

MEMORANDUM

To: Pete Breitenbach
From: Edward Tai and Greg Yarwood
Date: June 22, 2006
Subject: Task 16: DFW EGU Controls

Introduction

A CAMx sensitivity run (run44.fy2009.a1.dfw_egu) examined the impact to 8-hour ozone in the DFW 9-county NAA during the August 13-22, 1999 episode for the 2009 future year when reducing NOx emissions from DFW EGUs to Houston ESAD levels. The same controls were used in Task 11, when they were bundled with NOx reductions from DFW major sources.

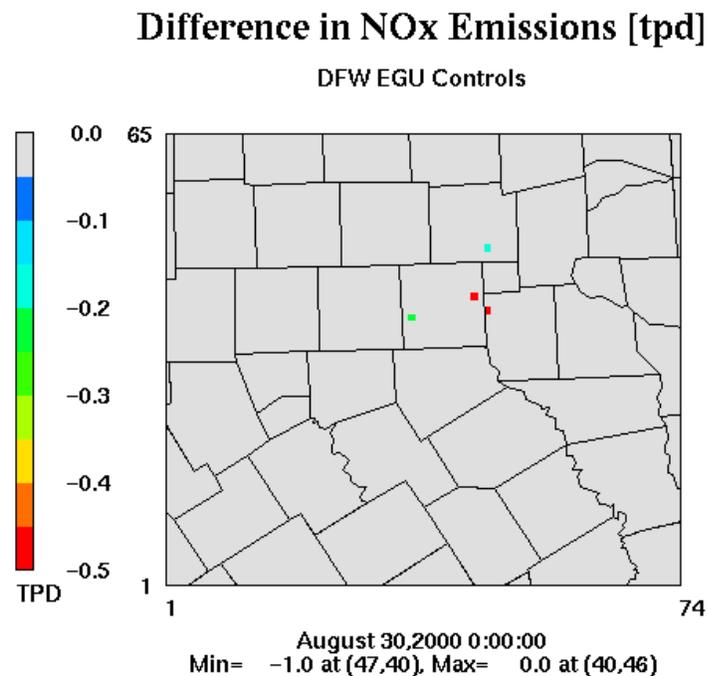
The run was based on the Run 44 baseline configuration, with the modeling domain covering the expanded 36 km domain with 14 km model top. Inputs included meteorology from MM5 Run 6, which was based on the ETA PBL scheme coupled with the Noah land surface model, with the kv100 patch applied to the vertical diffusivity. The boundary conditions assigned moderate conditions in the mixed layer over land, and clean conditions over the Gulf, Atlantic and all areas aloft. A modified version of CAMx 4.03 was used in which several NOx recycling reactions were added to the CB4 mechanism (CB4xi).

Emissions

NOx controls were applied to the 2009 “a1” baseline emissions, which incorporated 2005 acid rain data for the Texas EGUs. The 15 DFW EGUs with controls are listed in Table 1. Most of the 2.0 tpd NOx reduction was in Dallas and Kaufman Counties, as shown in Figure 1. VOCs were unchanged from the 2009 baseline.

Table 1. DFW EGUs with NOx controls.

EGU	LCPx [km]	LCPy [km]	County	Facility	Stack	Baseline NOx [tpd]	NOx after Controls [tpd]	Change in NOx [tpd]
Ray Olinger	326.247	-745.762	Collin	15	1	0.42	0.27	-0.14
Ray Olinger	326.247	-745.762	Collin	15	4	0.17	0.13	-0.04
Ray Olinger	326.466	-746.556	Collin	15	1000	0.03	0.03	0.00
C E Newman	311.478	-764.272	Dallas	7	4	0.02	0.01	0.00
Lake Hubbard	318.967	-772.391	Dallas	9	2	0.86	0.28	-0.59
Mountain Creek Gen	283.419	-786.197	Dallas	10	2	0.01	0.00	0.00
Mountain Creek Gen	283.423	-786.075	Dallas	10	8	0.13	0.09	-0.04
Mountain Creek Gen	283.422	-786.043	Dallas	10	10	0.23	0.07	-0.16
Spencer	266.050	-734.020	Denton	2	4	0.03	0.03	0.00
Cobisa Forney FPLE	324.467	-780.715	Kaufman	1000	100	0.59	0.48	-0.11
Cobisa Forney FPLE	324.453	-780.751	Kaufman	1000	200	0.60	0.49	-0.11
Cobisa Forney FPLE	324.440	-780.903	Kaufman	1000	300	0.49	0.41	-0.09
Cobisa Forney FPLE	324.392	-780.903	Kaufman	1000	400	0.68	0.42	-0.26
Cobisa Forney FPLE	324.377	-780.939	Kaufman	1000	500	0.70	0.50	-0.20
Cobisa Forney FPLE	324.362	-780.975	Kaufman	1000	600	0.72	0.44	-0.27
Total						5.67	3.66	-2.01

