2022 Transportation Conformity

Appendix 12.6: Applicable SIP Excerpts

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

AGENDA ITEM REQUEST

for State Implementation Plan Revision Adoption

AGENDA REQUESTED: July 6, 2016

DATE OF REQUEST: June 17, 2016

INDIVIDUAL TO CONTACT REGARDING CHANGES TO THIS REQUEST, IF NEEDED: Joyce Spencer-Nelson, (512) 239-5017

CAPTION: Docket No. 2015-1380-SIP. Consideration for adoption of revisions to the Dallas-Fort Worth (DFW) 2008 Eight-Hour Ozone Nonattainment Area Attainment Demonstration (AD) State Implementation Plan (SIP) Revision for the 2017 Attainment Year. The counties affected include Collin, Dallas, Denton, Ellis, Johnson, Kaufman, Parker, Rockwall, Tarrant, and Wise.

In the DFW AD SIP revision for the 2008 eight-hour ozone National Ambient Air Quality Standard (NAAQS) submitted to the EPA on July 10, 2015, a commitment was made to address the United States Court of Appeals for the District of Columbia Circuit decision that changed the attainment deadlines for the 2008 eight-hour ozone NAAQS to a July 20, 2018 attainment date and a 2017 attainment year. This SIP revision includes a photochemical modeling analysis, a weight of evidence analysis, and a reasonably available control measures analysis that reflect the 2017 attainment year. (Kathy Singleton, Terry Salem) (Non-rule Project No. 2015-014-SIP-NR)

Steve Hagle, P.E.	David Brymer
Deputy Director	**Division Director**

Joyce Nelson
Agenda Coordinator

Copy to CCC Secretary? NO X YES

Texas Commission on Environmental Quality
Interoffice Memorandum

To: Commissioners **Date:** June 17, 2016

Thru: Bridget C. Bohac, Chief Clerk
Richard A. Hyde, P.E., Executive Director

From: Steve Hagle, P.E., Deputy Director
Office of Air

Docket No.: 2015-1380-SIP

Subject: Commission Approval for Adoption of the Dallas-Fort Worth (DFW) 2008 Eight-Hour Ozone Nonattainment Area Attainment Demonstration (AD) State Implementation Plan (SIP) Revision for the 2017 Attainment Year

DFW 2008 Eight-Hour Ozone Standard AD SIP Revision
SIP Project No. 2015-014-SIP-NR

Background and reason(s) for the SIP revision:
The Federal Clean Air Act (FCAA) requires states to submit plans to demonstrate attainment of the National Ambient Air Quality Standards (NAAQS) for nonattainment areas within the state. On May 1, 2012, the 10-county DFW area, consisting of Collin, Dallas, Denton, Ellis, Johnson, Kaufman, Parker, Rockwall, Tarrant, and Wise Counties, was designated a moderate nonattainment area for the 2008 eight-hour ozone standard. The attainment date for the DFW moderate nonattainment area was established in the United States Environmental Protection Agency's (EPA) implementation rule for the 2008 ozone NAAQS published in the *Federal Register* (FR) on May 21, 2012 (77 FR 30160) and was set as December 31, 2018. Attainment of the standard (expressed as 0.075 parts per million) is achieved when an area's design value does not exceed 75 parts per billion (ppb).

On December 23, 2014, the United States Court of Appeals for the District of Columbia Circuit (D.C. Circuit Court) ruled on a lawsuit that resulted in vacatur of the EPA's December 31, 2018 attainment date for the 2008 0zone NAAQS. As a result of the court case, the attainment date for the DFW moderate nonattainment area was changed to July 20, 2018 with a 2017 attainment year (80 FR 12264). Due to the timing of the D.C. Circuit Court ruling and finalization of the 2008 ozone SIP requirements rule (effective April 6, 2015), the SIP development schedule did not allow for a full update of the DFW AD SIP revision to address the change in attainment year from 2018 to 2017. The DFW AD SIP revision that was submitted to the EPA on July 10, 2015 was developed based on the EPA's May 21, 2012 implementation rule for the 2008 ozone NAAQS (77 FR 30160), which set 2018 as the attainment year for areas classified as moderate. The deadline to submit AD SIP revisions for areas classified as moderate for the 2008 ozone NAAQS was July 20, 2015, which the EPA did not alter after the court's opinion. The DFW AD SIP revision included a commitment to develop a new AD SIP revision for the DFW 2008 eight-hour ozone nonattainment area to reflect the 2017 attainment year. This DFW AD SIP revision includes the following analyses to reflect the 2017 attainment year: a modeled AD, a reasonably available control measures (RACM) analysis, a weight of evidence (WoE) analysis, and a motor vehicle emissions budget (MVEB).

Scope of the SIP revision:
This memo applies to the DFW AD SIP revision for the 2008 Ozone NAAQS requirement under a moderate ozone nonattainment classification for the 2017 attainment year.

A.) Summary of what the SIP revision will do:
This DFW AD SIP revision demonstrates attainment of the 2008 eight-hour ozone NAAQS by July 20, 2018 based on a photochemical modeling analysis of reductions in nitrogen oxides (NO_X) and volatile organic compounds (VOC) emissions from existing control strategies and a WoE analysis.

B.) Scope required by federal regulations or state statutes:
The DFW AD SIP revision is consistent with the requirements of FCAA, §182(b)(1) and the EPA's 2008 ozone standard SIP requirements rule, published on March 6, 2015 (80 FR 12264). The FCAA-required SIP elements include a RACM analysis and an MVEB. Consistent with EPA guidance, this SIP revision also includes a modeled AD and a WoE analysis. As discussed above, due to the change in the required attainment date, this SIP revision, including the modeled AD, WoE, RACM, and MVEB elements, has been updated to address the 2017 attainment year. The peak ozone design value in 2017 for the DFW nonattainment area is projected to be 77 ppb using older EPA modeling guidance from 2007 and 76 ppb using newer draft guidance released by the EPA in December 2014.

C.) Additional staff recommendations that are not required by federal rule or state statute:
None

Statutory authority:
The authority to propose and adopt SIP revisions is derived from the following sections of Texas Health and Safety Code, Chapter 382, Texas Clean Air Act (TCAA), §382.002, which provides that the policy and purpose of the TCAA is to safeguard the state's air resources from pollution; §382.011, which authorizes the commission to control the quality of the state's air; and §382.012, which authorizes the commission to prepare and develop a general, comprehensive plan for the control of the state's air. This DFW AD SIP revision is required by FCAA, §110(a)(1) and implementing rules in 40 Code of Federal Regulations Part 51.

The DFW nonattainment area for the 1997 eight-hour ozone standard, comprised of Collin, Dallas, Denton, Ellis, Johnson, Kaufman, Parker, Rockwall, and Tarrant Counties, is required to continue to meet the mandates of FCAA, §172(c)(2) and §182(c)(2)(B) and requirements established under Phase II of the EPA's implementation rule for the 1997 eight-hour ozone NAAQS (70 FR 71615) for nonattainment areas classified as serious.

Re: Docket No. 2015-1380-SIP

Effect on the:

A.) Regulated community:
None

B.) Public:
The general public in the DFW ozone nonattainment area would benefit from improved air quality as a result of lower ozone levels.

C.) Agency programs:
None

Stakeholder meetings:
The North Central Texas Council of Governments hosted a meeting of the Air Quality Technical Committee on November 6, 2015. The purpose of this committee is to exchange information and provide a forum for public input on air quality issues in the DFW nonattainment area. Agenda topics included the status of DFW photochemical modeling development for the DFW 2008 Eight-Hour Ozone Standard Nonattainment Area AD SIP Revision for the 2017 Attainment Year. The committee includes representatives from industry, county and city government, environmental groups, and the public. More information about this committee is available on the NCTGOC's Air Quality Technical Committee Web page (http://www.nctcog.org/trans/committees/AQTC/index.asp).

Public comment:
The public comment period opened on December 11, 2015 and closed on January 29, 2016. The commission conducted a public hearing in Arlington on January 21, 2016, at 6:30 p.m., and in Austin on January 26, 2016, at 10:00 a.m. During the comment period, staff received comments from Amanda Crowe for United States Congresswoman Eddie Bernice Johnson (Congresswoman Johnson), the DFW Chapter of System Change Not Climate Change, Dallas City Councilmember Sandy Greyson (Councilmember Greyson), the Dallas County Medical Society, the Denton Drilling Awareness Group, Downwinders at Risk (Downwinders), Empowering Oak Cliff, Erin Moore for Dallas County Commissioner Dr. Theresa Daniel (Commissioner Daniel), the Fort Worth League of Neighborhood Associations, Frack Free Denton, Keep America Moving, the League of Women Voters of Dallas, the League of Women Voters of Irving, Liveable Arlington, the Lone Star Chapter of the Sierra Club, the North Texas Renewable Energy Group, Public Citizen, the Regional Transportation Council, the Sierra Club, the Sierra Club of Dallas, the Texas Campaign for the Environment, the Texas Medical Association, the EPA, and 51 individuals.

Generally, the commenters expressed their extreme displeasure with the poor air quality in DFW and how it adversely affects the public health, and with the SIP planning process that the commenters asserted has been ineffective for over 20 years. Also, many commenters expressed concern that the DFW nonattainment area continually falls short of complying with federal standards and stated that the current SIP revision should not be approved by the EPA without new controls and should be replaced with a federal implementation plan (FIP). Specific concerns by selected commenters are noted below.

- Congresswoman Johnson, Commissioner Daniel, Public Citizen, the Sierra Club of Dallas, the Dallas County Medical Society, the Texas Medical Association, Liveable Arlington, the Sierra Club and Downwinders, the Fort Worth League of Neighborhood Associations, Empowering Oak Cliff, and 40 individuals expressed concern for the DFW area's air quality and its impact on human health.

- Councilmember Greyson commented that after 20 years of plans that have not met clean air standards, the Texas Commission on Environmental Quality (TCEQ) needs to put a better plan in place than the one currently proposed.

- Many individuals commented that there is a need for meaningful pollution standards on oil and gas equipment, coal plants, cement kilns, and other major pollution sources. Several commenters expressed anger about ineffective SIP revisions, including the proposed DFW AD SIP revision, and expressed concern that the TCEQ does not adequately consider or address public comment through the SIP development process. Many commented that the people of DFW have suffered for many years under inadequate clean air plans, that the proposed SIP revision will not help to achieve cleaner air, and that the TCEQ does not consider the health and welfare of the public when developing SIP revisions.

- The Sierra Club and Downwinders provided information from a photochemical modeling analysis performed by the University of North Texas, which the commenters asserted shows that a mix of controls on oil and gas production, cement kilns in Ellis County, and coal fired power plants in East Texas will bring the DFW area into attainment of the 2008 ozone standard while yielding substantial economic development and creating jobs.
- The EPA commented that with the shorter attainment date, the EPA remains concerned that there are no new measures beyond federal measures and fleet turnover and additional local and regional ozone precursor emission reductions will be necessary to reach attainment by 2017. The EPA expressed appreciation for the TCEQ's consideration of the numerous measures to reduce emissions of ozone precursors, and noted that the TCEQ analysis indicates that a number of the measures would require local action to implement. The EPA encouraged the TCEQ to support local, voluntary implementation of the most cost effective measures, to the extent possible.

Summaries of public comments and TCEQ responses are included as part of the DFW AD SIP Revision.

Re: Docket No. 2015-1380-SIP

Significant changes from proposal:
None

Potential controversial concerns and legislative interest:
In its comments on the previous DFW AD SIP revision for the 2008 ozone NAAQS submitted to the EPA on July 10, 2015, the EPA indicated that the proposed reasonably available control technology (RACT) analysis for cement kilns should be reevaluated. In particular, the EPA indicated that the retirement of the higher emitting wet kilns and operation of more energy efficient and lower emitting dry kilns in Ellis County makes it necessary for the TCEQ to revisit its NO_X cap limit set forth in 2007 at 17.4 tons per day. The EPA further indicated that failure to conduct a thorough RACT analysis for cement kilns, which would include appropriate emission limits, would prevent it from approving the RACT portion of the attainment plan submittal. This SIP revision does not make any revisions to the cement kiln NO_X cap limit.

The EPA commented that it is unlikely the model projections of an additional 8 ppb reduction between 2015 and 2017 can be achieved without additional NO_X reduction on the order of 100 to 200 tons per day in the local area or a combination of local and larger upwind reductions are needed to achieve an 8 ppb drop in two years. Without emission reductions on this scale, the EPA commented that it is unlikely that the area will attain by the attainment date.

Does this SIP revision affect any current policies or require development of new policies?
No

What are the consequences if this SIP revision does not go forward? Are there alternatives to this SIP revision?
The commission could choose to not comply with requirements to develop and submit this DFW AD SIP revision to the EPA. If the DFW AD SIP revision is not submitted, the EPA could impose sanctions on the state and promulgate a FIP. Sanctions could include transportation funding restrictions, grant withholdings, and 200% emissions offsets requirements for new construction and major modifications of stationary sources in the DFW nonattainment area. The EPA could impose such sanctions and implement a FIP until the state submitted, and the EPA approved, a replacement DFW 2008 eight-hour ozone AD SIP revision for the area.

Agency contacts:
Kathy Singleton, SIP Project Manager, (512) 239-0703, Air Quality Division
Terry Salem, Staff Attorney, (512) 239-0469, Environmental Law Division

Re: Docket No. 2015-1380-SIP

cc: Chief Clerk, 2 copies
Executive Director's Office
Marshall Coover
Erin Chancellor
Stephen Tatum
Jim Rizk
Office of General Counsel
Kathy Singleton

REVISIONS TO THE STATE OF TEXAS AIR QUALITY IMPLEMENTATION PLAN FOR THE CONTROL OF OZONE AIR POLLUTION

DALLAS-FORT WORTH EIGHT-HOUR OZONE NONATTAINMENT AREA

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY
P.O. BOX 13087
AUSTIN, TEXAS 78711-3087

DALLAS-FORT WORTH 2008 EIGHT-HOUR OZONE STANDARD NONATTAINMENT AREA ATTAINMENT DEMONSTRATION STATE IMPLEMENTATION PLAN REVISION FOR THE 2017 ATTAINMENT YEAR

PROJECT NUMBER 2015-014-SIP-NR

Adoption
July 6, 2016

This page intentionally left blank

EXECUTIVE SUMMARY

On March 12, 2008, the United States Environmental Protection Agency (EPA) strengthened the eight-hour ozone standard from 0.08 parts per million (ppm) to 0.075 ppm. Under the 0.075 ppm (75 parts per billion [ppb]) standard, the EPA designated Collin, Dallas, Denton, Ellis, Johnson, Kaufman, Parker, Rockwall, Tarrant, and Wise Counties as nonattainment with a moderate classification, effective July 20, 2012. These 10 counties form the Dallas-Fort Worth (DFW) 2008 eight-hour ozone standard moderate nonattainment area. The attainment date for moderate nonattainment areas was established in the EPA's implementation rule for the 2008 ozone National Ambient Air Quality Standard (NAAQS), published in the *Federal Register* (FR) on May 21, 2012 (77 FR 30160), and was set as December 31, 2018.

