Appendix G-15:  WOE Probable Range With Voluntary Measures

**This Appendix supplies results and methodology for the Baltimore 8-Hour Ozone NAA WOE Attainment Demonstration Without  Voluntary Measures & With Voluntary Measures**

## Baltimore 8-Hour Ozone NAA WOE Attainment Demonstration
## Without Voluntary Measures & With Voluntary Measures

| Site Name – County, State | Site ID Number | Observed | Modeled | | WOE Without Voluntary Measures | | | | Modeled | WOE With Voluntary Measures | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2002 Base Year | 2009 BOTW-B4 | 2012 BOTW-B4 | 2009 Probable | 2009 Probable Range | 2012 Probable | 2012 Probable Range | 2009 Telecommute | 2009 Probable | 2009 Probable Range |
| Davidsonville – ANNE ARUNDEL CO, MD | 240030014 | 98.0 | 84 | 78 | 77.0 | 80.1 - 73.9 | 68.0 | 71.1 - 64.9 | 80.5 | 74.8 | 77.9 - 71.7 |
| Ft. Meade – ANNE ARUNDEL CO, MD | 240030019 | 97.0 | 84 | 78 | 77.5 | 80.6 - 74.4 | 68.5 | 71.6 - 65.4 | 80.1 | 75.1 | 78.2 - 72.0 |
| Padonia – BALTIMORE CO, MD | 240051007 | 88.7 | 77 | 72 | 71.2 | 74.3 - 68.1 | 63.7 | 66.8 - 60.6 | 74.6 | 69.5 | 72.6 - 66.4 |
| Essex – BALTIMORE CO, MD | 240053001 | 91.3 | 80 | 76 | 74.4 | 77.5 - 71.3 | 68.4 | 71.5 - 65.3 | 78.6 | 73.2 | 76.3 - 70.1 |
| South Carroll – CARROLL CO, MD | 240130001 | 88.7 | 75 | 69 | 68.2 | 71.3 - 65.1 | 59.2 | 62.3 - 56.1 | 71.8 | 66.1 | 69.2 - 63.0 |
| Edgewood – HARFORD CO, MD | 240251001 | 100.3 | 85 | 80 | 77.4 | 80.5 - 74.3 | 69.9 | 73.0 - 66.8 | 83.3 | 76.0 | 79.1 - 72.9 |
| Aldino – HARFORD CO, MD | 240259001 | 97.0 | 82 | 76 | 74.5 | 77.6 - 71.4 | 65.5 | 68.6 - 62.4 | 80.0 | 73.0 | 76.1 - 69.9 |

**WOE Without Voluntary Measures**
**2009 & 2012**
**Probable Ranges**


The monitoring station at Edgewood was used for the following sample calculations.


Given:

All values are 8-hour ozone design values (ppb)
Observed 2002      = 100.3 ppb
Modeled 2009 BOTW-B4 = 85 ppb
Modeled Benefit    = Observed 2002 –Modeled 2009 BOTW-B4 = 100.3 ppb – 85 ppb = **15.3 ppb**


WOE Benefit = Modeled Benefit x 2

(Explanation: Due to 100% underestimation of the emissions reduction benefits by CMAQ because of the model's insensitivity to emissions changes)


Allowing for considerable margin, the underestimation of the WOE Benefit is conservatively cut in half (50%). The conservative WOE Benefit is calculated as follows:

WOE Benefit$_{Conservative}$ = Modeled Benefit x 1.5 = 15.3 ppb x 1.5 = **22.95 ppb**


WOE Without Voluntary Measures 2009 Probable = Observed 2002 – WOE Benefit$_{Conservative}$
= 100.3 ppb – 22.95 ppb = **77.4 ppb**


WOE Without Voluntary Measures 2009 Probable Range Calculations:
Upper Bound = Probable 2009 + 3.1 ppb = 77.4 ppb + 3.1 ppb = **80.5 ppb**
Lower Bound = Probable 2009 – 3.1 ppb = 77.4 ppb – 3.1 ppb = **74.3 ppb**


WOE Without Voluntary Measures 2012 Probable Range Calculations:
Process is identical to the steps described above, except for the substitution of Modeled 2012 BOTW-B4 instead of Modeled 2009 BOTW-B4.

Note:
The 3.1 ppb adjustment to calculate the lower bound and upper bound represents the uncertainty in future design values and was calculated by Jeff Stehr (UMD). More detailed information can be found in Appendix G-9.

**WOE With Voluntary Measures**
**2009**
**Probable Range**


The monitoring station at Edgewood was used for the following sample calculations.


Given:
        Modeled 2009 BOTW-B4 = 85 ppb
        Modeled 2009 Telecommute = 83.3 ppb


Benefit of Telecommuting = Modeled 2009 BOTW-B4 –   Modeled 2009 Telecommute
                            =  85 ppb – 83.3 ppb =  **1.7 ppb**


Assume an additional benefit of 1 ppb for the High Energy Demand Day (HEDD) program [1]:

    Total
    Voluntary    = Benefit of Telecommuting + Assumed Benefit of HEDD Program = 1.7 ppb +1 ppb=**2.7 ppb**
    Measures
    Benefit


Divide the Total Voluntary Measures Benefit by 2 to be conservative:
        Total Voluntary Measures Benefit$_{Conservative}$ = 2.7 ppb / 2 = **1.35 ppb**


WOE With Voluntary Measures 2009 Probable
        = WOE Without Voluntary Measures 2009 Probable - Total Voluntary Measures Benefit$_{Conservative}$
        = 77.4 ppb – 1.35 ppb = **76.0 ppb**


WOE With Voluntary Measures 2009 Probable Range Calculations:
        Upper Bound:  Probable 2009 + 3.1 ppb = 76.0 ppb + 3.1 ppb = **79.1 ppb**
        Lower Bound:  Probable 2009 - 3.1 ppb = 76.0 ppb - 3.1 ppb = **72.9 ppb**

Note:
[1] Additional modeling is planned to calculate the modeled benefit of the HEDD program.

The 3.1 ppb adjustment to calculate the lower bound and upper bound represents the uncertainty in future design values and was calculated by Jeff Stehr (UMD).  More detailed information can be found in the Appendix G-9, "Uncertainty in CMAQ and Over-predictions of Future Year Ozone Design Values".