APPENDIX L

TNRCC MEMO, RESULTS OF ZERO-OUT MODELING FOR 1993, 1995, AND 1996 OZONE REGIONAL EPISODES, 1/18/00

REGIONAL STRATEGY

APRIL 2000 REVISION

Texas Natural Resource Conservation Commission

INTEROFFICE MEMORANDUM

To: Jim Thomas, Director
Technical Analysis Division

Date: January 18, 2000

Thru: Candy Garrett, Manager
Air Modeling & Data Analysis Section

From: Cyril Durrenberger, P.E.
Air Modeling & Data Analysis Section

Subject: Results of Zero-Out Modeling for 1993, 1995, and 1996 Ozone Regional Episodes.

As a part of ozone State Implementation Plan (SIP) development for the Houston/Galveston (HG) area, large scale regional modeling was performed to set boundary conditions for the urban scale modeling. This modeling was performed with the 1993 episode used for the HG area. Similar fashion episodes in 1995 and 1996 were used for modeling performed for SIP development in the Dallas/Fort Worth (DFW) area. The 1993, 1995, and 1996 ozone regional modeling episodes have been used to provide analyses of ozone over the eastern part of Texas. Base case model performance was evaluated for each area for which monitoring data was available. The performance varied, but generally was approximately as good as that obtained with other regional scale modeling, such as that performed by the Ozone Transport Assessment Group (OTAG). The model performance was adequate to have confidence in the relative results obtained from the modeling.

Modeling source areas with all anthropogenic emissions removed (zero-out) is one type of analysis that can be performed to evaluate the impact of transport from one source area on other areas. Zero-out modeling was performed with the 1993, 1995, and 1996 regional episodes because these episodes were readily available and results could be available quickly. The source areas for zero-out modeling were three Texas nonattainment areas (excluding El Paso) and five near nonattainment areas. These episodes were not designed to evaluate all possible combinations of impacts from any one area upon all other possible combinations. The results of this modeling are summarized below and more detailed analyses are also provided.

Executive Summary

General Conclusions

- Each modeled area adds to the background concentrations of ozone and aggravates the ozone problem for other Texas cities.

- For each area to reach attainment, it may be necessary for background concentrations to be reduced, so emissions within the entire eastern part of Texas may have to be controlled.

- Since each modeled area impacts at least one other ozone problem area, it would be practical to establish a single attainment date for all of Texas.

Specific Conclusions

- All eight Texas nonattainment and near nonattainment areas have urban ozone plumes that stretch downwind of the urban area and affect other areas in Texas.

- The impact area from each urban plume is episode specific and dependent upon the wind direction and dispersion occurring that day.

- The urban plumes disperse with distance with significant impact limited to about 300 miles downwind. Each plume adds to the background concentration of ozone, making it more difficult for the downwind areas to reach attainment, especially for the proposed 8-hour standard.

- HG emissions impact all seven other areas in Texas and impact Austin and San Antonio on every episode day.

- Beaumont/Port Arthur (BPA) emissions impact all seven other areas in Texas and impact the HG area on every episode day.

- Victoria emissions impact five of the seven other areas in Texas, most frequently impacting San Antonio and Austin.

- Some areas appear to have a relatively infrequent impact on other cities, but this may be an artifact of the episodes used.

Technical Analysis

Metrics

A number of metrics can be utilized for the evaluation, but this study was limited to the following two metrics:

1. The difference in maximum concentrations over each analysis area, and
2. The maximum difference between concentrations over the analysis area.

In addition, visual analyses can be performed with the maps that show modeled results. Especially important are the maps of the differences. These are the largest differences in each grid cell, not the differences between maximums in each grid cell.