On December 23, 2014, the United States Court of Appeals for the District of Columbia Circuit (D.C. Circuit Court) ruled on a lawsuit which resulted in vacatur of the EPA's December 31, 2018 attainment date for the 2008 0zone NAAQS. As a result of the court case, the attainment date for the DFW moderate nonattainment area was changed to July 20, 2018 with a 2017 attainment year (80 FR 12264). Due to the timing of the D.C. Circuit Court ruling and finalization of the 2008 ozone state implementation plan (SIP) requirements rule (effective April 6, 2015), the SIP development schedule did not allow for a full update of the DFW attainment demonstration (AD) SIP revision to address the change in attainment year from 2018 to 2017. The DFW AD SIP revision that was submitted to the EPA on July 10, 2015 was developed based on the EPA's May 21, 2012 implementation rule for the 2008 ozone NAAQS (77 FR 30160), which set 2018 as the attainment year for areas classified as moderate. The deadline to submit AD SIP revisions for areas classified as moderate for the 2008 ozone NAAQS was July 20, 2015, which the EPA did not alter. The DFW AD SIP revision included a commitment to develop a 2017 DFW AD SIP revision for the 2008 eight-hour ozone nonattainment area to reflect the 2017 attainment year.

This 2017 DFW AD SIP revision includes the following analyses to reflect the 2017 attainment year: a modeled AD, a reasonably available control measures analysis, a weight of evidence (WoE), and a motor vehicle emissions budget. This 2017 DFW AD SIP revision demonstrates attainment of the 2008 eight-hour ozone NAAQS by July 20, 2018 based on a photochemical modeling analysis of reductions in nitrogen oxides (NO_X) and volatile organic compounds (VOC) emissions from existing control strategies and a WoE analysis. The peak ozone design value predicted through credited reductions, but without considering additional reductions discussed as WoE, in 2017 for the DFW nonattainment area is projected to be 77 ppb using EPA guidance from April 2007 and 76 ppb using draft guidance released by the EPA in December 2014.

This 2017 DFW AD SIP revision for the 2008 ozone NAAQS also provides ozone reduction trends analyses and other supplementary data and information to demonstrate that the DFW 10-county nonattainment area will attain the 2008 eight-hour ozone standard by the July 20, 2018 attainment date. The quantitative and qualitative corroborative analyses in Chapter 5: *Weight of Evidence* demonstrates attainment of the 2008 eight-hour ozone standard. This 2017 DFW AD SIP revision includes base case modeling of an eight-hour ozone episode that occurred during June and August/September 2006. These time periods were chosen because they are representative of the times of the year that eight-hour ozone levels above 75 ppb have historically been monitored within the DFW nonattainment area. The model performance evaluation of the 2006 base case indicates the modeling is suitable for use in conducting the modeling attainment test. The modeling attainment test was applied by modeling a 2006 baseline year and 2017 future year to project 2017 eight-hour ozone design values.

Table ES-1: *Summary of 2006 Baseline and 2017 Future Year Anthropogenic Modeling Emissions for DFW* lists the anthropogenic modeling emissions in tons per day (tpd) by source category for the 2006 baseline and 2017 future year for NO_X and VOC ozone precursors. The differences in modeling emissions between the 2006 baseline and the 2017 future year reflect the net of growth and reductions from existing controls. The existing controls include both state and federal measures that have already been promulgated. The electric utility emissions for the 2006 ozone season are an average of actual emission measurements, while the 2017 electric utility emission projections are based on the maximum ozone season caps required under the Cross-State Air Pollution Rule (CSAPR).[1] The emission inputs in Table ES-1 were based on the latest available information at the time development work was done for this 2017 DFW AD SIP revision. A file format conversion error was detected with the 2017 airport emission estimates included with the proposal that has been corrected, resulting in an increase of 0.04 NO_X tpd and 0.10 VOC tpd and no change to the final 2017 future design values.

Table ES-1: Summary of 2006 Baseline and 2017 Future Year Anthropogenic Modeling Emissions for DFW

DFW Nonattainment Area Source Type	2006 NO_X (tpd)	2017 NO_X (tpd)	2006 VOC (tpd)	2017 VOC (tpd)
On-Road	284.27	130.77	116.50	64.91
Non-Road	98.06	45.54	64.69	34.01
Off-Road – Locomotives	20.14	12.88	1.28	0.67
Off-Road – Airports	12.78	12.36	4.46	2.99
Area Sources	29.02	26.55	290.46	236.70
Oil and Gas – Production	61.84	10.80	43.72	31.86
Oil and Gas – Drill Rigs	18.23	3.07	1.16	0.32
Point – Oil and Gas	11.53	16.50	21.82	25.80
Point – Electric Utilities	9.63	13.98	1.03	0.55
Point – Cement Kilns	22.08	17.64	1.94	0.77
Point – Other	14.31	6.68	25.65	20.26
Total	581.89	296.77	572.71	418.84

Table ES-2: *Summary of Modeled 2006 Baseline and 2017 Future Year Eight-Hour Ozone Design Values for DFW Monitors* lists the eight-hour ozone design values in ppb for the 2006 baseline year design value (DV_B) and 2017 future year design value (DV_F) for the regulatory ozone monitors in the DFW nonattainment area. In accordance with the EPA's *Guidance on the Use of Models and Other Analyses for Demonstrating Attainment of Air Quality Goals for Ozone, $PM_{2.5}$ and Regional Haze,* April 2007, the 2017 DV_F figures presented have been rounded to one decimal place and then truncated. The 2007 version of this modeling guidance recommends that the attainment test used to calculate DV_F figures rely on all baseline episode

[1] On July 28, 2015, the D.C. Circuit Court found that the CSAPR 2014 SO_2 and ozone season NO_X budgets for Texas and certain other states were invalid because the budgets required more emission reductions than were necessary. The court remanded the rule without vacatur to the EPA for reconsideration of the emission budgets. On December 3, 2015, the EPA proposed to address the ozone season NO_X budgets as part of the CSAPR Update Rule for the 2008 eight-hour ozone standard (80 FR 75706). Remanded SO_2 budgets are still to be resolved. Therefore, while the current CSAPR budgets for Texas are still in effect, the budgets may be subject to change in the future after the EPA's reconsideration, finalization of the CSAPR Update Rule, or changes resulting from further appeals.

days modeled above a specific threshold such as 75 ppb. The EPA released a draft update to this modeling guidance in December 2014 that recommends the attainment test rely on only the 10 days from the baseline episode with the highest modeled ozone. Table ES-2 includes the DV_F figures for both the "all days" and "top 10 days" tests. Since the modeling cannot provide an absolute prediction of future year ozone design values, additional information from corroborative analyses are used in assessing whether the area will attain the ozone standard by July 20, 2018.

Table ES-2: Summary of Modeled 2006 Baseline and 2017 Future Year Eight-Hour Ozone Design Values for DFW Monitors

2006 DFW Nonattainment Area Monitor and Continuous Air Monitoring Station (CAMS) Code	DFW Monitor Alpha Code	2006 Baseline Design Value (ppb)	2017 "All Days" DV_F (ppb)	2017 "Top 10 Days" DV_F (ppb)
Denton Airport South - C56	DENT	93.33	77	76
Eagle Mountain Lake - C75	EMTL	93.33	77	76
Grapevine Fairway - C70	GRAP	90.67	77	75
Keller - C17	KELC	91.00	76	75
Fort Worth Northwest - C13	FWMC	89.33	75	74
Frisco - C31	FRIC	87.67	74	73
Dallas North #2 - C63	DALN	85.00	73	72
Dallas Executive Airport - C402	REDB	85.00	72	72
Parker County - C76	WTFD	87.67	72	72
Cleburne Airport - C77	CLEB	85.00	71	69
Dallas Hinton Street - C401	DHIC	81.67	71	69
Arlington Municipal Airport - C61	ARLA	83.33	70	69
Granbury - C73	GRAN	83.00	68	68
Midlothian Tower - C94*	MDLT	80.50	67	67
Pilot Point - C1032*	PIPT	81.00	67	66
Rockwall Heath - C69	RKWL	77.67	65	65
Midlothian OFW - C52*	MDLO	75.00	63	62
Kaufman - C71	KAUF	74.67	62	62
Greenville - C1006	GRVL	75.00	61	62

*PIPT, MDLT, and MDLO did not measure enough data from 2004 through 2008 to calculate a complete DV_B. The DV_B shown uses all available data.

#The 2006 DV_B is different from the 2006 regulatory design value (DV_R). Figure 3-1: 2006 *Baseline Design Value Calculation* illustrates how the 2006 DV_B is calculated using the three years of DV_R data.

The 2017 DV_F calculations are provided using both the all days and top 10 days attainment tests discussed above. A WoE range of 73-78 ppb is inferred from the April 2007 guidance, and use of the older "all days" attainment test results in a peak ozone design value of 77 ppb that falls within this 73-78 ppb range. The draft guidance from December 2014 does not specify a WoE range, and instead requires that the DV_F figures be "close to the NAAQS." The newer "top 10 days" attainment test results in a peak ozone design value of 76 ppb that meets this requirement.

Differences in the application of these two tests are more thoroughly described in Chapter 3: *Photochemical Modeling*, Section 3.7.2: *Future Baseline Modeling*.

Because this SIP revision only provides an analyses to reflect the 2017 attainment year, all other sections have been labeled "no change." An electronic version of the 2018 DFW AD SIP revision for the 2008 Ozone NAAQS submitted to the EPA on July 10, 2015 can be found at the Texas Commission on Environmental Quality's (TCEQ) Dallas-Fort Worth: Latest Ozone Planning Activities Web page (https://www.tceq.texas.gov/airquality/sip/dfw/dfw-latest-ozone).

The TCEQ is committed to developing and applying the best science and technology towards addressing and reducing ozone formation as required in the DFW and other ozone nonattainment areas in Texas. This 2017 DFW AD SIP revision also includes a description of how the TCEQ continues to use new technology and investigate possible emission reduction strategies and other practical methods to make progress in air quality improvement.

SECTION V-A: LEGAL AUTHORITY

General

The Texas Commission on Environmental Quality (TCEQ) has the legal authority to implement, maintain, and enforce the National Ambient Air Quality Standards (NAAQS) and to control the quality of the state's air, including maintaining adequate visibility.

The first air pollution control act, known as the Clean Air Act of Texas, was passed by the Texas Legislature in 1965. In 1967, the Clean Air Act of Texas was superseded by a more comprehensive statute, the Texas Clean Air Act (TCAA), found in Article 4477-5, Vernon's Texas Civil Statutes. The legislature amended the TCAA in 1969, 1971, 1973, 1979, 1985, 1987, 1989, 1991, 1993, 1995, 1997, 1999, 2001, 2003, 2005, 2007, 2009, 2011, and 2013 and 2015. In 1989, the TCAA was codified as Chapter 382 of the Texas Health and Safety Code.

Originally, the TCAA stated that the Texas Air Control Board (TACB) is the state air pollution control agency and is the principal authority in the state on matters relating to the quality of air resources. In 1991, the legislature abolished the TACB effective September 1, 1993, and its powers, duties, responsibilities, and functions were transferred to the Texas Natural Resource Conservation Commission (TNRCC). With the creation of the TNRCC, the authority over air quality is found in both the Texas Water Code and the TCAA. Specifically, the authority of the TNRCC is found in Chapters 5 and 7. Chapter 5, Subchapters A - F, H - J, and L, include the general provisions, organization, and general powers and duties of the TNRCC, and the responsibilities and authority of the executive director. Chapter 5 also authorizes the TNRCC to implement action when emergency conditions arise and to conduct hearings. Chapter 7 gives the TNRCC enforcement authority. In 2001, the 77th Texas Legislature continued the existence of the TNRCC until September 1, 2013, and changed the name of the TNRCC to the TCEQ. In 2009, the 81st Texas Legislature, during a special session, amended section 5.014 of the Texas Water Code, changing the expiration date of the TCEQ to September 1, 2011, unless continued in existence by the Texas Sunset Act. In 2011, the 82nd Texas Legislature continued the existence of the TCEQ until 2023.

The TCAA specifically authorizes the TCEQ to establish the level of quality to be maintained in the state's air and to control the quality of the state's air by preparing and developing a general, comprehensive plan. The TCAA, Subchapters A - D, also authorize the TCEQ to collect information to enable the commission to develop an inventory of emissions; to conduct research and investigations; to enter property and examine records; to prescribe monitoring requirements; to institute enforcement proceedings; to enter into contracts and execute instruments; to formulate rules; to issue orders taking into consideration factors bearing upon health, welfare, social and economic factors, and practicability and reasonableness; to conduct hearings; to establish air quality control regions; to encourage cooperation with citizens' groups and other agencies and political subdivisions of the state as well as with industries and the federal government; and to establish and operate a system of permits for construction or modification of facilities.

Local government authority is found in Subchapter E of the TCAA. Local governments have the same power as the TCEQ to enter property and make inspections. They also may make recommendations to the commission concerning any action of the TCEQ that affects their territorial jurisdiction, may bring enforcement actions, and may execute cooperative agreements with the TCEQ or other local governments. In addition, a city or town may enact and enforce ordinances for the control and abatement of air pollution not inconsistent with the provisions of the TCAA and the rules or orders of the commission.

Subchapters G and H of the TCAA authorize the TCEQ to establish vehicle inspection and maintenance programs in certain areas of the state, consistent with the requirements of the Federal Clean Air Act; coordinate with federal, state, and local transportation planning agencies to develop and implement transportation programs and measures necessary to attain and maintain the NAAQS; establish gasoline volatility and low emission diesel standards; and fund and authorize participating counties to implement vehicle repair assistance, retrofit, and accelerated vehicle retirement programs.

Applicable Law

The following statutes and rules provide necessary authority to adopt and implement the state implementation plan (SIP). The rules listed below have previously been submitted as part of the SIP.

Statutes

All sections of each subchapter are included, unless otherwise noted.