**Figure 1.** Tile plot of the change in NOx emissions from the DFW EGU controls.

Modeling Results

Spatial plots of the daily maximum 8-hour ozone and differences from the 2009 baseline are shown in Figure 2 for each episode date in the DFW 4 km domain. On dates with a south or east wind, the greatest 8-hour ozone reduction was located near northeast Dallas County, with peak benefits ranging from 0.7 to 1.1 ppb. On the two dates with north winds (August 19 and 20), the maximum ozone reduction was smaller and located more to the south.

The 8-hour ozone design value calculation is shown in Table 2 for all DFW monitoring sites using the 1999 baseline design value, and is compared to the 2009 baseline design values in Table 3. The 2 tpd NO_x reduction from the DFW EGUs benefited Frisco the most as its future design value was reduced 0.25 ppb; Denton was 0.10 ppb lower. Midlothian saw a slight disbenefit as its future design value increased 0.02 ppb, but remained in attainment for 8-hour ozone.

Table 4 compares the change in future design values when applying controls to the DFW EGUs only, and controls to both the DFW EGUs and DFW major sources (Task 11), which reduced NO_x by 15 tpd. Assuming that the difference in future design values between the two control runs yields benefits solely from the DFW major sources, as shown in the rightmost column of Table 4, then the 8-hour ozone benefit at Frisco was greater from the DFW EGU controls than the DFW major source controls. Both controls had comparable impacts at Dallas C63 and C60; at all other sites, the DFW major source controls had greater ozone benefits.

Tables 5 to 7 examine the 4-km grid cells in the DFW 9-county NAA in which the daily maximum 8-hour ozone exceeded 85 ppb. Table 5 lists the number of unique grid cells in DFW that exceed 85 ppb for each date in both the 2009 baseline and control scenario. The rightmost column shows the percent change in exceedance area. The DFW EGU controls only dropped 11 (1 %) of the 1199 exceedance cells below 85 ppb. Table 6 shows that no 8-hour ozone exceedance cells were reduced by more than 1 ppb from the controls during the episode.

Table 7 sums the number of ppb's in the daily maximum 8-hour ozone that exceed 85 ppb. For example, if the daily maximum ozone in a grid cell is 90 ppb, the grid cell adds 5 ppb (90 – 85 ppb) to the sum of ozone exceedances. The episode averaged a 1.3 % reduction.