Modeling for SIP development considers the maximum concentration over the nonattainment area as a key consideration in control strategy development. Thus, to evaluate the role of transport

into a nonattainment area, it is important to determine how the maximum concentration over the area changes. Not only is the change in maximum concentration important, but the magnitude of the maximum concentration is important. The most important impacts would be for concentrations that were above or near the standard. The first metric provides information on these conditions. However, the potential change in concentration is very dependent upon the meteorological parameters for the episode being modeled and is especially sensitive to wind direction. Therefore, the change in maximum concentration may not provide a good measure of the effect of transported emissions under other conditions. Over an area the maximum change in concentrations may be much larger at locations different from the location of the maximum concentration. Hence, the second metric provides another indication of the role of transport from the source area to each analysis area.

For this analysis modeled differences less than 2 parts per billion (ppb) were regarded as insignificant. One way to determine if there is a significant impact for modeled concentrations is to establish a level of significant impact. The U.S. Environmental Protection Agency has established significant impact levels for a number of pollutants and averaging times, but has not established a significant impact for ozone concentrations. For pollutants other than ozone, the significant impacts have been defined as approximately 2 percent of the standard. A significance level of 2 ppb was used for the modeling performed for OTAG. One approach to establishing a significant impact for ozone would be to use 2 percent of the standard. For the 1-hour ozone standard that would be 2.4 ppb and for the 8-hour ozone standard that would be 1.7 ppb. Thus, using 2 ppb as a significant impact is reasonable and consistent with the significant levels used in other cases.

Methodology

The study areas were the HG, DFW and BPA nonattainment areas. Additional study areas were multi-county near nonattainment areas around Austin, Corpus Christi, San Antonio, Tyler/Longview, and Victoria. Each study area was treated as a source area with its anthropogenic emissions zeroed out and then the impact was evaluated for each of the other areas.

Tables 1, 2, and 3 (attached) are summaries of the results. These show the number of days each source area makes a significant impact on each analysis area. In some cases, the impacts on a given analysis area may be small and for only one day. In other cases, the impacts are large and occur on many days. A total of 11 days was modeled. Table's 4 and 5 (attached) provide more detail than Tables 1, 2, and 3. All of the tabular results are included in the appendix. The results were also presented as isopleth maps. A few of the isopleth maps are included in the appendix. Additional isopleth maps can be reviewed by contacting Cyril Durrenberger at (512) 239-1482.

Conclusions

Table 1 indicates which areas each source area impacts. For the episodes modeled, these results show that the HG and BPA areas impact all other nonattainment and near nonattainment areas.

During the times modeled, the DFW area impacts the other nonattainment areas and two of the near nonattainment areas. For these three episodes, each near nonattainment area impacts at least one other near nonattainment area and some of the nonattainment areas. This indicates that a uniform year for attainment is needed for both the 1-hour and 8-hour standards. Also, this shows that emissions from Corpus Christi and Victoria affect 1-hour and soon to be designated 8-hour nonattainment areas.

Visual inspections of the difference maps show that emissions from HG and BPA impact large geographic areas. These maps also indicate that the most significant impact of Texas urban ozone plumes extends no farther than approximately 300 miles downwind.

These results should be placed in context of the episodes modeled. These episodes were not selected to evaluate transport, but were originally selected for urban scale modeling to support SIP development in the HG and DFW areas.

CD/lw

Attachments

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Table 1. Summary of Results of Zero-Out Regional Modeling

Source Area	Analysis Areas with Significant Impact
Houston/Galveston	Dallas/Fort Worth Beaumont/Port Arthur Austin Corpus Christi San Antonio Tyler/Longview Victoria
Dallas/Fort Worth	Houston/Galveston Beaumont/Port Arthur Austin Tyler/Longview
Beaumont/Port Arthur	Houston/Galveston Dallas/Fort Worth Austin Corpus Christi San Antonio Tyler/Longview Victoria
Austin	Dallas/Fort Worth San Antonio
Corpus Christi	San Antonio
San Antonio	Houston/Galveston Dallas/Fort Worth Austin
Tyler/Longview	Houston/Galveston Dallas/Fort Worth Beaumont/Port Arthur Austin
Victoria	Houston/Galveston Dallas/Fort Worth Austin Corpus Christi