Texas Health and Safety Code, Chapter 382	September 1, 2015
Texas Water Code	September 1, 2015

Chapter 5: Texas Natural Resource Conservation Commission

- Subchapter A: General Provisions
- Subchapter B: Organization of the Texas Natural Resource Conservation Commission
- Subchapter C: Texas Natural Resource Conservation Commission
- Subchapter D: General Powers and Duties of the Commission
- Subchapter E: Administrative Provisions for Commission
- Subchapter F: Executive Director (except §§5.225, 5.226, 5.227, 5.2275,5.231, 5.232, and 5.236)
- Subchapter H: Delegation of Hearings
- Subchapter I: Judicial Review
- Subchapter J: Consolidated Permit Processing
- Subchapter L: Emergency and Temporary Orders (§§5.514, 5.5145, and 5.515 only)
- Subchapter M: Environmental Permitting Procedures (§5.558 only)

Chapter 7: Enforcement

- Subchapter A: General Provisions (§§7.001, 7.002, 7.0025, 7.004, and 7.005 only)
- Subchapter B: Corrective Action and Injunctive Relief (§7.032 only)
- Subchapter C: Administrative Penalties
- Subchapter D: Civil Penalties (except §7.109)
- Subchapter E: Criminal Offenses and Penalties: §§7.177, 7.179-7.183

Rules

All of the following rules are found in 30 Texas Administrative Code, as of the following latest effective dates:

Chapter 7: Memoranda of Understanding, §§7.110 and 7.119
December 13, 1996 and May 2, 2002

Chapter 19: Electronic Reporting	March 15, 2007
Chapter 35: Subchapters A-C, K: Emergency and Temporary Orders and Permits; Temporary Suspension or Amendment of Permit Conditions	July 20, 2006

Chapter 39: Public Notice, §§39.402(a)(1) - (6), (8), and (10) - (12), 39.405(f)(3) and (g), (h)(1)(A) - (4), (6), (8) - (11), (i) and (j), 39.407, 39.409, 39.411(a), (e)(1) - (4)(A)(i) and (iii), (4)(B), (5)(A) and (B), and (6) - (10), (11)(A)(i) and (iii) and (iv), (11)(B) - (F), (13) and (15), and (f)(1) - (8), (g) and (h), 39.418(a), (b)(2)(A), (b)(3), and (c), 39.419(e), 39.420 (c)(1)(A) - (D)(i)(I) and (II), (D)(ii), (c)(2), (d) - (e), and (h), and 39.601 - 39.605 December 31, 2015

Chapter 55: Requests for Reconsideration and Contested Case Hearings; Public Comment, §§55.150, 55.152(a)(1), (2), (5), and (6) and (b), 55.154(a), (b), (c)(1) - (3), and (5), and (d) - (g), and 55.156(a), (b), (c)(1), and (g) December 31, 2015

Chapter 101: General Air Quality Rules June 25, 2015

Chapter 106: Permits by Rule, Subchapter A April 17, 2014

Chapter 111: Control of Air Pollution from Visible Emissions and Particulate Matter February 6, 2014

Chapter 112: Control of Air Pollution from Sulfur Compounds July 16, 1997

Chapter 113: Standards of Performance for Hazardous Air Pollutants and for Designated Facilities and Pollutants May 14, 2009

Chapter 114: Control of Air Pollution from Motor Vehicles May 21, 2015

Chapter 115: Control of Air Pollution from Volatile Organic Compounds June 25, 2015

Chapter 116: Permits for New Construction or Modification July 31, 2014

Chapter 117: Control of Air Pollution from Nitrogen Compounds June 25, 2015

Chapter 118: Control of Air Pollution Episodes March 5, 2000

Chapter 122: §122.122: Potential to Emit April 17, 2014

Chapter 122: §122.215: Minor Permit Revisions June 3, 2001

Chapter 122: §122.216: Applications for Minor Permit Revisions June 3, 2001

Chapter 122: §122.217: Procedures for Minor Permit Revisions December 11, 2002

Chapter 122: §122.218: Minor Permit Revision Procedures for Permit Revisions Involving the Use of Economic Incentives, Marketable Permits, and Emissions Trading June 3, 2001

SECTION VI: CONTROL STRATEGY

A. Introduction (No change)

B. Ozone (Revised)

   1. Dallas-Fort Worth (Revised)

      Chapter 1: General

      Chapter 2: Anthropogenic Emissions Inventory (EI) Description

      Chapter 3: Photochemical Modeling

      Chapter 4: Control Strategies and Required Elements

      Chapter 5: Weight of Evidence

      Chapter 6: Ongoing and Future Initiatives

   2. Houston-Galveston-Brazoria (No change)
   3. Beaumont-Port Arthur (No change)
   4. El Paso (No change)
   5. Regional Strategies (No change)
   6. Northeast Texas (No change)
   7. Austin Area (No change)
   8. San Antonio Area (No change)
   9. Victoria Area (No change)

C. Particulate Matter (No change)

D. Carbon Monoxide (No change)

E. Lead (No change)

F. Oxides of Nitrogen (No change)

G. Sulfur Dioxide (No change)

H. Conformity with the National Ambient Air Quality Standards (No change)

I. Site Specific (No change)

J. Mobile Sources Strategies (No change)

K. Clean Air Interstate Rule (No change)

L. Transport (No change)

M. Regional Haze (No change)

TABLE OF CONTENTS

LIST OF ACRONYMS

3-D	three-dimensional
ACT	alternative control techniques
AD	attainment demonstration
AGL	above ground level
AMPD	Air Markets Program Data
APCA	Anthropogenic Precursor Culpability Assessment
AQRP	Air Quality Research Program
ARLA	Arlington Monitor (C61)
Auto-GC	automated gas chromatograph
BACT	best available control technology
BOEMRE	United States Bureau of Ocean Energy Management Service
CAIR	Clean Air Interstate Rule
CAMS	Continuous Ambient Monitoring station
CAMx	Comprehensive Air Model with Extension(s)
CB05	Carbon Bond 05
CB6	Carbon Bond 6
CFR	Code of Federal Regulations
CISL	Computational and Information Systems Laboratory
CLEB	Cleburne Monitor (C77)
CLVL	Clarksville Monitor (C648)
CO	carbon monoxide
CSAPR	Cross-State Air Pollution Rule
CTG	control techniques guidelines
D.C.	District of Columbia
DALN	Dallas North Monitor (C63)
DENT	Denton Monitor (C56)
DERI	Diesel Emissions Reduction Incentive Program
DFW	Dallas-Fort Worth
DHIC	Dallas Hinton Monitor (C401)
DV_B	baseline year design value
DV_F	future year design value
DV_R	regulatory design value
EDMS	Emissions Dispersion Modeling System

EE	energy efficiency
EE/RE	energy efficiency and renewable energy
EGU	electric generating unit
EI	emissions inventory
EMTL	Eagle Mountain Lake Monitor (C75)
EPA	United States Environmental Protection Agency
EPS	Emissions Processing System
ERG	Eastern Research Group, Inc.
ESL	Energy Systems Laboratory
FAA	Federal Aviation Administration
FCAA	Federal Clean Air Act
FINN	Fire Inventory of NCAR
FR	*Federal Register*
FTP	File Transfer Protocol
FRIC	Frisco Monitor (C31)
FWMC	Fort Worth Northwest Monitor (C13)
FY	fiscal year
GCIP	Continental-International Project
GEOS-Chem	Goddard Earth Observing Station global atmospheric model with Chemistry
GEWEX	Global Energy and Water Cycle Experiment
GloBEIS	Global Biosphere Emissions and Interactions System
gm/hp-hr	grams per horsepower-hour
GOES	Geostationary Operational Environmental Satellite
GRAN	Granbury Monitor (C73)
GRAP	Grapevine Monitor (C70)
GRVL	Greenville Monitor (C1006)
GSE	ground support equipment
GWEI	Gulf-Wide Emissions Inventory
HB	House Bill
HECT	Highly Reactive Volatile Organic Compound Emissions Cap and Trade
HGB	Houston-Galveston-Brazoria
hp	horsepower
HPMS	Highway Performance Monitoring System
HRVOC	highly reactive volatile organic compounds
I/M	inspection and maintenance

ICI	industrial, commercial, and institutional
INEGI	National Institute of Statistics and Geography
ITHS	Italy High School (C60)
KAUF	Kaufman Monitor (C71)
KELC	Keller Monitor (C17)
km	kilometer
Kv	vertical diffusity
KVPATCH	landuse based minimum Kv for all domains
LAI	leaf area index
LAIv	fractional vegetated leaf area index
LANDFIRE	Landscape Fire and Resource Management
LCC	Lambert Conformal Conic
LIP	Local Initiative Projects
LIRAP	Low Income Vehicle Repair Assistance, Retrofit, and Accelerated Vehicle Retirement Program
m	meter
m/s	meters per second
MATS	Modeled Attainment Test Software
MACT	maximum achievable control technology
MDLO	Midlothian Old Fort Worth Monitor (C52)
MDLT	Midlothian Tower Monitor (C94)
MECT	Mass Emissions Cap and Trade
MEGAN	Model of Emissions of Gases and Aerosols from Nature
MM5	Mesoscale Meteorological Model, Fifth Generation
MMBTU	million British Thermal Units
MMcf	million cubic feet
MNB	Mean Normalized Bias
MNGE	Mean Normalized Gross Error
MODIS	Moderate-Resolution Imaging Spectroradiometer
MOVES	Motor Vehicle Emission Simulator
MOZART	Model for Ozone and Related Chemical Tracers
MPE	model performance evaluation
MVEB	motor vehicle emissions budget
MW	megawatt
MWh	megawatt-hours

NAAQS	National Ambient Air Quality Standard
NCAR	National Center for Atmospheric Research
NCEP	National Center for Environmental Prediction
NCTCOG	North Central Texas Council of Governments
NEI	National Emissions Inventory
NLCD	National Land Cover Dataset
NMIM	National Mobile Inventory Model
NO_2	nitrogen dioxide
NOAH	National Centers for Environmental Prediction, Oregon State, Air Force, and Hydrologic Research Laboratory
NO_X	nitrogen oxides
NSR	new source review
OMI	Ozone Monitoring Instrument
OSAT	Ozone Source Apportionment Technology
PAR	photosynthetically active radiation
PBL	planetary boundary layer
PEI	periodic emissions inventory
PFT	plant functional types
PiG	Plume-in-Grid
PIPT	Pilot Point Monitor (C1032)
PLTN	Palestine Monitor (C647)
$PM_{2.5}$	particulate matter with an aerodynamic diameter less than or equal to a nominal 2.5 micrometers
ppb	parts per billion
ppm	parts per million
PUCT	Public Utility Commission of Texas
RACM	reasonably available control measures
RACT	reasonably available control technology
RE	renewable energy
REDB	Dallas Executive Airport Monitor (C402)
RFP	reasonable further progress
RKWL	Rockwall Health Monitor (C69)
RRC	Railroad Commission of Texas
RRF	relative response factor
RRTM	Rapid Radiative Transfer Model
RS	redesignation substitute

RVP	Reid vapor pressure
SAGA	San Augustine Airport Monitor (C646)
SB	Senate Bill
SECO	State Energy Conservation Office
SIC	standard industrial classification
SIP	state implementation plan
SLAMS	State and Local Air Monitoring Stations
SO_2	sulfur dioxide
STARS	State of Texas Air Reporting System
TAC	Texas Administrative Code
TACB	Texas Air Control Board
TATU	TCEQ Attainment Test for Unmonitored Areas
TCAA	Texas Clean Air Act
TCEQ	Texas Commission on Environmental Quality (commission)
TCFP	Texas Clean Fleet Program
TCM	transportation control measure
TDM	travel demand model
TERP	Texas Emission Reduction Plan
TexAER	Texas Air Emissions Repository
TexAQS II	Texas Air Quality Study 2006
TexN	Texas NONROAD
TNGVGP	Texas Natural Gas Vehicle Grant Program
TNMOC	total non-methane organic carbon
TNRCC	Texas Natural Resource Conservation Commission
tpd	tons per day
tpy	tons per year
TTI	Texas Transportation Institute
TUC	Texas Utilities Code
TxDOT	Texas Department of Transportation
U.S.	United States
UMA	unmonitored area
UPA	Unpaired Peak Accuracy
UT-Austin	University of Texas at Austin
VMT	vehicle miles traveled
VNA	Voroni Neighbor Averaging

VOC	volatile organic compounds
WoE	weight of evidence
WPS	Weather Research and Forecasting Model Preprocessing System
WRF	Weather Research and Forecasting Model
WTFD	Weatherford Parker County Monitor (C76)
YSU	Yonsei University

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1: GENERAL

1.1 BACKGROUND (NO CHANGE)

1.2 INTRODUCTION (NO CHANGE)

1.2.1 One-Hour National Ambient Air Quality Standard (NAAQS) History (No change)

1.2.1.1 March 1999 (No change)

1.2.1.2 April 2000 (No change)

1.2.1.3 August 2001 (No change)

1.2.1.4 March 2003 (No change)

1.2.1.5 EPA Determination of One-Hour Ozone Attainment

Since the early 1990s, when the Dallas-Fort Worth (DFW) area was designated as nonattainment for the one-hour ozone standard, much has been done to bring the area into attainment with federal air quality standards. Contributions to improved air quality in the DFW nonattainment area include: Texas Commission on Environmental Quality (TCEQ)-implemented control strategies, local control strategies adopted by the North Central Texas Council of Governments (NCTCOG), and on-road and non-road mobile source measures implemented by the United States Environmental Protection Agency (EPA). Multiple state implementation plan (SIP) revisions have been submitted to the EPA and air quality in the DFW nonattainment area continues to improve.

In June 2005, the one-hour ozone standard was revoked after being replaced by the more stringent eight-hour ozone standard in 1997. By 2006, ambient monitoring data reflected attainment of the one-hour standard. On October 16, 2008, the EPA published final determination (73 *Federal* Register [FR] 61357) that the DFW area one-hour ozone nonattainment counties (Collin, Dallas, Denton, and Tarrant) had attained the one-hour ozone standard with a design value of 124 parts per billion (ppb), based on verified 2004 through 2006 monitoring data and continues to demonstrate attainment with a design value of 102 ppb based on certified data through 2014.

Since the DFW four-county area was not redesignated to attainment prior to the revocation of the one-hour ozone standard, anti-backsliding requirements for contingency measures and new source review (NSR) permitting requirements for serious nonattainment areas still apply. The EPA's *Implementation of the 2008 National Ambient Air Quality Standards for Ozone: State Implementation Plan Requirements; Final Rule* (2008 ozone standard SIP requirements rule) published in the *Federal Register* on March 6, 2015 (80 FR 12264), includes a mechanism for lifting anti-backsliding obligations under a revoked ozone NAAQS, termed a redesignation substitute (RS), based on Federal Clean Air Act (FCAA), §107(d)(3)(E) redesignation criteria. The EPA's approval of an RS would have the same effect on the area's nonattainment anti-backsliding obligations as would a redesignation to attainment for the revoked standard.

On August 18, 2015, the TCEQ submitted a DFW RS demonstration to the EPA in the form of a letter and attached report, followed by the formal SIP revision adoption in April 2015 should submittal of a SIP revision be necessary. The DFW RS demonstration is intended to satisfy the anti-backsliding obligations for the revoked one-hour and 1997 eight-hour ozone NAAQS by ensuring that the EPA's requirements for the redesignation of revoked ozone standards are met for the DFW ozone nonattainment area. The DFW RS demonstration was submitted to the EPA as provided for by the 2008 ozone standard SIP requirements rule instead of a redesignation request and maintenance plan, which the FCAA requires to remove anti-backsliding obligations under a standard that has not been revoked.

The DFW RS demonstrates that the DFW one-hour and 1997 eight-hour ozone areas will continue to attain the standards due to permanent and enforceable emission reductions and demonstrates continued attainment of both standards through 2028 via emissions inventory trends, 2012 attainment inventory, and projected future emissions. Since removing anti-backsliding obligations is contingent upon the EPA's approval, the TCEQ has set a horizon year of 2028. This 10-year period also aligns with the EPA's requirement of maintenance plans to demonstrate attainment for a 10-year period following the date of redesignation.

1.2.2 1997 Eight-Hour Ozone NAAQS History (No change)

1.2.2.1 May 23, 2007 (No change)

1.2.2.2 Reclassification to Serious for the 1997 Eight-Hour Ozone Standard (No change)

1.2.2.3 EPA Determination of Attainment for the 1997 Eight-Hour Ozone NAAQS

Under the serious classification, the DFW nonattainment area was given until June 15, 2013 to attain the 1997 eight-hour ozone NAAQS. The area did not monitor attainment by that date but at the end of the 2014 ozone season, the eight-hour design value was 81 ppb, based on 2012, 2013, and 2014 air monitoring data, which is in attainment of the 1997 eight-hour ozone standard. On February 24, 2015, the TCEQ submitted early certification of 2014 ozone air monitoring data to the EPA, along with a request for a determination of attainment for the 1997 eight-hour ozone standard for the DFW area. On September 1, 2015, the EPA published a determination of attainment for the DFW 1997 eight-hour ozone nonattainment area and disapproval of portions of the 2011 DFW 1997 Eight-Hour Ozone Attainment Demonstration (AD) SIP Revision (80 FR 52630). A revised attainment demonstration for the 1997 eight-hour ozone standard will not be required as a result of the EPA's determination of attainment.

The EPA revoked the 1997 eight-hour ozone standard in its 2008 ozone standard SIP requirements rule (80 FR 12264). Since the DFW nine-county area was not redesignated to attainment prior to the revocation of the one-hour or the 1997 eight-hour ozone standards, anti-backsliding requirements for contingency measures and NSR permitting requirements for serious nonattainment areas still apply.