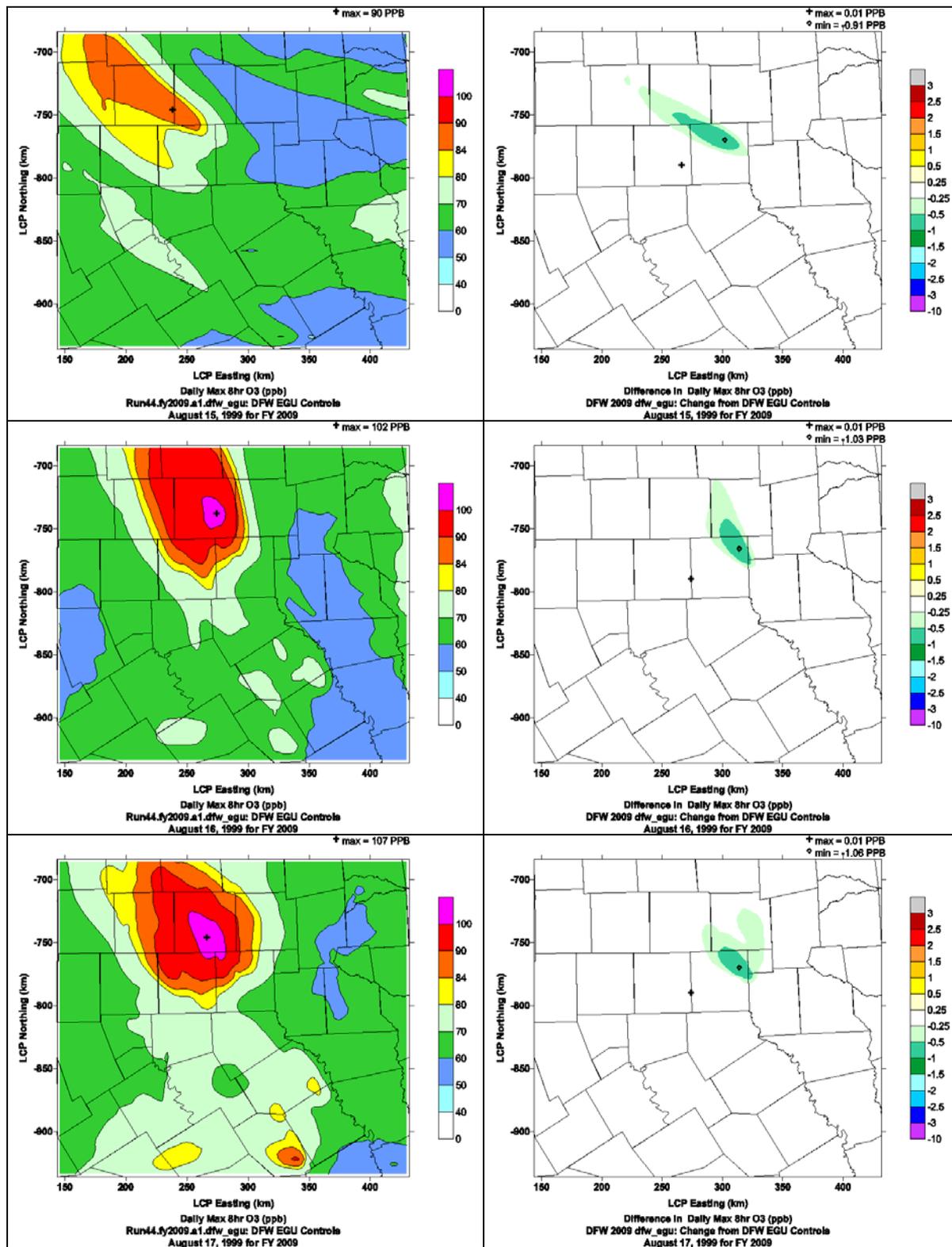


Figure 2. Daily maximum 8-hour ozone in the DFW EGU control scenario (left) and differences from the 2009 baseline (right) for each episode date.

