# Summary of Baltimore NAA Attainment Demonstration

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

**\* All values in ppb**

Notes:
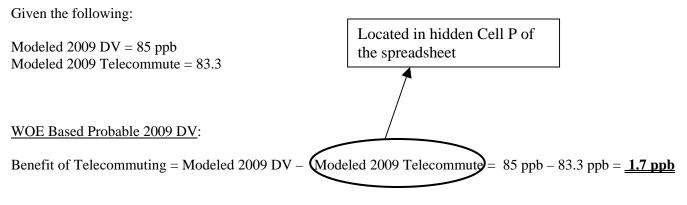upper Bound:                3.1
lower bound:                -3.1

**Explanation of calculations in the Summary of Baltimore 8-Hour Ozone NAA
Attainment Demonstration**

## Maryland's Edgewood monitor was used for the sample calculations

## 1. With Voluntary Measures

Given the following:

Modeled 2009 DV = 85 ppb
Modeled 2009 Telecommute = 83.3

> Located in hidden Cell P of the spreadsheet

WOE Based Probable 2009 DV:

Benefit of Telecommuting = Modeled 2009 DV – (Modeled 2009 Telecommute) = 85 ppb – 83.3 ppb = **1.7 ppb**

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

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

Next take the total voluntary measures benefit and divide by 2 to be conservative: 2.7 ppb / 2 = **1.35 ppb**

Next subtract the conservative total voluntary benefit from the without voluntary measures WOE based probable 2009 DV to calculate the voluntary WOE based probable 2009 DV.

Voluntary WOE Based Probable 2009 DV = Without Voluntary Measures WOE Based Probable 2009 DV - Conservative Total Voluntary Benefit = 77.4 ppb – 1.35ppb = **76.0 ppb**

WOE 2009 Upper Bound: WOE Probable 2009 DV + 3.1 ppb = 76.0 ppb + 3.1 ppb = **79.1 ppb**

WOE 2009 Lower Bound: WOE Probable 2009 DV - 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.
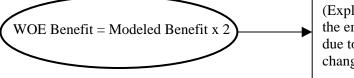
The 3.1 ppb adjustment to calculate the lower bound and upper bound represents the uncertainty in future design values and was calculated by Jeff Stehr (UMD). More detailed information can be found in the WOE chapter 9, "Uncertainty in CMAQ and Over-predictions of Future Year Ozone Design Values".

# Explanation of calculations in the Summary of Baltimore 8-Hour Ozone NAA Attainment Demonstration

## 2.  Without Voluntary Measures (2009 DV)

Given the following:

Observed 2002 DV = 100.3 ppb
Modeled 2009 DV = 85 ppb
Modeled Benefit = Observed  2002 DV – Modeled 2009 DV = 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 due to the model's insensitivity to emissions changes)

Allowing for considerable margin, the underestimation of the WOE Benefit is conservatively cut in half (50%).

Now 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 Based Probable 2009 DV = Observed 2002 DV – WOE Benefit_Conservative = 100.3 – 22.95 = **77.4 ppb**

Calculation of the WOE Based Upper and Lower Bound of 2009 DV:

WOE 2009 Upper Bound = WOE Based Probable 2009 DV + 3.1 ppb = 77.4 ppb + 3.1 ppb = **80.5 ppb**

WOE 2009 Lower Bound = WOE Based Probable 2009 DV – 3.1 ppb = 77.4 ppb – 3.1 ppb = **74.3 ppb**
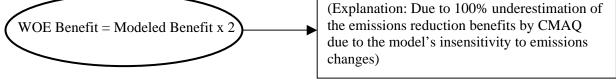
Note:
The 3.1 ppb adjustment to calculate the lower bound and upper bound represents the uncertainty in future design values and was calculated by Jeff Stehr (UMD).  More detailed information can be found in the WOE chapter 9, "Uncertainty in CMAQ and Over-predictions of Future Year Ozone Design Values".