As discussed in Section 1.2.1.5, *EPA Determination of One-Hour Ozone Attainment*, the TCEQ submitted a DFW RS demonstration to the EPA on August 18, 2015 in the form of a letter and attached report, followed by the formal SIP revision adoption in April 2016 should submittal be necessary. The DFW RS is intended to satisfy the anti-backsliding obligations for the revoked one-hour and 1997 eight-hour ozone NAAQS by ensuring that the EPA's requirements for the redesignation of revoked ozone standards are met for the DFW ozone nonattainment area.

1.2.3 2008 Eight-Hour Ozone NAAQS (No change)

1.2.4 AD SIP Revision for the 2008 Ozone NAAQS (No change)

1.2.5 Current AD SIP Revision for 2008 Ozone NAAQS for the 2017 Attainment Year

In the *DFW AD SIP Revision for the 2008 Ozone NAAQS* submitted to the EPA on July 10, 2015, the TCEQ committed to develop a new 2017 DFW AD SIP revision for the 2008 eight-hour ozone nonattainment area to include the following analyses to reflect the 2017 attainment year: a modeled AD, corroborative analysis, a reasonably available control measures analysis, and a motor vehicle emissions budget.

Because this SIP revision only provides an analyses to reflect the 2017 attainment year, all other sections have been labeled "no change." An electronic version of the 2018 DFW AD SIP revision for the 2008 Ozone NAAQS submitted to the EPA on July 10, 2015 can be found at the TCEQ's Dallas-Fort Worth: Latest Ozone Planning Activities Web page (https://www.tceq.texas.gov/airquality/sip/dfw/dfw-latest-ozone).

This 2017 DFW AD SIP revision demonstrates attainment of the 2008 eight-hour ozone NAAQS by July 20, 2018 based on a photochemical modeling analysis of reductions in nitrogen oxides (NO_X) and volatile organic compounds (VOC) emissions from existing control strategies and a weight of evidence analysis. The peak ozone design value in 2017 for the DFW nonattainment area is projected to be 77 ppb using EPA guidance from April 2007 and 76 ppb using draft guidance released by the EPA in December 2014.

1.2.6 Existing Ozone Control Strategies

Existing control strategies implemented to address the one-hour and eight-hour ozone standards are expected to continue to reduce emissions of ozone precursors in the DFW nonattainment area and positively impact progress toward attainment of the 1997 eight-hour ozone standard and the 2008 eight-hour ozone standard. The one-hour and eight-hour ozone design values for the DFW nonattainment area from 1991 through 2014 are illustrated in Figure 1-1: *One-Hour and Eight-Hour Ozone Design Values and DFW Population*. Both design values have decreased over the past 24 years. The 2015 one-hour ozone design value was 102 ppb, representing a 27% decrease from the value for 1991 (140 ppb). The 2015 eight-hour ozone design value was 83 ppb, a 21% decrease from the 1991 value of 105 ppb. These decreases occurred despite a 69% increase in area population from 1991 through 2014, as shown in Figure 1-1.

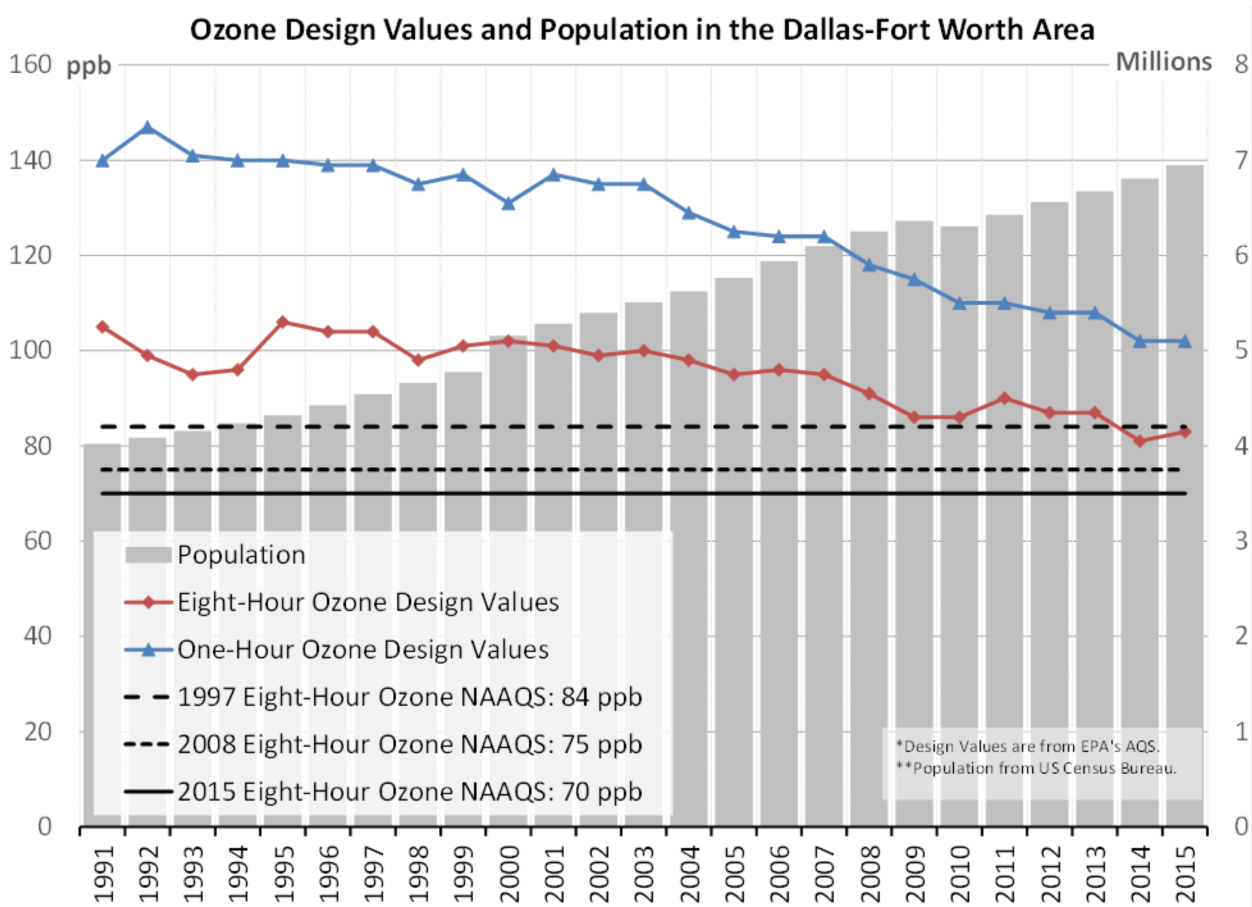


Figure 1-1: One-Hour and Eight-Hour Ozone Design Values and DFW Population

1.3 HEALTH EFFECTS (NO CHANGE)

1.4 STAKEHOLDER PARTICIPATION

1.4.1 DFW Air Quality Technical Committee Meetings

The NCTCOG hosted a meeting of the Air Quality Technical Committee on November 6, 2015. The purpose of this committee is to exchange information and provide a forum for public input on air quality issues in the DFW nonattainment area. Agenda topics included the status of DFW photochemical modeling development for the DFW 2008 Eight-Hour Ozone Standard Nonattainment Area AD SIP Revision for the 2017 Attainment Year. The committee includes representatives from industry, county and city government, environmental groups, and the public. More information about this committee is available on the NCTGOC's Air Quality Technical Committee Web page (http://www.nctcog.org/trans/committees/AQTC/index.asp).

1.5 PUBLIC HEARING INFORMATION

The public comment period opened on December 11, 2015, and closed on January 29, 2016. Notice of public hearings for this 2017 DFW AD SIP revision was published in the *Texas Register* and various newspapers. Written comments were accepted via mail, fax, and through the eComments (http://www1.tceq.texas.gov/rules/ecomments/index.cfm) system.

The commission conducted a public hearing in Arlington on January 21, 2016, at 6:30 p.m., and offered a public hearing in Austin on January 26, 2016, at 10:00 a.m. During the comment period, staff received comments from the DFW Chapter of System Change Not Climate Change, Dallas City Council member Sandy Greyson, Dallas County Commissioner Dr. Theresa Daniel, the Dallas County Medical Society, the Denton Drilling Awareness Group, Downwinders at Risk, Empowering Oak Cliff, the Fort Worth League of Neighborhoods, Frack Free Denton, Keep America Moving, the League of Women Voters of Dallas, the League of Women Voters of Irving, Liveable Arlington, the Lone Star Chapter of the Sierra Club, the North Texas Renewable Energy Group, the Regional Transportation Council, the Texas Campaign for the Environment, the Texas Medical Association, Public Citizen, the Regional Transportation Council, the Sierra Club, the Sierra Club of Dallas, United States Congresswoman Eddie Bernice Johnson, the EPA, and 51 individuals. Summaries of public comments and TCEQ responses are included as part of this 2017 DFW AD SIP revision.

An electronic version of the 2017 DFW AD SIP revision for the 2008 Ozone NAAQS and appendices can be found at the TCEQ's Dallas-Fort Worth: Latest Ozone Planning Activities Web page (https://www.tceq.texas.gov/airquality/sip/dfw/dfw-latest-ozone).

1.6 SOCIAL AND ECONOMIC CONSIDERATIONS (NO CHANGE)

1.7 FISCAL AND MANPOWER RESOURCES (NO CHANGE).

CHAPTER 2: ANTHROPOGENIC EMISSIONS INVENTORY (EI) DESCRIPTION

2.1 INTRODUCTION (NO CHANGE)

2.2 POINT SOURCES (NO CHANGE)

2.3 AREA SOURCES

Stationary sources that do not meet the reporting requirements for point sources are classified as area sources. Area sources are small-scale industrial, commercial, and residential sources that use materials or perform processes that generate emissions. Examples of sources of volatile organic compounds (VOC) emissions include the following: oil and gas production facilities, printing processes, industrial coating and degreasing operations, gasoline service station underground tank filling, and vehicle refueling operations. Examples of typical fuel combustion sources include the following: oil and gas production facilities, stationary source fossil fuel combustion at residences and businesses, outdoor burning, structural fires, and wildfires.

Emissions for area sources are calculated as county-wide totals rather than as individual sources. Area source emissions are typically calculated by applying a United States Environmental Protection Agency (EPA)-established emission factor (emissions per unit of activity) by the appropriate activity or activity surrogate responsible for generating emissions. Population is one of the more commonly used activity surrogates for area source calculations. Other activity data commonly used are the amount of gasoline sold in an area, employment by industry type, and crude oil and natural gas production.

The air emissions data from the different area source categories are collected, reviewed for quality assurance, stored in the Texas Air Emissions Repository database system, and compiled to develop the statewide area source EI. This area source periodic emissions inventory (PEI) is reported every third year (triennially) to the EPA for inclusion in the National Emissions Inventory. The Texas Commission on Environmental Quality (TCEQ) submitted the most recent PEI for calendar year 2014.

2.4 NON-ROAD MOBILE SOURCES

Non-road vehicles do not normally operate on roads or highways and are often referred to as off-road or off-highway vehicles. Non-road emissions sources include, but are not limited to: agricultural equipment; commercial and industrial equipment; construction and mining equipment; lawn and garden equipment; aircraft and airport equipment; locomotives; and commercial marine vessels. A Texas-specific version of the EPA's latest NONROAD 2008a model, called the Texas NONROAD (TexN) model, was used to calculate emissions from all non-road mobile source equipment and recreational vehicles, with the exception of airports, locomotives, and drilling rigs used in upstream oil and gas exploration activities. While the TexN model utilizes input files and post-processing routines to estimate Texas specific emissions estimates, it retains the EPA NONROAD 2008a model to conduct the basic emissions estimation calculations. Several input files provide necessary information to calculate and allocate emission estimates. The inputs used in the TexN model include emission factors, base year equipment population, activity, load factor, meteorological data, average lifetime, scrappage function, growth estimates, emission standard phase-in schedule, and geographic and temporal allocation. TexN 1.7.1 was used to estimate non-road emissions for this Dallas-Fort Worth (DFW) Attainment Demonstration (AD) State Implementation Plan (SIP) revision.

Because emissions for airports and locomotives are not included in either the NONROAD model or the TexN model, the emissions for these categories are estimated using other EPA-approved methods and guidance. Emissions for the source categories that are not in the EPA NONROAD

2008a model are estimated using other EPA-approved methods and guidance documents. Airport emissions are calculated using the Federal Aviation Administration's Emissions and Dispersion Modeling System. Locomotive emission estimates for Texas are based on specific fuel usage data derived from railway segment level gross ton mileage activity (line haul locomotives) and hours of operation (yard locomotives) provided directly by the Class I railroad companies operating in Texas. Although emissions for oilfield drilling rigs are included in the NONROAD model, alternate emissions estimates were developed for that source category in order to develop more accurate inventories. Drilling rig inventories are developed using improved drilling rig emissions characterization profiles based on 2015 survey data from Texas oil and gas companies. These drilling rig emissions characterization profiles are combined with drilling activity data obtained from the Railroad Commission of Texas (RRC) to develop drilling rig emissions estimates. The equipment populations for drilling rigs were set to zero in the TexN model to avoid double counting emissions from these sources.

2.5 ON-ROAD MOBILE SOURCES (NO CHANGE)

2.6 EI IMPROVEMENT

The TCEQ EI reflects years of emissions data improvement, including extensive point and area source inventory reconciliation with ambient emissions monitoring data. The following projects have significantly improved the DFW point source and area source inventory for oil and gas related activities in recent years.

- TCEQ Work Order Nos. 582-7-84003-FY-10-26 and 582-7-84005-FY-10-29 quantified nitrogen oxides (NO_X) and VOC emissions from various oil and gas processes and produced water storage tanks at upstream oil and gas operations Texas, which the TCEQ has added to the area source inventory.
- The TCEQ conducted a special inventory of companies that own or operate leases or facilities associated with Barnett Shale oil and gas operations. The TCEQ conducted the special EI under the authority of 30 Texas Administrative Code §101.10(b)(3) to determine the location, number, and type of emission sources associated with upstream and midstream oil and gas operations in the Barnett Shale. The results of the special inventory were used to improve the compressor engine population profiles in both the DFW nine-county 1997 eight-hour ozone nonattainment area as well as the ozone nonattainment Barnett Shale counties. This improved profile was used in determining the area source emissions estimates for this source category.
- The TCEQ conducted two surveys of pneumatic devices at oil and gas wells. The first survey was conducted in 2011 and focused on the Barnett Shale area. The second survey was conducted in 2012 and focused on the remainder of the state. The results of the 2011 pneumatic device survey were used to update emission factors and activity data (including the average number of pneumatic devices per well) in the Barnett Shale area. In addition, revised bleed rate information from the EPA's Oil and Gas Emission Estimation Tool was used in the development of the emission factors.
- TCEQ Work Order No. 582-11-99776-FY11-05 developed improved drilling rig emissions characterization profiles. The drilling rig emissions characterization profiles from this study were combined with drilling activity data obtained from the RRC to develop area source emissions estimates for this source category.
- TCEQ Work Order No. 582-11-99776-FY12-12 developed projection factors for oil and gas sources from a 2011 baseline year through 2035. Using historical data from the RRC, different projection methodologies were considered with the most robust one being based on the Hubbert peak curve theory. Yearly production factors are provided for the Barnett, Eagle Ford, and Haynesville shale formations, with separate factors for oil, natural gas, and

condensate. The Barnett Shale factors were used for the DFW ten-county 2008 eight-hour ozone nonattainment area.