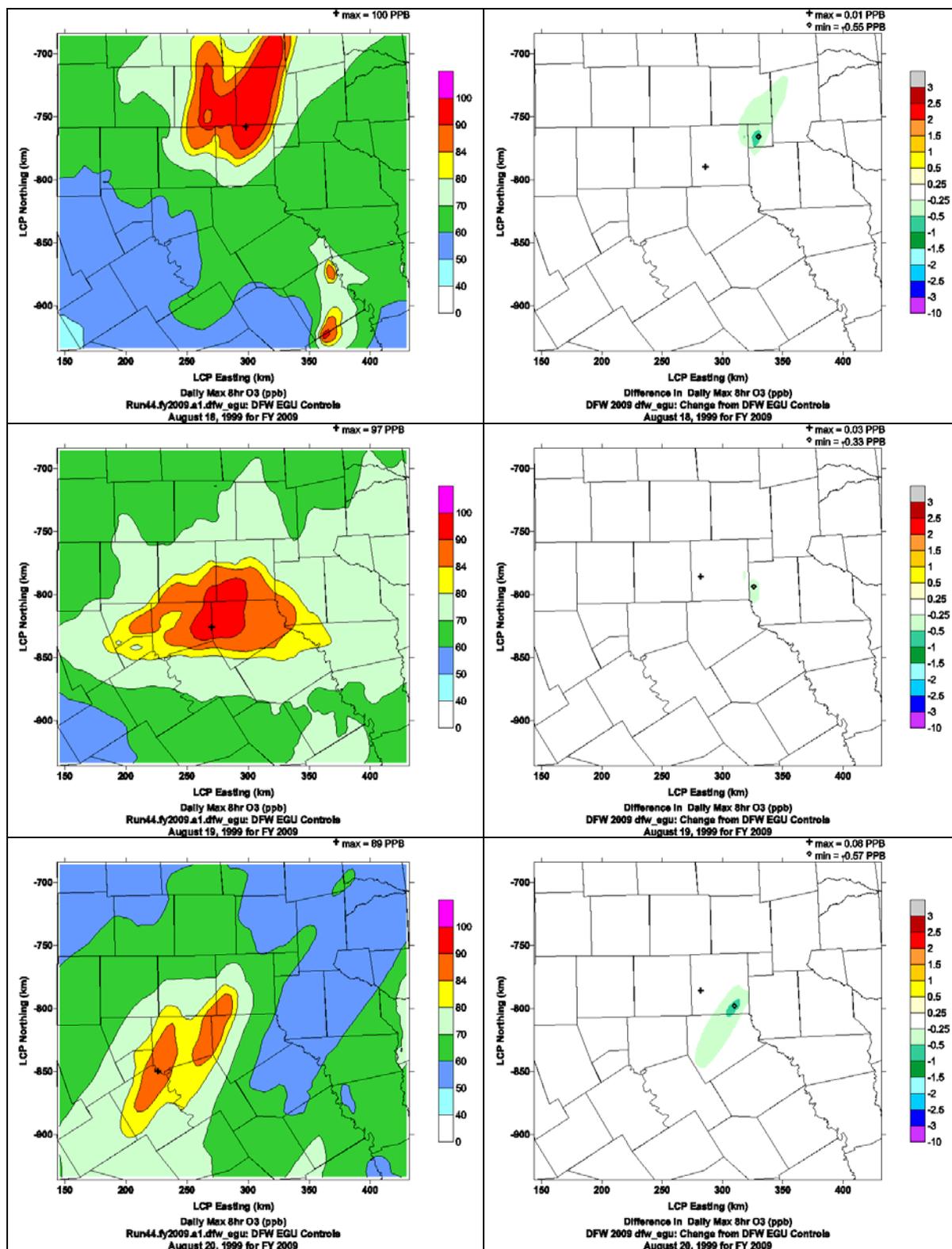


Figure 2. (Continued) Daily maximum 8-hour ozone in the DFW EGU control scenario (left) and differences from the 2009 baseline (right) for each episode date.

