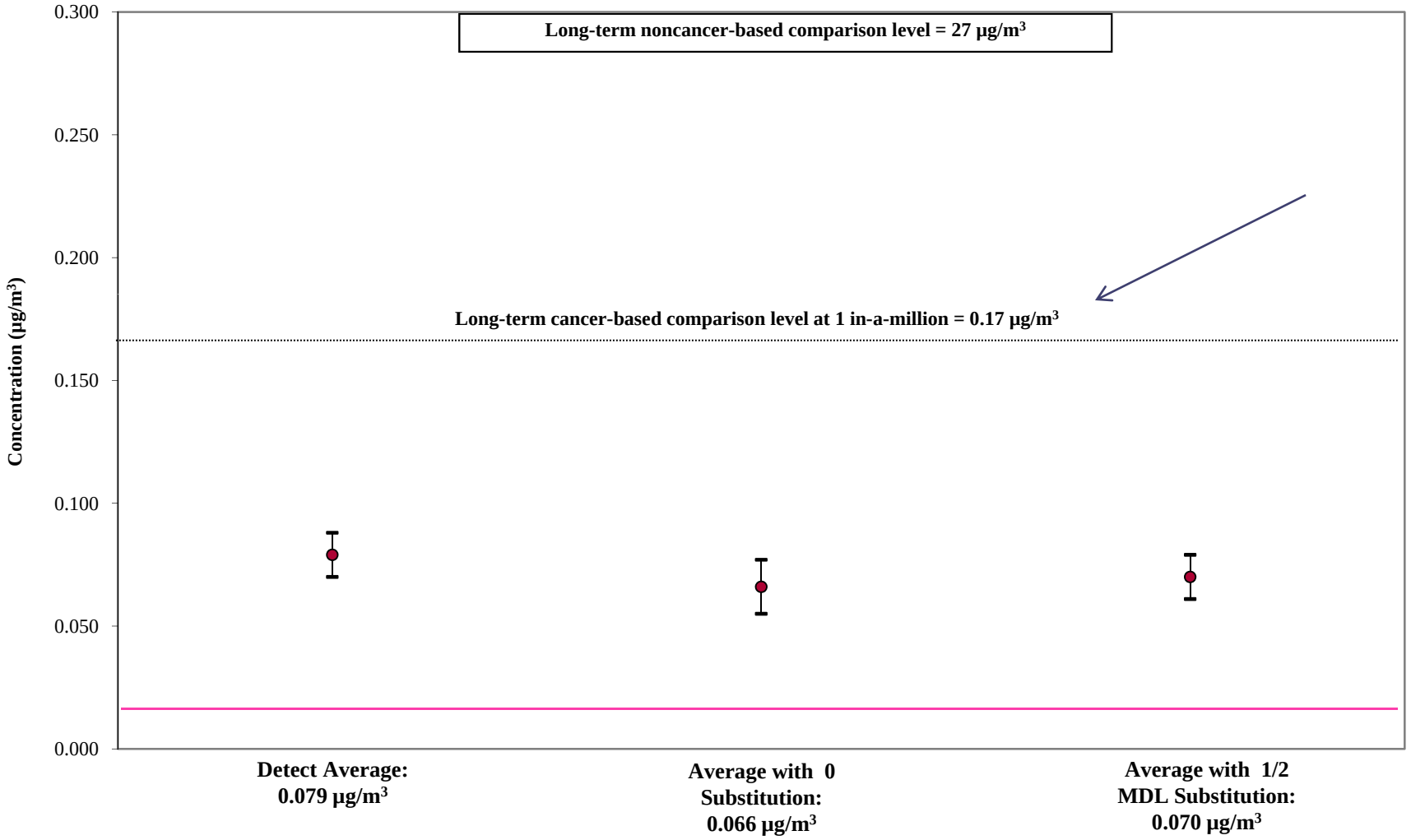
NBIL 2008 1,3-Butadiene Averages



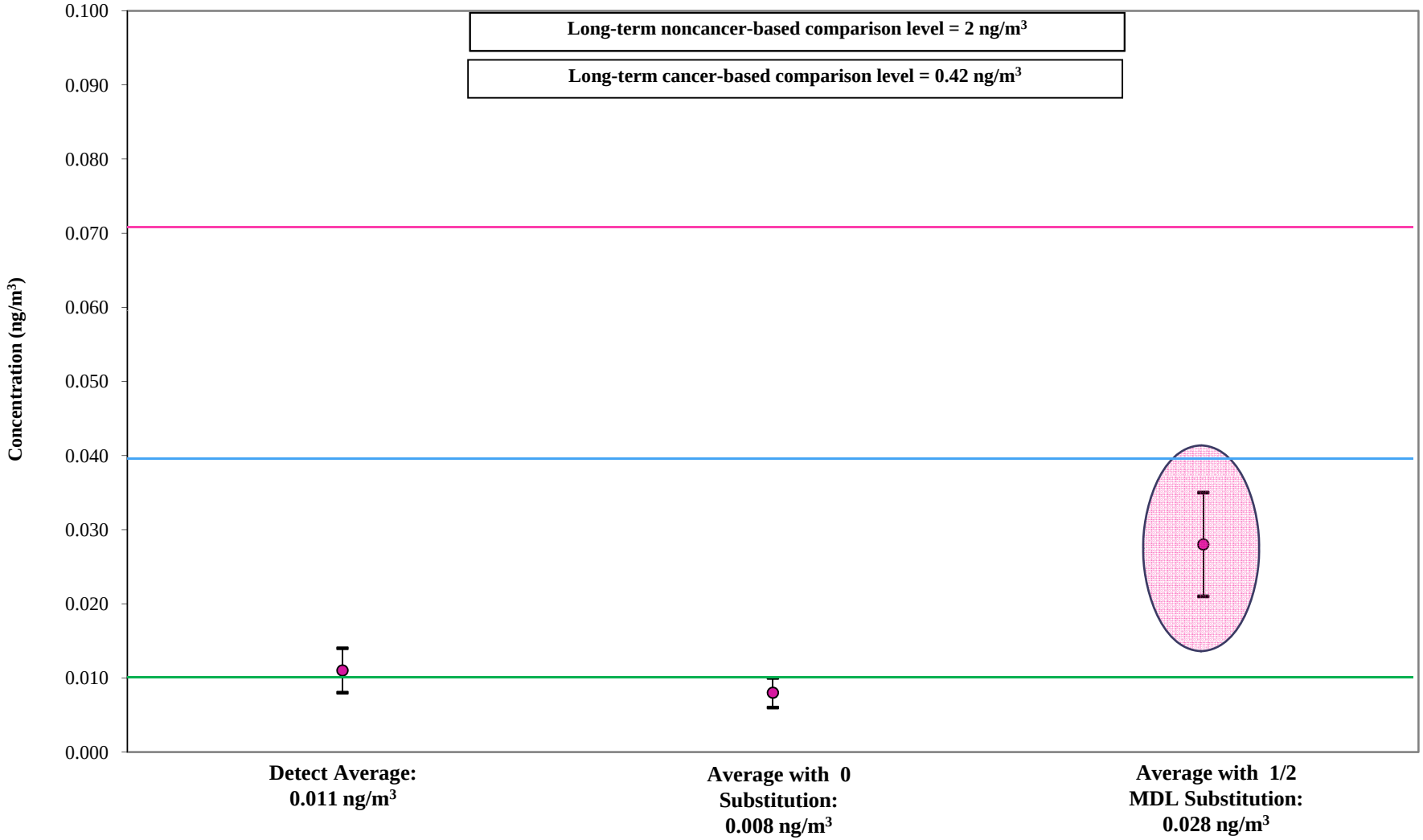
TOOK 2008 Chloroform Averages



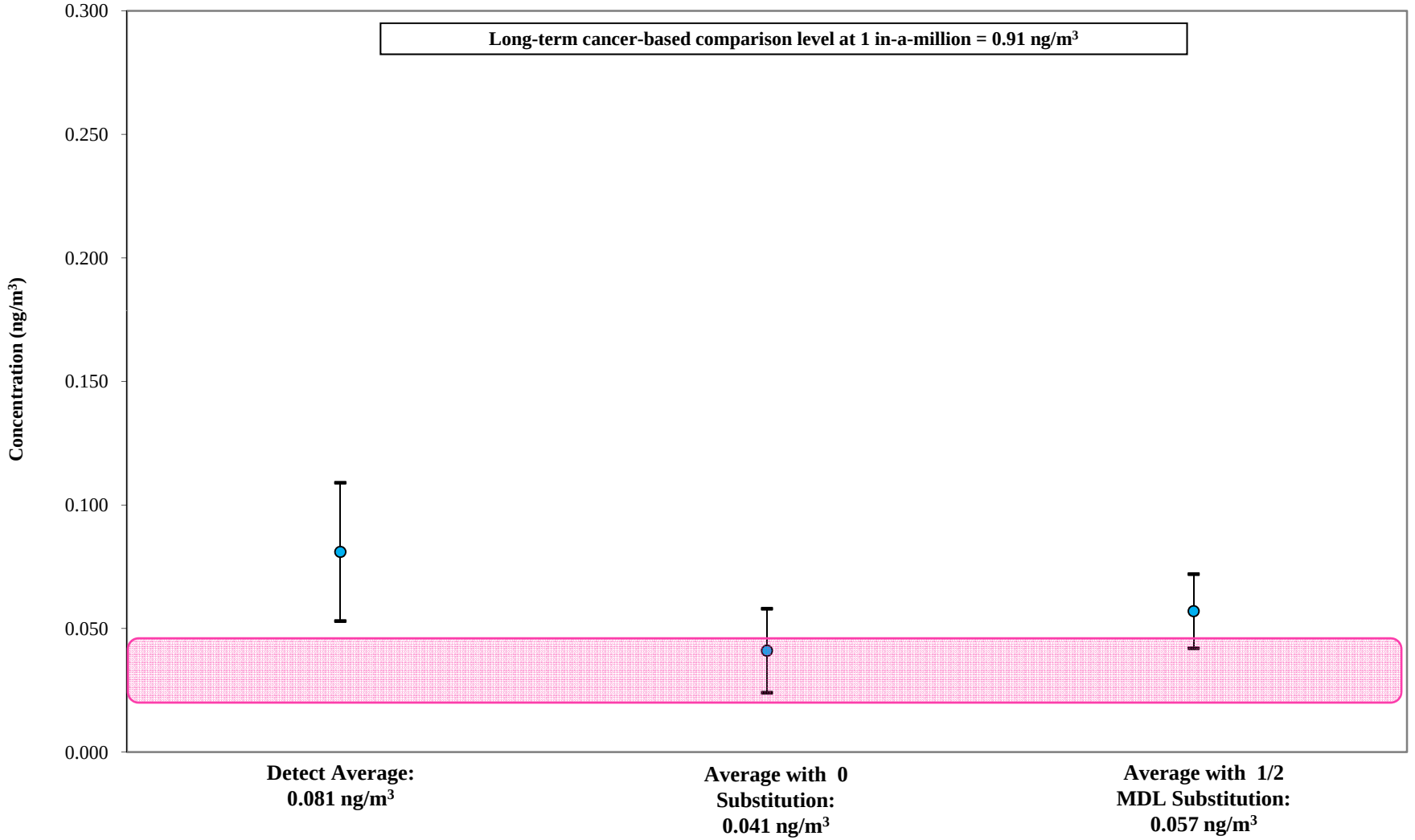
LDTN 2008 Tetrachloroethylene Averages



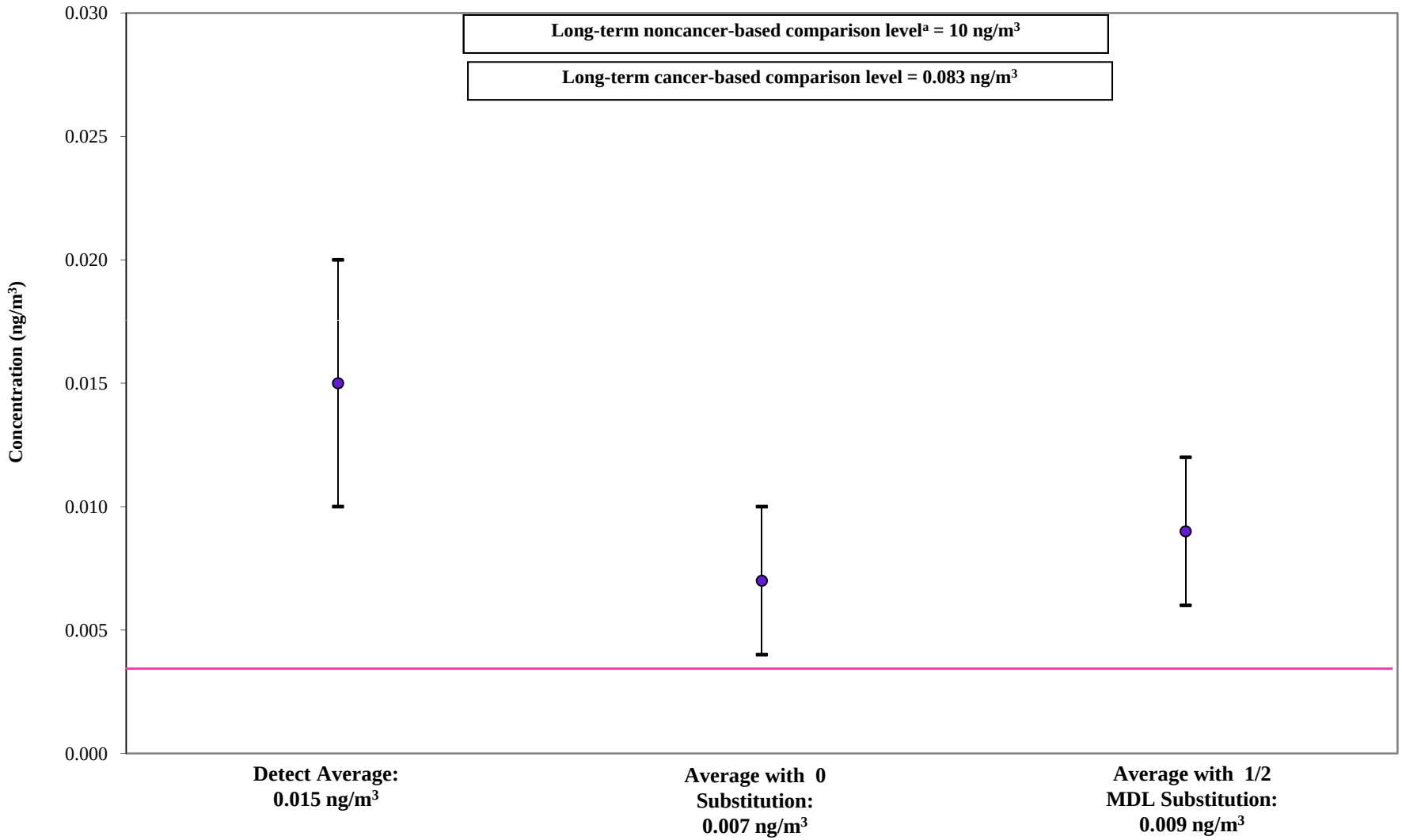
BTUT 2008 Beryllium Averages



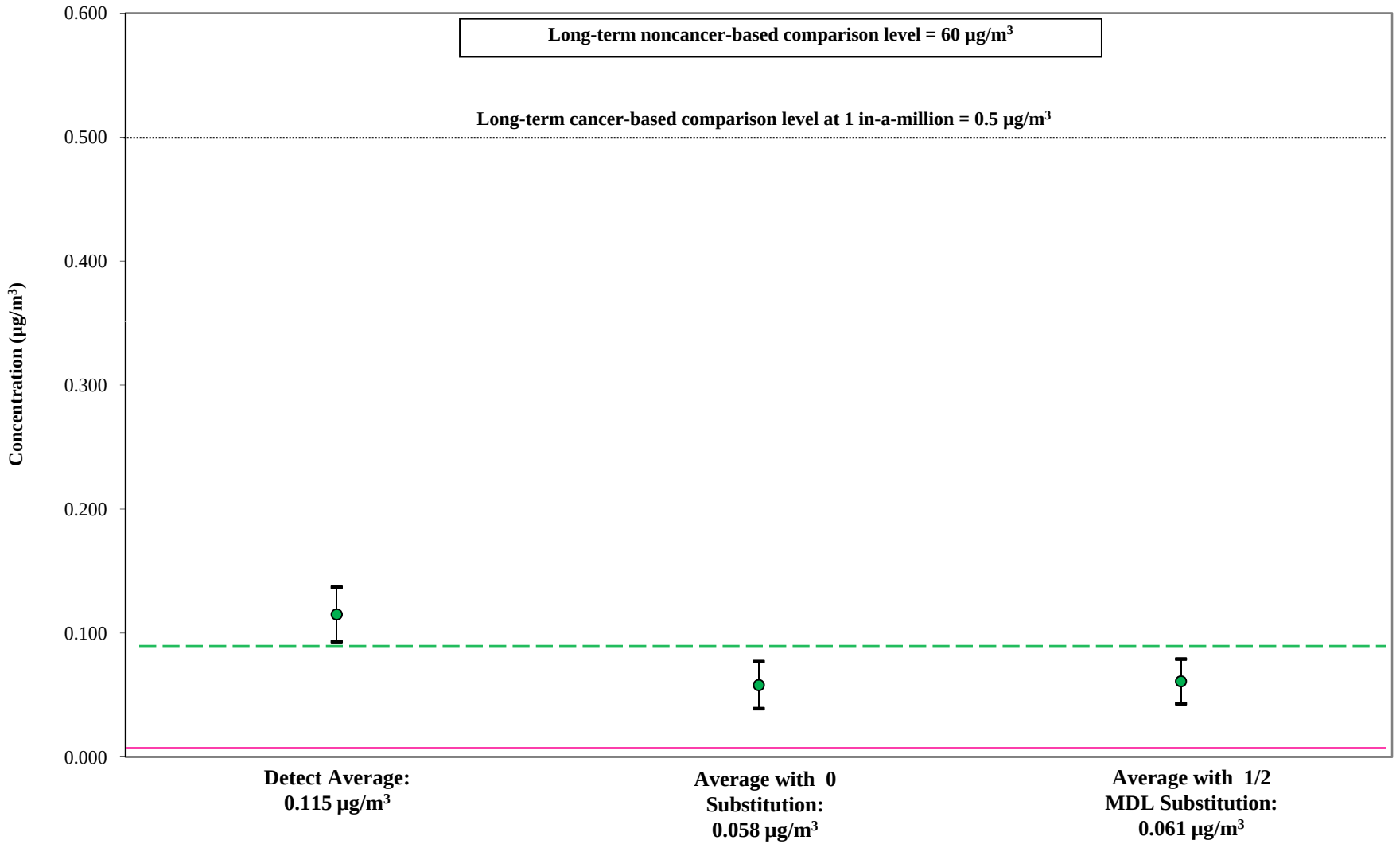
GLKY 2009 Benzo (a) pyrene Averages



WADC 2008 Hex Chrome Averages



GPCO 2009 Trichloroethylene Averages



Thoughts

- No Vinyl Chloride graph – not enough detects
- Our detection rates are what they are because our MDLs are low.