- TCEQ Work Order No. 582-11-99776-FY12-11 refined emissions factors and methods to estimate emissions from condensate storage tanks for area source inventory development at the county-level. The project developed region-specific emission factors and control factors for eight geographic regions in the state.
- A study contracted to Eastern Research Group, Inc. (ERG) was completed on August 1, 2014 that updated emission rates for hydraulic pump engines and mud degassing activities associated with oil and gas production. The oil and gas emissions estimates included with the 2018 DFW AD SIP revision were developed with older emission factors for this type of activity.
- Revised 2014 historical production data became available from the RRC, which impacted 2017 projections of emissions from natural gas compressor engines. These updated RRC data sets were used for projecting the 2017 oil and gas emission estimates included with this 2017 DFW AD SIP revision.

In addition to these projects, the TCEQ annually updates and publishes *Emissions Inventory Guidelines* (RG-360), a comprehensive guidance document that explains all aspects of the point source EI process. The latest version of this document is available on the TCEQ's Point Source Emissions Inventory Web page (http://www.tceq.state.tx.us/implementation/air/industei/psei/psei.html). Currently, six technical supplements provide detailed guidance on determining emissions from potentially underreported VOC emissions sources such as cooling towers, flares, and storage tanks.

CHAPTER 3: PHOTOCHEMICAL MODELING

3.0 INTRODUCTION

This chapter describes modeling conducted in support of the 2017 Dallas-Fort Worth (DFW) Attainment Demonstration (AD) State Implementation Plan (SIP) Revision for the 2008 Eight-Hour Ozone Standard. The DFW ozone nonattainment area consists of Collin, Dallas, Denton, Ellis, Johnson, Kaufman, Parker, Rockwall, Tarrant, and Wise Counties. The 1990 Federal Clean Air Act (FCAA) Amendments require that ADs be based on photochemical grid modeling or any other analytical methods determined by the United States Environmental Protection Agency (EPA) to be at least as effective. When development work on this 2017 DFW AD SIP revision commenced in 2012, the EPA's April 2007 *Guidance on the Use of Models and Other Analyses for Demonstrating Attainment of Air Quality Goals for Ozone, $PM_{2.5}$, and Regional Haze* (EPA, 2007) was the latest modeling guidance available. The EPA released an update to this guidance in December 2014 entitled *Draft Modeling Guidance for Demonstrating Attainment of Air Quality Goals for Ozone, $PM_{2.5}$, and Regional Haze* (EPA, 2014). The April 2007 document will be referred to as either the "2007 guidance" or "2007 modeling guidance," and the December 2014 version will be referred to as either the "draft guidance" or "draft modeling guidance."

Both the 2007 and draft guidance documents recommend air quality modeling procedures for predicting attainment of the eight-hour ozone National Ambient Air Quality Standard (NAAQS). They recommend several qualitative methods for preparing ADs that acknowledge the limitations and uncertainties of photochemical models when used to project ozone concentrations into future years. First, both modeling guidance documents recommend using model results in a relative sense and applying the model response to the observed ozone data. Second, both modeling guidance documents recommend using available air quality, meteorology, and emissions data to develop a conceptual model for eight-hour ozone formation and to use that analysis in episode selection. Third, both modeling guidance documents recommend using other analyses, i.e., weight of evidence (WoE), to supplement and corroborate the model results and support the adequacy of a proposed control strategy package.

A large portion of the modeling and technical analysis for this 2017 DFW AD SIP revision was done prior to release of the current draft guidance, so the development work is consistent with the 2007 guidance. However, most of these procedures are very similar between the 2007 guidance and draft guidance. A notable difference is that the 2007 guidance recommends the attainment test be performed for all baseline episode days modeled above a specific threshold, while the draft guidance recommends performing the test for only the 10 days from the baseline with the highest modeled ozone values. Chapter 3: *Photochemical Modeling*, Section 3.7.2: *Future Baseline Modeling*, summarizes these attainment tests in more detail and provides the results for both approaches.

The remainder of this chapter includes an overview of the photochemical modeling, while portions of Chapter 5: *Weight of Evidence* discuss the conceptual model and WoE analyses. More detail on each of these components can be found in the following appendices to this 2017 DFW AD SIP revision:

- Appendix A: *Meteorological Modeling for the DFW Attainment Demonstration SIP Revision for the 2008 Eight-Hour Ozone Standard*;
- Appendix B: *Emissions Modeling for the DFW Attainment Demonstration SIP Revision for the 2008 Eight-Hour Ozone Standard*;
- Appendix C: *Photochemical Modeling for the DFW Attainment Demonstration SIP Revision for the 2008 Eight-Hour Ozone Standard*;

- Appendix D: *Conceptual Model for the DFW Attainment Demonstration SIP Revision for the 2008 Eight-Hour Ozone Standard*; and
- Appendix E: *Modeling Protocol for the DFW Attainment Demonstration SIP Revision for the 2008 Eight-Hour Ozone Standard*.

The 1990 FCAA Amendments established five classifications for ozone nonattainment areas based on the magnitude of the regional one-hour ozone design value. Based on the monitored one-hour ozone design value at that time, four counties in the DFW area (Collin, Dallas, Denton, and Tarrant) were classified as a moderate nonattainment area. As published in the October 16, 2008 edition of the *Federal Register* (FR), the EPA determined the four-county DFW area to be in attainment of the one-hour ozone standard based on 2004 through 2006 monitored data (73 FR 61357).

With the change of the ozone NAAQS from a one-hour standard to an eight-hour standard in 1997, the EPA classified the DFW area as a moderate ozone nonattainment area in 2004 with an attainment date of June 15, 2010. Five additional counties (Ellis, Johnson, Kaufman, Parker, and Rockwall) were added to the four original one-hour standard nonattainment counties to create the nonattainment area for the 1997 eight-hour standard. Ozone AD SIP revisions addressing the 1997 eight-hour ozone standard were required to be submitted to the EPA by June 15, 2007. In May 2007, photochemical modeling and other analyses conducted by the Texas Commission on Environmental Quality (TCEQ) were included in the AD SIP revision submitted to the EPA supporting the DFW area's attainment of the 1997 eight-hour ozone standard by June 15, 2010. The EPA published final conditional approval of the May 2007 DFW AD SIP Revision on January 14, 2009 (*74 FR 1903*).

In 2009, the monitored design value (complete ozone season prior to the attainment date) for the DFW area was 86 parts per billion (ppb), which is 2 ppb above the attainment level. The EPA published the final rule to determine the DFW area's failure to attain the 1997 eight-hour ozone standard and reclassify the DFW area as a serious nonattainment area on December 10, 2010 (*75 FR 79302*). The attainment date for the serious classification was June 15, 2013. The EPA prescribed that the attainment test be applied to the 2012 previous ozone season to determine compliance with the 2013 attainment date. Based on the fourth highest ozone readings per monitor from 2010, 2011, and 2012, 15 of the 17 regulatory monitors active within DFW during this time period had three-year ozone design values ranging from 69 to 83 ppb. However, two regulatory monitors had three-year ozone design values above the 84 ppb standard. The Keller monitor had a 2012 design value of 87 ppb, and the Grapevine Fairway monitor had a 2012 design value of 86 ppb. Both of these monitors are located in the northwest quadrant of the DFW nonattainment area where the highest ozone concentrations have historically been measured.

Ozone nonattainment designations under the revised 2008 eight-hour ozone standard became effective on July 20, 2012. Wise County was added to the nine nonattainment counties, which resulted in a 10-county DFW nonattainment area for the 2008 eight-hour ozone standard. The DFW area was classified as moderate nonattainment with a required attainment date of December 31, 2018. In July 2015, photochemical modeling and other analyses conducted by the TCEQ were included in the AD SIP revision submitted to the EPA supporting the DFW area's attainment of the 1997 eight-hour ozone standard by December 31, 2018.

On December 23, 2014, the United States Court of Appeals for the District of Columbia Circuit (D.C. Circuit Court) ruled on a lawsuit filed by the Natural Resources Defense Council, which resulted in vacatur of the EPA's December 31 attainment date for the 2008 0zone NAAQS. As a result, the attainment date for the DFW moderate nonattainment area was changed from December 31, 2018 to July 20, 2018, which requires modeling a 2017 future year for the AD because it contains the full ozone season immediately preceding the attainment date. This 2017 DFW AD SIP revision uses photochemical modeling in combination with corroborative analyses to support a conclusion that the 10-county DFW nonattainment area will attain the 2008 eight-hour ozone standard of 75 ppb by July 20, 2018. Also, the limited data collected in the DFW nonattainment area during Texas Air Quality Study 2006 (TexAQS II) is used to evaluate the model's performance and to improve understanding of the physical and chemical processes leading to ozone formation.

3.1 OVERVIEW OF THE OZONE PHOTOCHEMICAL MODELING PROCESS

The modeling system is composed of a meteorological model, several emissions processing models, and a photochemical air quality model. The meteorological and emission models provide the major inputs to the air quality model.

Ozone is a secondary pollutant; it is not generally emitted directly into the atmosphere. Ozone is created in the atmosphere by a complex set of chemical reactions between sunlight and several primary (directly emitted) pollutants. The reactions are photochemical and require ultraviolet energy from sunlight. The majority of primary pollutants directly involved in ozone formation fall into two groups, nitrogen oxides (NO_X) and volatile organic compounds (VOC). In addition, carbon monoxide (CO) is also an ozone precursor, but much less effective than either NO_X or VOC in forming ozone. As a result of NO_X and VOC reacting in the presence of sunlight, higher eight-hour concentrations of ozone are most common during the summer when daytime hours are extended, with concentrations peaking during the day and falling during the night and early morning hours.

Ozone chemistry is complex, involving hundreds of chemical compounds and chemical reactions. As a result, ozone cannot be evaluated using simple dilution and dispersion algorithms. Due to this chemical complexity, the 2007 and draft modeling guidance documents strongly recommend using photochemical computer models to simulate ozone formation and to evaluate the effectiveness of future control strategies. Computer simulations are the most effective tools to address both the chemical complexity and the future case evaluation.

3.2 OZONE MODELING

Ozone modeling involves two major phases, the base case modeling phase and the future year modeling phase. The purpose of the base case modeling phase is to evaluate the model's ability to adequately replicate measured ozone and ozone precursor concentrations during recent periods with high ozone concentrations. The purpose of the future year modeling phase is to predict attainment year ozone design values at each monitor and to evaluate the effectiveness of controls in reaching attainment. The TCEQ developed a modeling protocol, which is attached as Appendix E, describing the process to be followed to evaluate the ozone in the urban area as prescribed by the 2007 guidance available at the time. This modeling protocol was originally submitted to the EPA in August 2013.

3.2.1 Base Case Modeling

Base case modeling involves several steps. First, ozone episodes are analyzed to determine what factors were associated with ozone formation in the area and whether those factors were consistent with the conceptual model and the EPA's episode selection criteria. Once an episode is selected, emissions and meteorological data are generated and quality assured. Then the meteorological and emissions (NO_X, VOC, and CO) data are input to the photochemical model and the ozone photochemistry is simulated, resulting in predicted ozone and ozone precursor concentrations.

Base case modeling results are evaluated by comparing them to the observed measurements of ozone and ozone precursors that were monitored during the base case period. Typically, this step is an iterative process incorporating feedback from successive evaluations to ensure that the model is adequately replicating observations throughout the modeling episode. The adequacy of the model in replicating observations is assessed statistically and graphically as recommended in the 2007 and draft modeling guidance documents. Additional analyses using special study data are included when available. Satisfactory performance of the base case modeling provides a degree of reliability that the model can be used to predict future year ozone concentrations (future year design values), as well as to evaluate the effectiveness of possible control measures.

3.2.2 Future Year Modeling

Future year modeling involves several steps. The procedure for predicting a future year ozone design value (attainment test) involves determining the ratio of the future year to the baseline year modeled ozone concentrations. This ratio is called the relative response factor (RRF). Whereas the emissions data for the base case modeling are episode-specific, the emissions data for the baseline year are based on typical ozone season emissions. Similarly, the emissions data for the future year are developed by applying growth and control factors to the baseline year emissions. Growth projections are based on expected increases in factors such as human population, vehicle miles traveled (VMT), and demand for goods and services. Controls are applied to reflect expected emission rate reductions that are scheduled to occur from state, local, and federal programs. For example, the periodic tightening of vehicle emission standards leads to lower average tailpipe emission rates over time.

Both the baseline and future years are modeled using their respective ozone season emissions and the base case episode meteorological data as inputs. The same meteorological data are used for modeling both the baseline and future years. Thus, the ratio of future year modeled ozone concentrations to the baseline year concentrations provides a measure of the response of ozone concentrations to the change in emissions from projected growth and controls.

A future year ozone design value is calculated by multiplying the RRF by a baseline year ozone design value (DV_B). The DV_B is the average of the regulatory design values for the three consecutive years containing the baseline year, as show in Figure 3-1: *2006 Baseline Design Value Calculation*. A calculated future year ozone design value of less than or equal to 75 ppb signifies modeled attainment. The model can also be used to test the effectiveness of various control measures when evaluating control strategies.

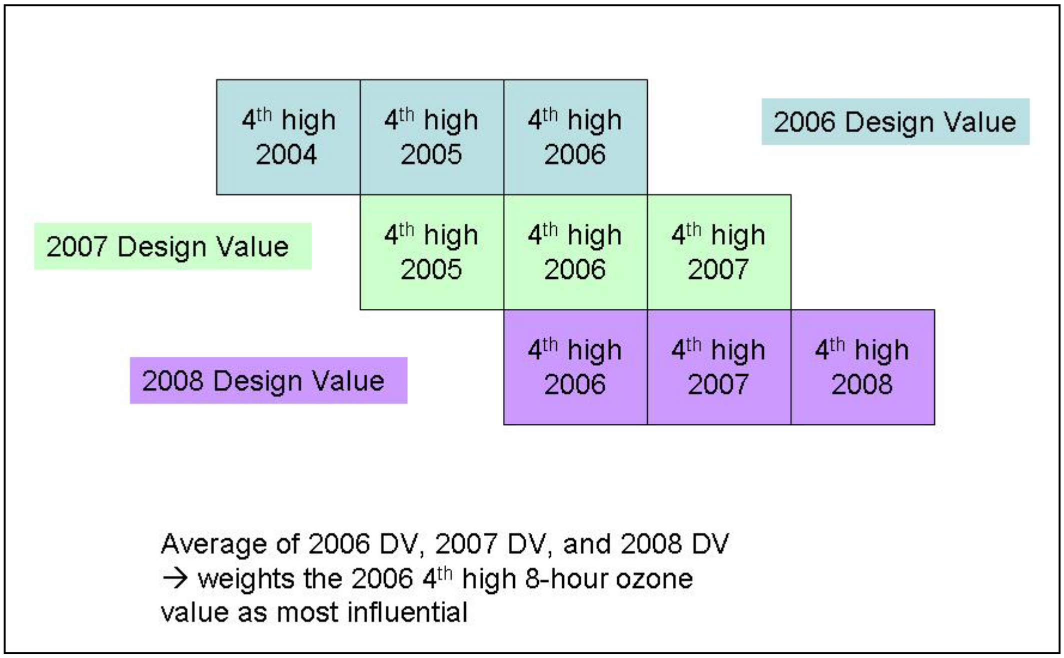


Figure 3-1: 2006 Baseline Design Value Calculation

3.3 EPISODE SELECTION

3.3.1 EPA Guidance for Episode Selection

When development work commenced for this 2017 DFW AD SIP revision in 2012, the EPA's 2007 guidance for the 1997 eight-hour ozone standard of 84 ppb was in effect. The episode selection work for this attainment analysis was done in accordance with this 2007 guidance, but the requirements are similar for the draft guidance. The primary criteria for selecting ozone episodes for eight-hour ozone AD modeling are set forth in the 2007 guidance (as modified for the 2008 eight-hour ozone standard) and shown below.