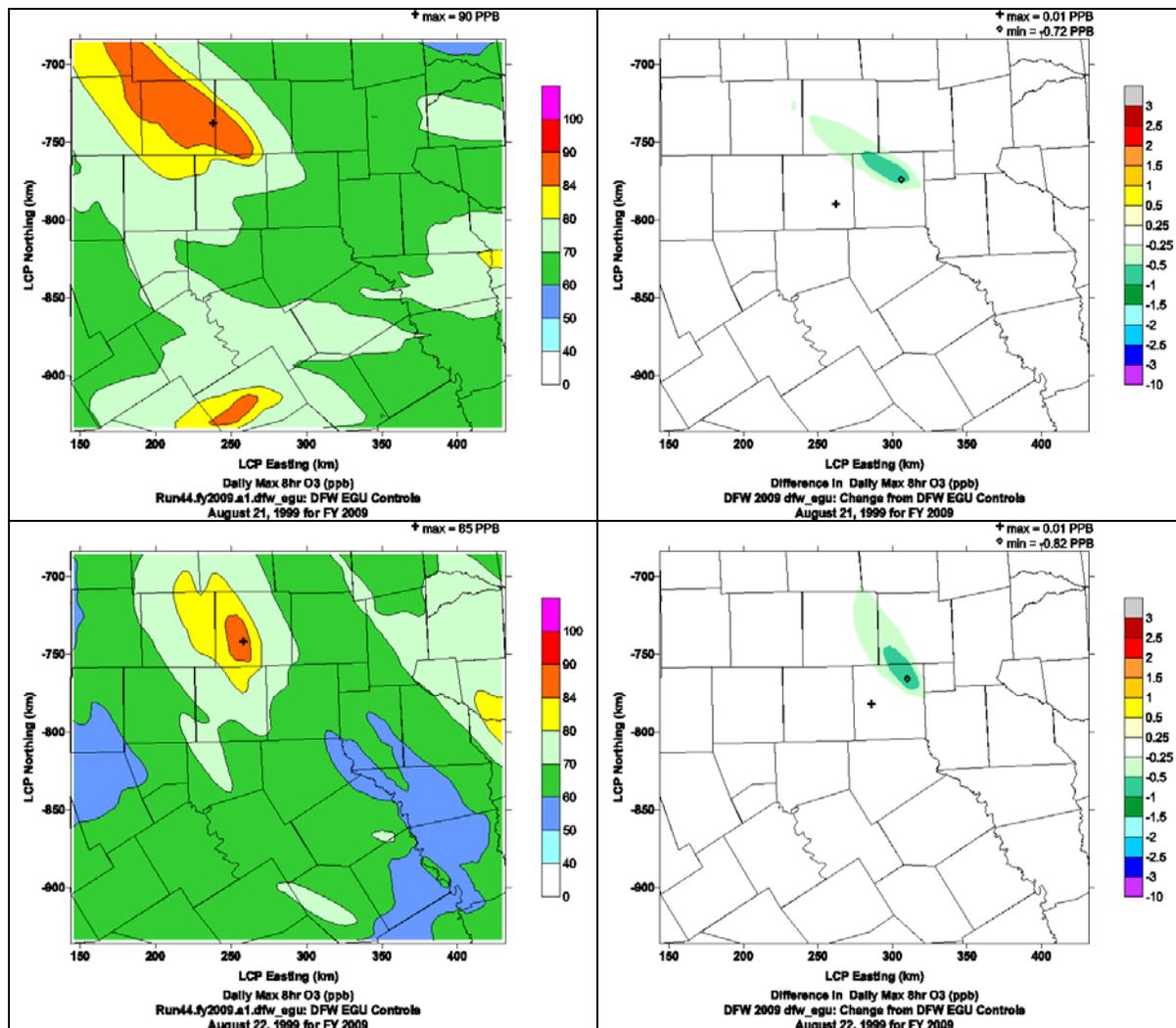


Figure 2. (Concluded) Daily maximum 8-hour ozone in the DFW EGU control scenario (left) and differences from the 2009 baseline (right) for each episode date.

Table 2. Design value calculation for the DFW EGU control scenario.

Base Case: run44												
Site	990815	990816	990817	990818	990819	990820	990821	990822	Average	#Days>70		
Frisco	80.7	105.6	99.0	104.9	85.6	70.0	85.9	89.4	90.1	8		
Dallas C60	83.2	98.1	100.6	102.8	96.7	77.4	86.0	85.1	91.2	8		
North Dallas C63	82.8	99.6	99.0	104.7	94.0	76.0	86.0	87.5	91.2	8		
Dallas C402	78.3	92.9	98.0	98.3	104.7	84.7	80.5	80.6	89.7	8		
Denton	102.4	110.5	108.5	113.0	83.9	72.4	101.6	100.1	99.0	8		
Midlothian	75.5	85.0	86.2	78.0	111.8	89.6	75.0	74.9	84.5	8		
Arlington	86.3	98.3	99.6	94.5	104.5	84.2	81.8	86.6	92.0	8		
Fort Worth C13	94.2	105.4	102.6	104.2	94.9	79.9	90.9	91.9	95.5	8		
Fort Worth C17	100.4	110.1	107.6	106.8	92.3	77.9	95.1	97.3	98.4	8		
Future Year: run44.fv2009.a1.dfw egu												
Site	990815	990816	990817	990818	990819	990820	990821	990822	Average	RRF ¹	Base DV	Future DV ²
Frisco	67.9	99.9	100.2	98.3	73.2	64.9	74.7	75.1	81.8	0.907	100.3	91.0
Dallas C60	73.2	93.0	102.1	99.5	89.4	82.7	78.7	75.0	86.7	0.950	92.0	87.4
North Dallas C63	71.2	95.6	100.2	99.9	83.9	78.8	77.3	74.0	85.1	0.934	93.0	86.9
Dallas C402	68.4	82.5	90.2	88.1	95.6	87.6	72.1	70.1	81.8	0.912	87.3	79.6
Denton	88.3	102.3	106.5	92.2	71.0	64.1	89.4	85.1	87.4	0.882	101.5	89.5
Midlothian	70.6	76.1	78.3	70.5	97.4	87.0	69.2	68.4	77.2	0.914	92.5	84.6
Arlington	74.2	90.3	91.6	83.6	94.3	87.6	74.0	79.5	84.4	0.917	95.0	87.1
Fort Worth C13	81.5	94.9	93.7	88.2	83.7	76.5	80.4	81.6	85.1	0.891	98.3	87.6
Fort Worth C17	88.7	97.6	102.5	90.6	79.8	71.0	87.7	84.5	87.8	0.892	96.3	85.9
Daily RRFs ³												
Site	990815	990816	990817	990818	990819	990820	990821	990822				
Frisco	0.841	0.946	1.013	0.937	0.855	0.926	0.869	0.840				
Dallas C60	0.880	0.947	1.014	0.968	0.924	1.068	0.916	0.881				
North Dallas C63	0.861	0.960	1.012	0.954	0.893	1.038	0.899	0.846				
Dallas C402	0.873	0.888	0.920	0.897	0.913	1.034	0.896	0.870				
Denton	0.862	0.925	0.982	0.816	0.847	0.886	0.879	0.850				
Midlothian	0.935	0.896	0.909	0.904	0.871	0.971	0.923	0.913				
Arlington	0.860	0.918	0.920	0.885	0.903	1.041	0.905	0.918				
Fort Worth C13	0.865	0.900	0.914	0.846	0.882	0.958	0.885	0.888				
Fort Worth C17	0.883	0.887	0.952	0.849	0.864	0.912	0.922	0.868				

1. RRF = Future year average / base year average
2. Future DV = Baseline DV * RRF
3. Daily RRFs are for information only and are not used to calculate the future DVs.