San Antonio

Table 2. Summary of 1-Hour Zero-Out Modeling - Number of Days With Significant Impact

Source Area	Analysis Areas							
	HG	**DFW**	**BPA**	**Aus**	**CC**	**SA**	**TL**	**Vic**
HG		7	9	11	3	11	3	5
DFW	2		1	3			1	
BPA	11	1		4	1	3	3	3
Aus		3				9		
CC						4		
SA	1	1		5				
TL	5	7	3	3				
Vic	1	1		5	2	9		

Table 3. Summary of 8-Hour Zero-Out Modeling - Number of Days With Significant Impact

Source Area	Analysis Areas							
	HG	**DFW**	**BPA**	**Aus**	**CC**	**SA**	**TL**	**Vic**
HG		7	9	10	3	10	3	4
DFW	2			3			1	
BPA	11	1		5	1	3	3	3
Aus	3					10		
CC						3		
SA		1		6				
TL	5	6	4	4				

Vic		1		5	2	10		

Table 4. Summary of Results 1-Hour Zero-Out Modeling

Houston/Galveston Source Area

Data for Date of Maximum Difference					
Impact Area	**Total Number of Impact Days**	**Date**	**Base Case Max Conc**	**Zero-Out Max Conc**	**Maximum Difference**
DFW	7	6/20/95	112	112	4
BPA	9	9/9/93	165	130	72
Aus	11	9/11/93	106	98	24
CC	3	9/8/93	87	80	10
SA	11	9/7/93	123	107	27
TL	3	7/2/96	135	117	27
Vic	5	9/8/93	123	104	37

Beaumont/Port Arthur Source Area

Data for Date of Maximum Difference					
Impact Area	**Total Number of Impact Days**	**Date**	**Base Case Max Conc**	**Zero-Out Max Conc**	**Maximum Difference**
HGA	11	9/7/93	154	148	54
DFW	1	6/20/95	112	112	2
Aus	4	9/7/93	108	107	3
CC	1	9/8/93	87	86	2
SA	3	9/8/93	134	133	2
TL	3	7/2/96	135	133	9
Vic	3	9/7/93	100	98	4

Table 4. Summary of Results 1-Hour Zero-Out Modeling - Continued

Dallas/Fort Worth Source Area

Data for Date of Maximum Difference					
Impact Area	**Total Number of Impact Days**	**Date**	**Base Case Max Conc**	**Zero-Out Max Conc**	**Maximum Difference**
HGA	2	9/10/93	211	211	3
BPA	1	9/10/93	185	185	2
Aus	3	9/9/93	109	108	6
TL	1	9/9/93	122	119	7

Austin Source Area

Data for Date of Maximum Difference					
Impact Area	**Total Number of Impact Days**	**Date**	**Base Case Max Conc**	**Zero-Out Max Conc**	**Maximum Difference**
DFW	3	7/2/96	113	109	5
SA	9	9/10/93	122	117	32

Corpus Christi Source Area

Data for Date of Maximum Difference					
Impact Area	**Total Number of Impact Days**	**Date**	**Base Case Max Conc**	**Zero-Out Max Conc**	**Maximum Difference**
SA	4	7/2/96	82	80	4

Table 4. Summary of Results 1-Hour Zero-Out Modeling - Continued

San Antonio Source Area

Data for Date of Maximum Difference					
Impact Area	**Total Number of Impact Days**	**Date**	**Base Case Max Conc**	**Zero-Out Max Conc**	**Maximum Difference**
HG	1	7/4/96	162	162	2
DFW	1	7/2/96	113	112	4
Aus	5	9/11/93	106	106	5

Tyler/Longview Source Area

Data for Date of Maximum Difference					
Impact Area	**Total Number of Impact Days**	**Date**	**Base Case Max Conc**	**Zero-Out Max Conc**	**Maximum Difference**
HG	5	6/22/95	208	206	8
DFW	7	9/11/93	116	115	14
BPA	3	6/21/95	149	148	6
Aus	5	9/7/93	108	108	5