- Select periods reflecting a variety of meteorological conditions that frequently correspond to observed eight-hour daily maximum ozone concentrations greater than 75 ppb at different monitoring sites.
- Select periods during which observed eight-hour ozone concentrations are close to the eight-hour ozone design values at monitors with a DV_B greater than or equal to 75 ppb.
- Select periods for which extensive air quality and/or meteorological data sets exist.
- Model a sufficient number of days so that the modeled attainment test can be applied at all of the ozone monitoring sites that are in violation of the eight-hour ozone NAAQS.

Based on these criteria, the TCEQ selected ozone episodes from June 2006 and August/September 2006 for use in this 2017 DFW AD SIP revision.

3.3.2 DFW Ozone Episode Selection Process

As shown in Figure 3-2: *DFW Eight-Hour Ozone Days Above 75 ppb by Month from 1991 through 2014*, the highest ozone levels in DFW typically follow a bi-modal pattern with peaks in June and August-September. The 1997 eight-hour ozone DFW AD SIP revision from December 2011 relied on a 33-day June 2006 episode ranging from May 31 through July 2, 2006. A primary goal of the episode selection process for the current modeling work was to reflect this historical bi-modal pattern by including both June and August-September (August 13 through September 15, 2006) episodes.

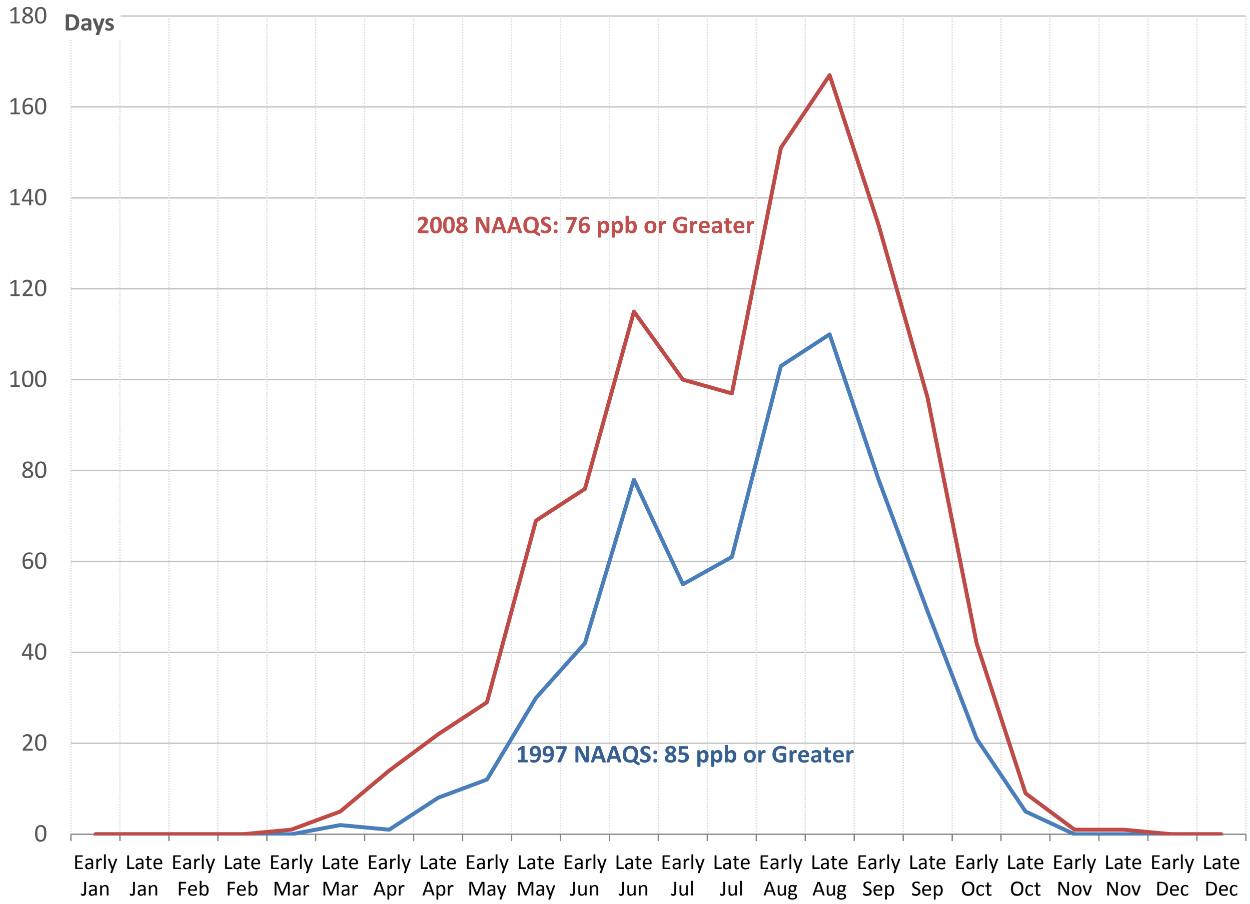


Figure 3-2: DFW Eight-Hour Ozone Days Above 75 ppb by Month from 1991 through 2014

Table 3-1: *DFW Days with Ozone Above 75 ppb by Month from 2006 through 2014* shows that there were 50 days with a DFW area monitor above 75 ppb in 2006 with 18 occurring in June and 13 in August-September. Annual days with a DFW area monitor measuring above 75 ppb in subsequent years ranged from 12 in 2014 to 40 in 2011. An evaluation of these post-2006 years indicated that 2012 would be the best candidate for development of a new ozone episode. The nine days above 75 ppb in June 2012 combined with the 16 in August-September correlate well with the historical bi-modal pattern shown in Figure 3-2. The 2011 calendar year was not representative of this historical norm because there were only four days in June and 26 in August-September with ozone monitored above 75 ppb, which is an unusual ozone season distribution for the DFW nonattainment area. The years 2007, 2010, 2013, and 2014 also had a relatively low number of days above 75 ppb in June compared with August-September.

Both 2008 and 2009 had a June/August-September total of 21 days with at least one monitor measuring above 75 ppb. While 2008 and 2009 could be considered as suitable candidates for seasonal ozone modeling, 2012 is a more recent option that would benefit from the use of more recently available emission inventory data sets, such as the 2011 National Emissions Inventory (NEI) submitted by states to the EPA. Also, the EPA has a 2011 national scale modeling platform that will provide useful data sets for a 2012 Texas ozone episode. Even though only the DFW nonattainment area high ozone days are shown here, the TCEQ has begun development of a 2012 seasonal episode because it is a suitable representation for DFW and other metropolitan areas of the state such as Houston-Galveston-Brazoria (HGB). However, the 2012 ozone episode is not within the performance bounds required for AD SIP submissions, and therefore work on this newer episode is still in progress.

Table 3-1: DFW Days with Ozone Above 75 ppb by Month from 2006 through 2014

Month	2006	2007	2008	2009	2010	2011	2012	2013	2014
January	0	0	0	0	0	0	0	0	0
February	0	0	0	0	0	0	0	0	0
March	1	0	0	0	0	0	2	0	0
April	2	3	1	1	0	2	0	0	0
May	3	1	3	5	4	0	4	1	0
June	18	2	6	8	3	4	9	2	1
July	9	3	5	7	0	6	5	8	5
August	8	11	7	8	9	15	11	7	3
September	5	5	8	5	2	11	5	13	3
October	4	2	0	0	0	2	0	1	0
November	0	0	0	0	0	0	0	0	0
December	0	0	0	0	0	0	0	0	0
Annual Total	50	27	30	34	18	40	36	32	12
June Only	18	2	6	8	3	4	9	2	1
August-September Only	13	16	15	13	11	26	16	20	6
June/August-September Total	31	18	21	21	14	30	25	22	7

To ensure that both early and late summer ozone periods are represented in the current modeling, and that all necessary modeling work for this AD could be completed in a timely manner, the 34-day period from August 13 through September 15, 2006 was added to the 33-day June 2006 episode for a total 67-day period representative of historical high ozone patterns in DFW. This August-September episode incorporates the extensive monitoring data collected during TexAQS II, including data from radar wind profilers and was used in the March 2010 HGB AD SIP revision. Throughout this discussion, the terms June episode and August-September episode will be used when the episodes need to be referenced separately. When analyses are performed on both, the term 67-day episode will be used to reflect the combination.

3.3.3 Summary of the Combined 67-Day 2006 Ozone Episode

Figure 3-3: *DFW Area Ozone Monitoring Locations* shows the spatial distribution of ozone monitors in the DFW nonattainment area. Monitors are located in the upwind areas to the east and south, within the urban core, and in the downwind locations to the north and west. Table 3-2: *Greater DFW Area Ozone Monitor Reference Table* provides the names, Continuous Ambient Monitoring Station (CAMS) code, alpha code, and activation/deactivation dates for 22 ozone monitors located within and surrounding the DFW nonattainment counties. 19 of these monitors had been active for a sufficient amount of time in 2006 that DV_B figures are available for the attainment test that utilizes RRF values. Table 3-3: *Monitor Specific Days Above 75 ppb During 67-Day Combined 2006 Episode* shows that 12 of the DFW area monitors measured ozone above the 75 ppb standard on at least 10 days of the 2006 episodes, which is the minimum preferred by the 2007 modeling guidance. Use of the 67-day combined episode results in a range of 19 to 25 days above 75 ppb at the five downwind northwestern monitors that have typically monitored the highest ozone levels in the DFW nonattainment area: Denton Airport South, Eagle Mountain Lake, Grapevine Fairway, Keller, and Fort Worth Northwest. Seven of the DFW nonattainment area monitors had fewer than 10 days with eight-hour ozone above 75 ppb during this period. However, these seven are all located along the upwind eastern and southern perimeters of DFW where the lowest regional ozone levels are typically monitored. Use of the secondary 70 ppb threshold suggested by the 2007 modeling guidance results in all of the monitors above the preferred 10 days for RRF calculations.

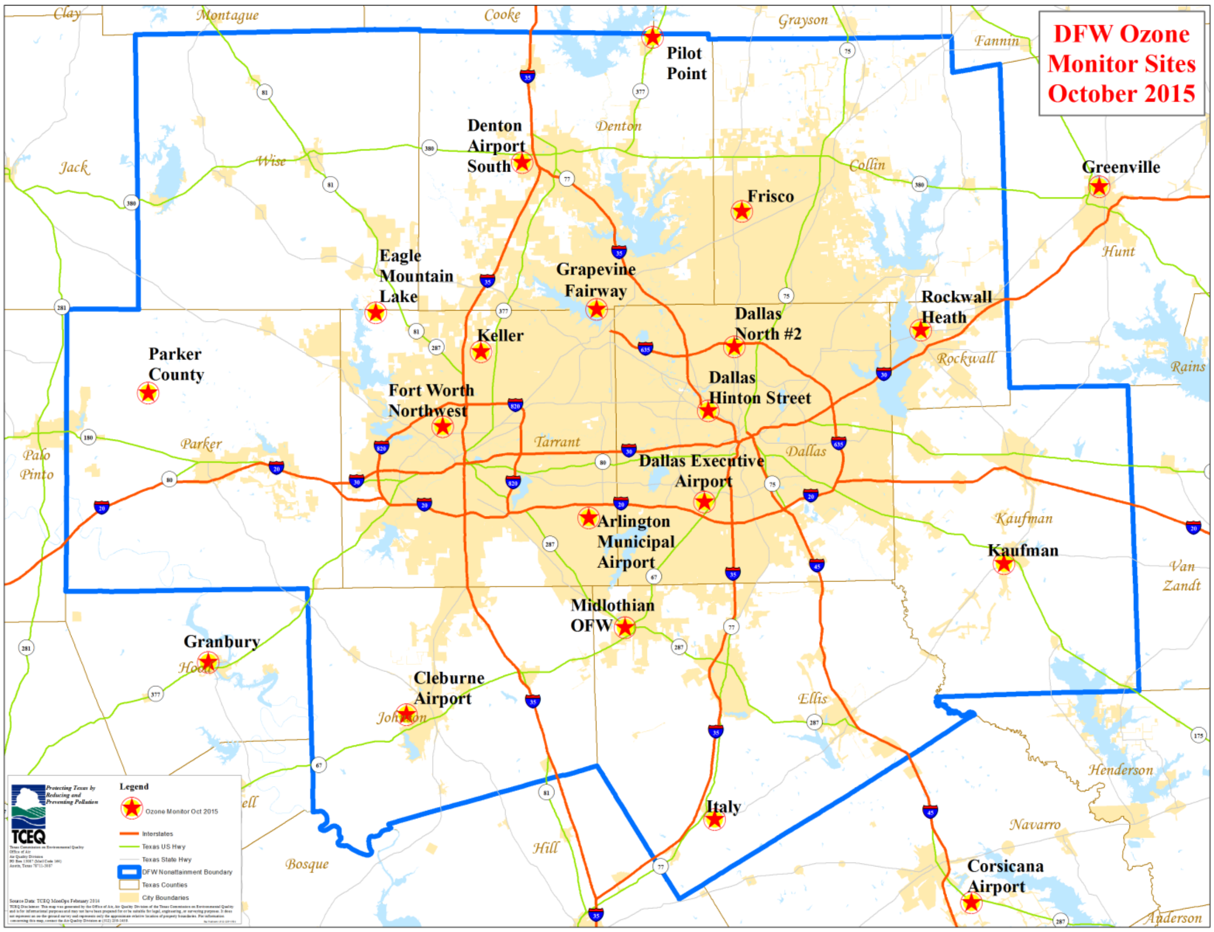


Figure 3-3: DFW Area Ozone Monitoring Locations

Table 3-2: Greater DFW Area Ozone Monitor Reference Table

DFW Area Ozone Monitor Name	CAMS Code	Alpha Code	County of Operation	Date Ozone Active	Date Ozone Deactivated
Frisco	C31	FRIC	Collin	07/29/1997	NA
Dallas Executive Airport	C402	REDB	Dallas	12/13/1999	NA
Dallas Hinton Street	C401	DHIC	Dallas	12/15/1999	NA
Dallas North #2	C63	DALN	Dallas	11/13/1998	NA
Denton Airport South	C56	DENT	Denton	03/22/1998	NA
Pilot Point	C1032	PIPT	Denton	05/03/2006	NA
Italy	C1044	ITLY	Ellis	09/09/2007	NA
Italy High School	C650	ITHS	Ellis	08/23/2005	11/05/2006
Midlothian OFW	C52	MDLO	Ellis	03/29/2006	NA
Midlothian Tower	C94	MDLT	Ellis	08/31/1997	08/22/2007
Cleburne Airport	C77	CLEB	Johnson	05/10/2000	NA
Kaufman	C71	KAUF	Kaufman	09/23/2000	NA
Parker County	C76	WTFD	Parker	08/03/2000	NA
Rockwall Heath	C69	RKWL	Rockwall	08/08/2000	NA
Arlington Municipal Airport	C61	ARLA	Tarrant	01/17/2002	NA
Eagle Mountain Lake	C75	EMTL	Tarrant	06/06/2000	NA
Fort Worth Northwest	C13	FWMC	Tarrant	08/14/1997	NA
Grapevine Fairway	C70	GRAP	Tarrant	08/23/2000	NA
Keller	C17	KELC	Tarrant	07/16/1997	NA
Granbury	C73	GRAN	Hood	05/10/2000	NA
Greenville	C1006	GRVL	Hunt	03/21/2003	NA
Corsicana Airport	C1051	CRSA	Navarro	06/17/2009	NA

Table 3-3: Monitor Specific Days Above 75 ppb During 67-Day Combined 2006 Episode

DFW Area Monitor and CAMS Code	Maximum Eight-Hour Ozone (ppb)	Number of Days Above 70 ppb	Number of Days Above 75 ppb	Number of Days Above 85 ppb	Baseline Design Value (ppb)
Denton Airport South - C56	106	29	22	11	93.33
Eagle Mountain Lake - C75	107	27	22	9	93.33
Grapevine Fairway - C70	98	26	19	9	90.67
Keller - C17	103	33	25	11	91.00
Fort Worth Northwest - C13	101	27	21	9	89.33
Frisco - C31	101	25	20	9	87.67
Dallas North #2 - C63	90	19	14	3	85.00
Parker - County - C76	101	19	12	4	87.67
Dallas Executive Airport - C402	95	28	18	5	85.00
Cleburne Airport - C77	98	18	8	2	85.00
Arlington Municipal Airport - C61	91	18	14	3	83.33
Dallas Hinton Street - C401	96	22	13	2	81.67
Granbury - C73	92	16	8	3	83.00
Midlothian Tower - C94	98	17	8	1	NA
Pilot Point - C1032	101	23	17	9	NA
Rockwall Heath - C69	86	16	9	1	77.67
Midlothian OFW - C52	96	14	5	1	NA
Greenville - C1006	84	13	3	0	75.00
Kaufman - C71	86	11	5	1	74.67

Midlothian Tower, Pilot Point, and Midlothian OFW did not measure enough data from 2004 through 2008 for calculation of a complete 2006 baseline design value. Greenville and Granbury are not in the 2008 eight hour ozone nonattainment area.