## Explanation of calculations in the Summary of Baltimore 8-Hour Ozone NAA Attainment Demonstration

## 3. Without Voluntary Measures (2012 DV)

Given the following:

Observed 2002 DV = 100.3 ppb
Modeled 2012 DV = 80 ppb
Modeled Benefit = Observed 2002 DV – Modeled 2012 DV = 100.3 ppb – 80 ppb = **20.3 ppb**

WOE Benefit = Modeled Benefit x 2

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

Allowing for considerable margin, the underestimation of the WOE Benefit is conservatively cut in half (50%).

Now the conservative WOE Benefit is calculated as follows:

WOE Benefit_Conservative = Modeled Benefit x 1.5 = 20.3 ppb x 1.5 = **30.45 ppb**

WOE Based Probable 2009 DV = Observed 2002 DV – WOE Benefit_Conservative = 100.3 – 30.45 = **69.9 ppb**

Calculation of the WOE Based Upper and Lower Bound of 2009 DV:

WOE 2009 Upper Bound = WOE Based Probable 2009 DV + 3.1 ppb = 69.9 ppb + 3.1 ppb = **73.0 ppb**

WOE 2009 Lower Bound = WOE Based Probable 2009 DV – 3.1 ppb = 69.9 ppb – 3.1 ppb = **66.8 ppb**

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 the WOE chapter 9, "Uncertainty in CMAQ and Over-predictions of Future Year Ozone Design Values".

# Supplemental Voluntary Measure Weight of Evidence Demonstration

In addition to the existing weight of evidence (WOE) analysis performed for the Baltimore Nonattainment Area (NAA), the following supplementary evidence further exemplifies the probability that the region will attain the 8-hour ozone standard.  The analysis described below was completed to examine how the modeled predicted future year 8-hour ozone design values might be lowered and given as a range based on voluntary controls which were not included in the full modeling demonstration completed by the Ozone Transport Commission (OTC) modeling centers for the Ozone Transport Region (OTR) states and is used in this modeling demonstration as part of this State Implementation Plan (SIP).  The potential benefits from voluntary programs (i.e., an aggressive telecommuting program, the high electricity demand day (HEDD) program, and even an aggressive tree canopy program) help demonstrate that all of the region's monitors are progressing towards attaining the 8-hour ozone standard.

While not a formal part of MDE's WOE chapter, the analysis was completed to present supplemental evidence that leads to the conclusion that MDE is confident that the Baltimore NAA will attain the 8-hour ozone standard.

**Description of Analysis:**

1.  Using the Edgewood, Harford County Maryland Monitor as the example monitor the predicted 2009 design value (DV) using the on the books/ on the way control measures is 85 ppb.

2.  The UMD telecommute modeling included in the WOE documentation for this SIP predicted Edgewood's DV to be 83.3 ppb.

3.  Subtracting the telecommute run of 83.3 ppb from the predicted 2009 DV of 85 ppb there is a 1.7 ppb benefit from the telecommute program.

4.  Assuming an additional 1 ppb of benefit from the HEDD program (based on cursory estimates from UMD modeling) there could be a total benefit 2.7 ppb based on the telecommute and HEDD programs.

5.  In an effort to be conservative, divide the total benefit of 2.7 ppb by half and there potentially is 1.35 ppb benefit from telecommute and HEDD programs.

6.  Now you can subtract the conservative 1.35 ppb of total benefit from the WOE based probable 2009 DV for Edgewood (77.4ppb – 1.35 ppb = 76.0 ppb)

7.  Jeff Stehr at UMD (as presented in the WOE chapter 11 of this SIP) has calculated that there should be a 3.1 ppb range used for the upper and lower boundaries of a CMAQ predicted DV.  This 3.1 ppb upper and lower boundary represents the uncertainty in future design values (for more info see chapter 11 of this SIP).

8.  Using the 3.1 ppb upper and lower boundaries and applying them to the results of step 6 (benefit of the telecommute and HEDD programs) the 2009 future year DV range for the Edgewood monitor could be 72.9 ppb – 79.1 ppb.