Victoria Source Area

Data for Date of Maximum Difference					
Impact Area	**Total Number of Impact Days**	**Date**	**Base Case Max Conc**	**Zero-Out Max Conc**	**Maximum Difference**
HG	1	7/3/96	162	162	2
DFW	1	7/2/96	113	112	2
Aus	5	9/11/93	106	106	5
CC	2	9/9/93	81	81	7
SA	9	7/2/96	84	84	11

Table 5. Summary of Results 8-Hour Zero-Out Modeling

Houston/Galveston Source Area

Data for Date of Maximum Difference					
Impact Area	**Total Number of Impact Days**	**Date**	**Base Case Max Conc**	**Zero-Out Max Conc**	**Maximum Difference**
DFW	7	6/20/95	104	104	4
BPA	9	9/9/93	149	112	71
Aus	10	9/11/93	86	82	20
CC	3	9/8/93	75	68	9
SA	10	9/7/93	108	92	28
TL	3	7/2/96	119	106	22
Vic	4	9/7/93	95	73	33

Beaumont/Port Arthur Source Area

Data for Date of Maximum Difference					
Impact Area	**Total Number of Impact Days**	**Date**	**Base Case Max Conc**	**Zero-Out Max Conc**	**Maximum Difference**
HGA	**11**	**9/7/93**	**139**	**135**	**51**
DFW	**1**	**6/20/95**	**104**	**104**	**2**
Aus	**5**	**9/7/93**	**100**	**99**	**3**
CC	**1**	**9/8/93**	**75**	**74**	**2**
SA	**3**	**9/7/93**	**108**	**107**	**3**
TL	**3**	**7/2/96**	**119**	**117**	**7**
Vic	**3**	**9/8/93**	**115**	**112**	**3**

Table 5. Summary of Results 8-Hour Zero-Out Modeling - Continued

Dallas/Fort Worth Source Area

Data for Date of Maximum Difference					
Impact Area	**Total Number of Impact Days**	**Date**	**Base Case Max Conc**	**Zero-Out Max Conc**	**Maximum Difference**
HGA	2	9/10/93	195	195	3
Aus	3	9/9/93	102	100	5
TL	1	9/9/93	112	110	6

Austin Source Area

Data for Date of Maximum Difference					
Impact Area	**Total Number of Impact Days**	**Date**	**Base Case Max Conc**	**Zero-Out Max Conc**	**Maximum Difference**
DFW	3	7/2/96	97	93	4
SA	10	9/10/93	105	100	27

Corpus Christi Source Area

Data for Date of Maximum Difference					
Impact Area	**Total Number of Impact Days**	**Date**	**Base Case Max Conc**	**Zero-Out Max Conc**	**Maximum Difference**
SA	3	7/2/96	72	70	4

Table 5. Summary of Results 8-Hour Zero-Out Modeling - Continued

San Antonio Source Area

Data for Date of Maximum Difference					
Impact Area	**Total Number of Impact Days**	**Date**	**Base Case Max Conc**	**Zero-Out Max Conc**	**Maximum Difference**
DFW	1	7/2/96	97	95	4
Aus	6	7/2/96	73	73	6

Tyler/Longview Source Area

Data for Date of Maximum Difference					
Impact Area	**Total Number of Impact Days**	**Date**	**Base Case Max Conc**	**Zero-Out Max Conc**	**Maximum Difference**
HG	5	6/21/95	173	173	7
DFW	6	9/11/93	103	102	10
BPA	4	9/10/93	167	167	5
Aus	4	9/8/93	119	118	5

Victoria Source Area

Data for Date of Maximum Difference					
Impact Area	**Total Number of Impact Days**	**Date**	**Base Case Max Conc**	**Zero-Out Max Conc**	**Maximum Difference**
DFW	1	7/2/96	97	96	2
Aus	5	9/11/93	86	86	9
CC	2	9/9/93	73	70	6

SA	10	9/10/93	105	102	10