Appendix D describes the general meteorological conditions that are typically present on days when monitored eight-hour ozone concentrations are higher than 75 ppb. High ozone is typically formed in the DFW nonattainment area on days with slower wind speeds out of the east and southeast. These prevailing winds also typically bring higher background ozone levels into the DFW nonattainment area. High background ozone concentrations are then amplified as an air mass moves over the urban core of Dallas and Tarrant Counties, both of which contain large amounts of NO_X emissions. Those emissions are then transported across the DFW nonattainment area to the northwest, where the highest eight-hour ozone concentrations are observed.

The conditions that typically lead to high ozone were present in the 33-day June 2006 episode. High pressure developed over the area from June 5 through June 10, which resulted in mostly sunny days with high temperatures above 90 degrees Fahrenheit. High pressure also caused winds that were calm or light out of the southeast. With light winds a gradual buildup of ozone and ozone precursors developed over the DFW nonattainment area, peaking in an eight-hour ozone concentration of 106 ppb at Eagle Mountain Lake and Denton Airport South on June 9, as shown in Figure 3-4: *Maximum Eight-Hour Ozone by Monitor from May 31 through July 2, 2006*. High pressure began to erode away as a weak frontal boundary approached from the north. Wind speeds then increased over the area, causing ozone dilution and lowering the eight-hour ozone concentrations over the area. As winds switched directions and began blowing from the east-northeast on the backside of the frontal boundary, ozone concentrations again increased. Winds from the east-northeast have the potential for long range transport from the direction of the Ohio River Valley. Transport from the east-northeast likely contributed to an eight-hour ozone concentration of 107 ppb at Eagle Mountain Lake on June 14. Over the next few days, low pressure moved into the area from the Gulf of Mexico. This low pressure caused an increase in cloudiness and wind speed, which reduced the potential for ozone formation. High pressure returned to the area from June 27 through June 30. With the resultant high temperatures and low wind speeds, conditions were again favorable for ozone formation.

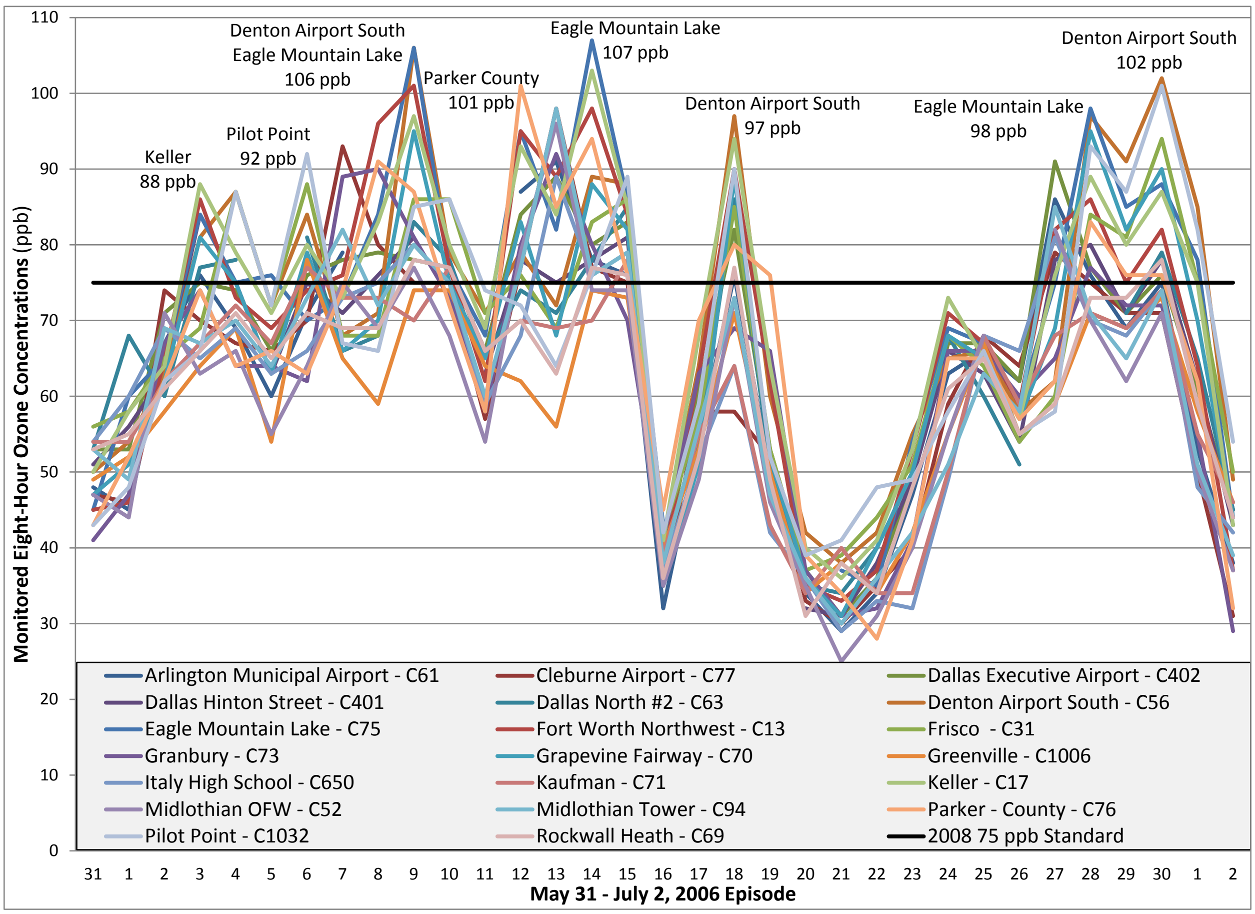


Figure 3-4: Maximum Eight-Hour Ozone by Monitor from May 31 through July 2, 2006

As shown in Figure 3-5: *Maximum Eight-Hour Ozone by Monitor from August 13 through September 15, 2006*, the 34-day August-September episode also had conditions favorable for elevated ozone concentrations. Strong southerly winds and a weak warm front kept ozone concentrations below 76 ppb from August 13 through August 17. High pressure settled in by August 18 with clear sunny skies and slow southerly winds allowing for the build-up of ozone concentrations, such as the 91 ppb peaks at Denton Airport South and Grapevine Fairway. Another weak front entered the area on August 22, causing winds to shift from the northeast, indicating possible transport of polluted air from the Ohio and Mississippi River valleys. The weak front stalled just north of the DFW nonattainment area through August 24 keeping winds slow and allowing pollutants to accumulate. Stronger south winds returned by August 25, keeping ozone concentrations low through August 28. A stronger cold front moved through the DFW nonattainment area on August 29, bringing north winds and clouds. Clear skies with light north winds followed, which allowed for ozone concentrations to exceed the NAAQS through September 1, such as the 101 ppb peak at Frisco and 102 ppb peak at Denton Airport South. Another cold front brought cloudy skies and cooler temperatures, which limited ozone production. High pressure and ozone-conducive conditions returned from September 7 through 10 resulting in peak levels of 87 ppb at Frisco and Pilot Point. Northeast winds after a cold front may have again transported polluted air from areas east and north of DFW on September 14.

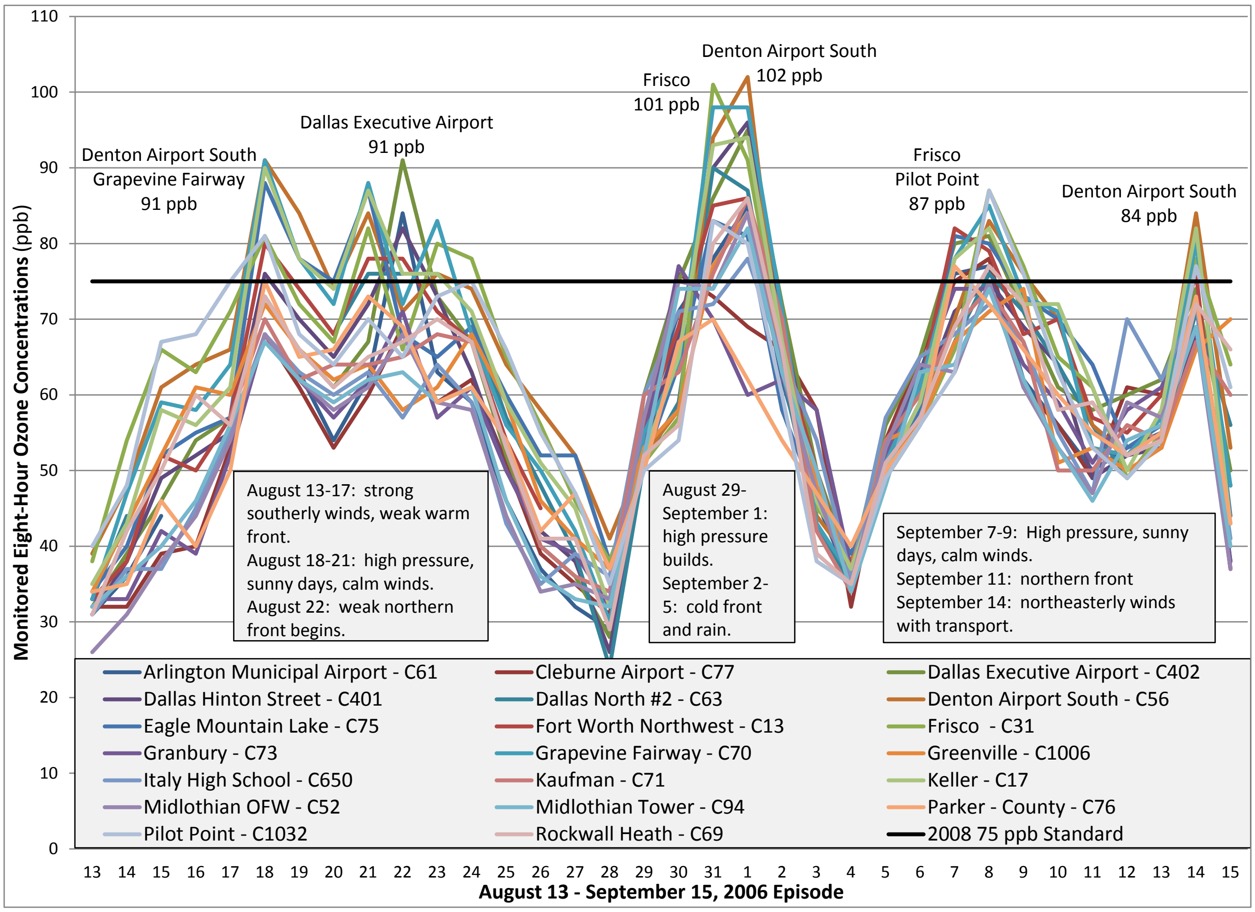


Figure 3-5: Maximum Eight-Hour Ozone by Monitor from August 13 through September 15, 2006

Back trajectories from the Eagle Mountain Lake monitor extending backwards in time for 48 hours and terminating at 500 meters above ground level (AGL) are shown for every day of the extended June 2006 episode in Figure 3-6: *Eagle Mountain Lake Monitor Back Trajectories for May 31 through July 2, 2006*. The left panel shows the May 31 through June 15, 2006, period while the right panel shows the June 16 through July 2, 2006, period. Similar 48-hour back trajectories for every day of the August-September episode are shown in Figure 3-7: *Denton Airport South Monitor Back Trajectories for August 13 through September 15, 2006*. The trajectories in both Figure 3-6 and Figure 3-7 depict air coming from north, east, and southerly directions. Westerly winds are not common during the summer months in the DFW nonattainment area, so there are no trajectories coming from the west to northwest. These trajectories illustrate that the combined 67-day episode includes periods of synoptic flow from each of the directions commonly associated with elevated eight-hour ozone concentrations as more fully described in Appendix D.

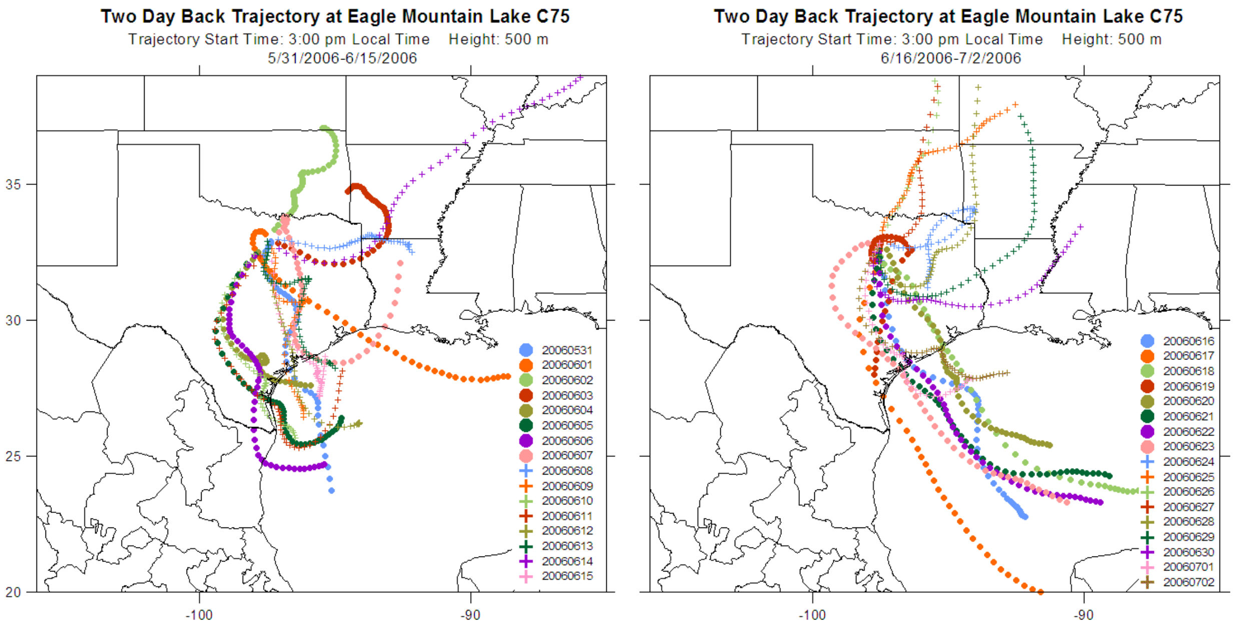


Figure 3-6: Eagle Mountain Lake Monitor Back Trajectories for May 31 through July 2, 2006