- Further, the differences between the averages with the substitutions are generally small because what we're subbing in is low (not much difference between 0.00X and 0).

Nat'l Contract Lab vs. State Lab

State Lab	July 2008 to June 2010				Note: 2009 MDLs not reported	
Pollutant	***# of Non-Detects***	***# of Detects***	***# of Conc***	***Min MDL (ug/m3)***	***Max MDL (ug/m3)***	***Risk***
1,3-Butadiene	228	0	228	0.442	0.526	0.033
Benzene	202	26	228	0.639	0.76	0.13
Carbon Tetrachloride	228	0	228	1.26	1.5	0.17
Chloroform	228	0	228	0.976	1.16	9.8
Tetrachloroethylene	228	0	228	1.36	1.61	0.17
Trichloroethylene	228	0	228	1.07	1.28	0.5
Vinyl Chloride	228	0	228	0.511	0.608	0.11
Nat'l lab	**June 2010 to Dec 2010**					
Pollutant	***# of Non-Detects***	***# of Detects***	***# of Conc***	***Min MDL (ug/m3)***	***Max MDL (ug/m3)***	***Risk***
1,3-Butadiene	10	25	35	0.022	0.022	0.033
Benzene	0	35	35	0.061	0.061	0.13
Carbon Tetrachloride	0	35	35	0.151	0.151	0.17
Chloroform	7	28	35	0.083	0.083	9.8
Tetrachloroethylene	20	15	35	0.075	0.075	0.17
Trichloroethylene	35	0	35	0.092	0.092	0.5
Vinyl Chloride	35	0	35	0.033	0.033	0.11

Take-away Points

The substitution used makes little difference among pollutants that are:

- Detected often
- Have low MDLs (consistent with those specified for the EPA NATTS Program)

2005 NATA

- EPA completed its Model-to-Monitor Comparison for the 2005 NATA in December 2010.
- In calculating annual averages for this effort, zeros were substituted for non-detects.
- This was a deviation from the 2002 Model-to-Monitor Comparison for the 2002 NATA, which used ½ MDL substitutions.
- A side-by-side comparison of the 2005 results using both surrogate values of zero and ½ MDL for NDs showed similar results in the median Model-to-Monitor ratios.

References

- NATTS TAD, Section 5: http://www.epa.gov/ttnamti1/airtox.html
- EPA Region 4 Preliminary Risk-Based Screening Approach for Air Toxics Monitoring Data Sets, February 2006: http://www.epa.gov/region4/air/airtoxic/Screening-041106-KM.pdf
- UATMP Reports: http://www.epa.gov/ttnamti1/uatm.html
- Acrolein

  http://www.epa.gov/schoolair/acrolein.html

Thank you!

Any Questions?