Table 3. 2009 design value summary [ppb].

Run	run44.fy2009.a1	run44.fy2009.a1.dfw_egu	
Scenario	2009 baseline [ppb]	DFW EGU Controls [ppb]	Difference [ppb]
Frisco	91.2	91.0	-0.25
Dallas C60	87.6	87.4	-0.16
Dallas C63	87.0	86.9	-0.15
Dallas C402	79.7	79.6	-0.06
Denton	89.6	89.5	-0.10
Midlothian	84.5	84.6	0.02
Arlington	87.2	87.1	-0.11
Fort Worth C13	87.6	87.6	-0.01
Fort Worth C17	86.0	85.9	-0.06

Table 4. Differences from the 2009 baseline design values [ppb].

Run	run44.fy2009.a1.dfw_major	run44.fy2009.a1.dfw_egu	
Scenario	DFW EGU + DFW Major Source Controls (Task 11) [ppb]	DFW EGU Controls [ppb]	Estimated DFW Major Source Controls ¹ [ppb]
Frisco	-0.36	-0.25	-0.11
Dallas C60	-0.33	-0.16	-0.17
Dallas C63	-0.33	-0.15	-0.18
Dallas C402	-0.40	-0.06	-0.34
Denton	-0.28	-0.10	-0.18
Midlothian	-0.61	0.02	-0.63
Arlington	-0.60	-0.11	-0.49
Fort Worth C13	-0.52	-0.01	-0.51
Fort Worth C17	-0.31	-0.06	-0.25

1. Estimated by assuming a linear relationship

Table 5. Exceedance Area (Number of 4-km grid cells in DFW with daily maximum 8-hour ozone > 85 ppb).

Run	run44.fy2009.a1	run44.fy2009.a1.dfw_egu	
Scenario	2009 Baseline	DFW EGU Controls	Difference
990815	19	19	0.0%
990816	223	223	0.0%
990817	296	292	-1.4%
990818	253	251	-0.8%
990819	304	303	-0.3%
990820	70	68	-2.9%
990821	29	28	-3.4%
990822	5	4	-20.0%
Totals	1199	1188	-0.9%

Table 6. Number of exceedance grid cells reduced at least 1 ppb.

Run	run44.fy2009.a1.dfw_egu
Scenario	DFW EGU Controls
990815	0
990816	0
990817	0
990818	0
990819	0
990820	0
990821	0
990822	0
Totals	0

Table 7. Number of ppb's exceeding 85 ppb¹ in the daily maximum ozone in DFW NAA.

Run	run44.fy2009.a1	run44.fy2009.a1.dfw_egu
Scenario	2009 Future Base	DFW EGU Controls
990815	50	44
990816	2184	2164
990817	2594	2563
990818	1660	1648
990819	1201	1177
990820	84	80
990821	74	67
990822	1	0
Total	7846	7744
% Reduced		-1.3%

¹ $\Sigma(\max(O_3-85, 0.0))$ for all grid cells in DFW

Summary

A CAMx sensitivity run examined the 8-hour ozone impact from NO_x controls on EGUs inside the DFW 9-county NAA to the same level as the Houston ESADs. The controls lowered NO_x emissions by 2.0 tpd. Most of the reductions were located in Dallas and Kaufman Counties.

Ozone benefits were greatest in northeast Dallas County, ranging from 0.7 to 1.1 ppb on dates with south or east winds. Frisco had the greatest future design value reduction of 0.25 ppb while Midlothian showed a slight gain of 0.02 ppb. Denton's future design value was 0.10 ppb lower. When compared to the future design value benefits from the combined DFW EGU and major source control scenario in Task 11, the northeastern DFW monitoring sites benefited more from the EGU controls while the southern and western sites benefited more from the DFW major source controls. The DFW EGU controls did not change the grid cell statistics significantly due to the small magnitude of NO_x reduction.