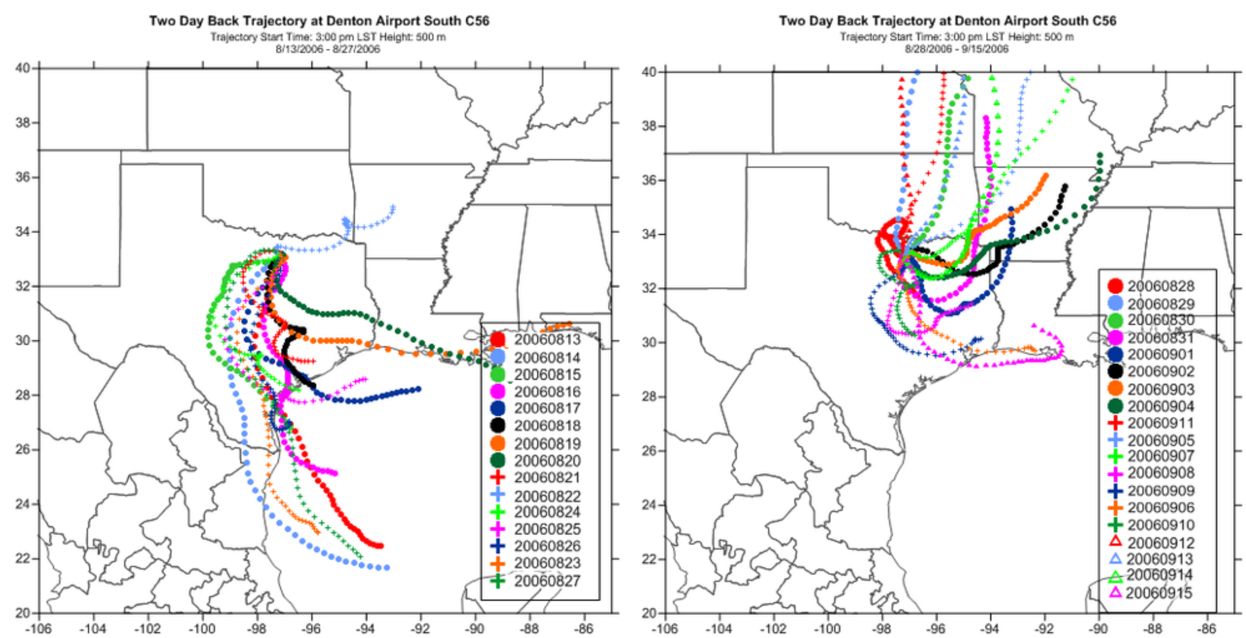


Figure 3-7: Denton Airport South Monitor Back Trajectories for August 13 through September 15, 2006

3.4 METEOROLOGICAL MODEL

The TCEQ is using the Weather Research and Forecasting Model (WRF), which has now largely replaced the Penn State University/National Center for Atmospheric Research (NCAR) Mesoscale Meteorological Model, Fifth Generation (MM5) for both forecasting and retrospective modeling of historical episodes. The WRF model development was driven by a community effort to provide a modeling platform that supported the most recent research and allowed testing in forecast environments. WRF was designed to be completely mass conservative and built to allow better flux calculations, both of which are of central importance to the air quality community. The model was also designed with higher order numerical techniques than MM5 for many physical calculations. These model improvements over MM5 as well as a decision by NCAR to no longer support MM5 prompted the TCEQ as well as various Texas universities, the Central Regional Air Planning Association, and the EPA to adopt WRF for their respective meteorological modeling platforms.

3.4.1 Modeling Domains

As shown in Figure 3-8: *WRF Modeling Domains*, the meteorological modeling was configured with three nested grids at a resolution of 36 kilometers (km) for North America (na_36km), 12 km for Texas plus portions of surrounding states (sus_12km), and 4 km for the eastern portion of Texas (4 km). The extent of each of the WRF modeling domains was selected to accommodate the embedding of the commensurate air quality modeling domains. Table 3-4: *WRF Modeling Domain Definitions* provides the specific northing and easting parameters for these grid projections.

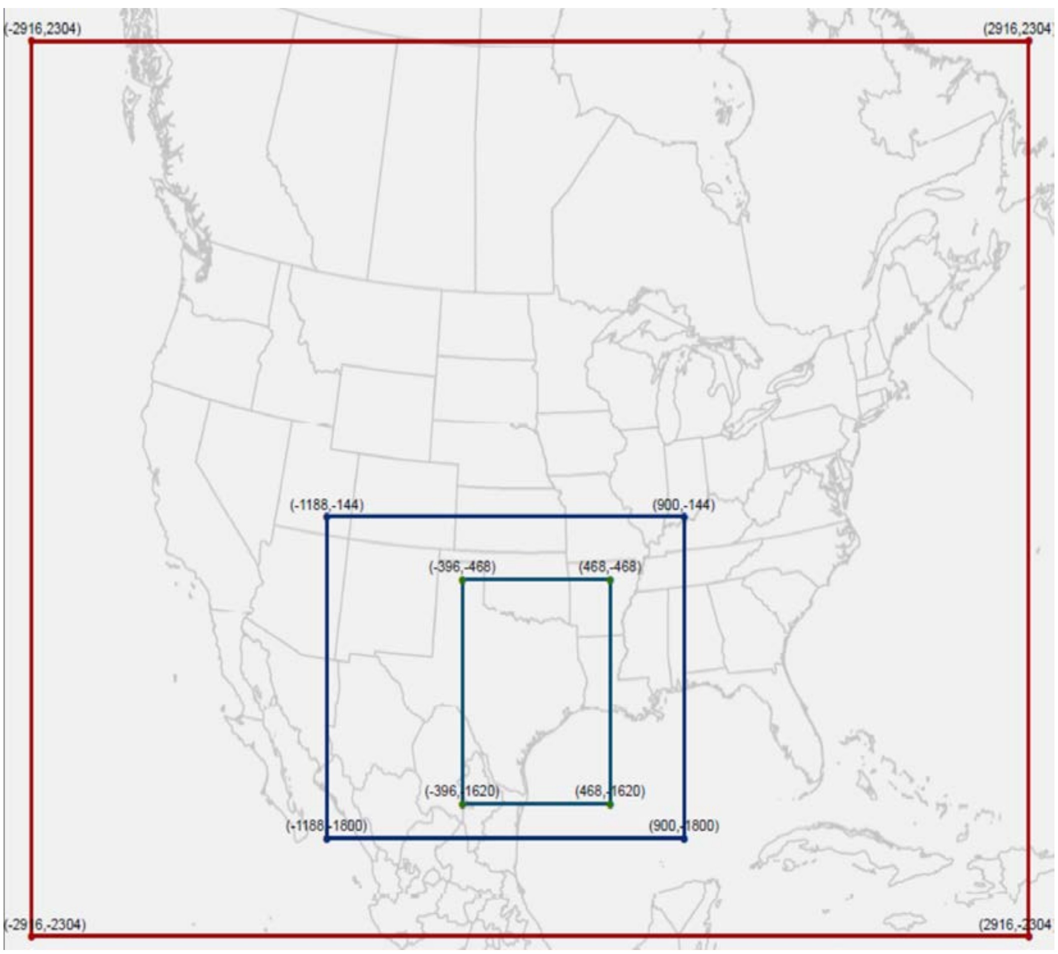


Figure 3-8: WRF Modeling Domains

Table 3-4: WRF Modeling Domain Definitions

Domain	Easting Range (km)	Northing Range (km)	East/West Grid Points	North/South Grid Points
na_36 km	(-2916,2916)	(-2304,2304)	163	129
sus_12km	(-1188,900)	(-1800,-144)	175	139
4 km	(-396,468)	(-1620,-468)	217	289

As shown in Figure 3-9: *WRF Vertical Layer Structure*, the vertical configuration of the WRF modeling domains consists of a varying 43-layer structure used with all of the horizontal domains. The first 21 vertical layers are identical to the same layers used with the Comprehensive Air Quality Model with Extensions (CAMx), while CAMx layers 22 through 28 each comprise multiple WRF layers.

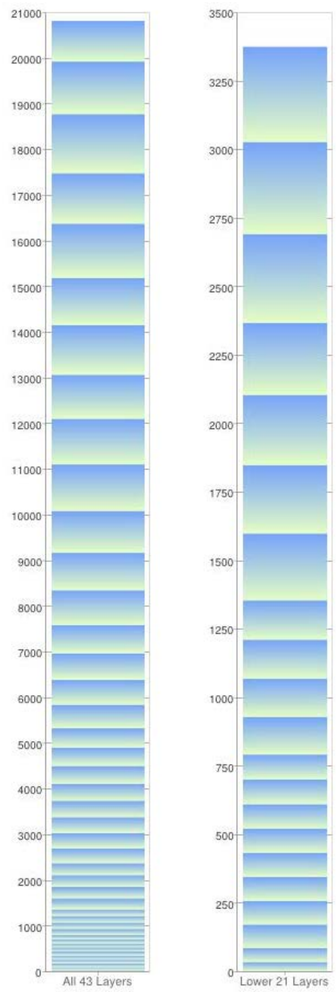


Figure 3-9: WRF Vertical Layer Structure

3.4.2 Meteorological Model Configuration

The selection of the final meteorological modeling configuration for the two episodes during 2006 resulted from numerous sensitivity tests and model performance evaluation. The preparation of WRF input files involves the execution of different models within the WRF Preprocessing System (WPS). To further improve WRF performance, two types of nudging were utilized that help keep modeled meteorological values in line with observational data. The first type is the analysis nudging, both three-dimensional (3-D) and surface. The 3-D analysis nudging was used on all three domains (4 km, 12 km, and 36 km) to nudge the wind, temperature and moisture. The surface analysis nudging was only used on the 4 km domain to nudge the wind and temperature. The second type is the observational nudging, which uses the radar profiler data for nudging the wind to the 4 km domain. The analysis nudging files are generated as part of WPS preparation of WRF input and boundary condition files. The observational nudging files were developed separately using TCEQ-generated programs.

For optimal photochemical model performance, low-level wind speed and direction are of greater importance than surface temperature. Additional meteorological features of critical importance for air quality modeling include cloud coverage and the strength and depth of the planetary boundary layer (PBL). Observational nudging using TexAQS II radar profiler data and one-hour surface analysis nudging improved wind performance. Switching from the National Centers for Environmental Prediction, Oregon State, Air Force, and Hydrologic Research Laboratory (NOAH) Land-Surface Model to the five-layer soil model also improved the representation of precipitation, temperature, and PBL depths.

The TCEQ continued to improve upon the performance of WRF for the June and August-September 2006 episodes through a series of sensitivities. The final WRF parameterization schemes and options selected are shown in Table 3-5: *WRF Model Configuration Parameters*. The selection of these schemes and options was based on extensive testing of model configurations that built upon experience with MM5 in previous SIP modeling. Among all the meteorological variables that can be validated, minimizing wind speed bias was the highest priority for model performance consideration. WRF output was post-processed using the WRFCAMx version 6.3 utility to convert the WRF meteorological fields to the appropriate CAMx grid and input format. The WRFCAMx now generates several alternative vertical diffusivity (Kv) files based upon multiple methodologies for estimating mixing given the same WRF meteorological fields. The Kv option to match the WRF Yonsei University (YSU) PBL scheme was used for the CAMx runs for the 2006 episodes. The Kv coefficients were also modified on a land-use basis to maintain vertical mixing within the first 100 meters of the model overnight using the landuse based minimum for Kv for all domains (KVPATCH) program (Environ, 2005).

Table 3-5: WRF Model Configuration Parameters

Domain	Nudging Type	PBL	Cumulus	Radiation	Land-Surface	Microphysics
36 km and 12 km	3-D	YSU	Kain-Fritsch	RRTM / Dudhia *	5-layer soil model	WSM6 †
4 km	3-D, Surface Analysis, and Observations	YSU	N/A	RRTM / Dudhia *	5-layer soil model	WSM6 †

* RRTM = Rapid Radiative Transfer Model

† WSM6 = WRF Single-Moment 6-Class Microphysics Scheme

Appendix A provides additional detail on the meteorological modeling inputs presented here.

3.4.3 WRF Performance Evaluation

The WRF modeling was evaluated by comparing the hourly modeled and measured wind speed, wind direction, and temperature for all monitors in the DFW nonattainment area. Figure 3-10: *June 2006 WRF Modeling Performance* exhibits the percent of hours for which the average absolute difference between the modeled and measured wind speed and direction was within the specified accuracy benchmarks for specific DFW nonattainment area monitors, as well as a regional average. These benchmarks are less than 30 degrees for wind direction, less than 2 meters per second (m/s) for wind speed, and less than 2 degrees Fahrenheit for temperature.

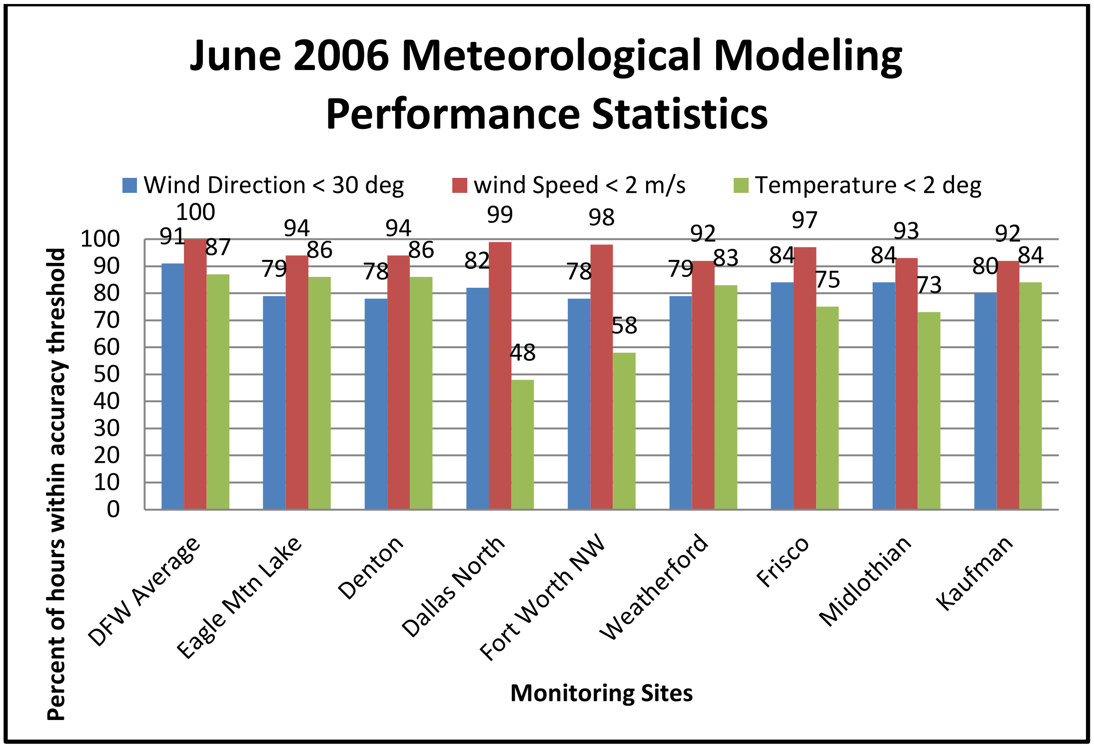


Figure 3-10: June 2006 WRF Modeling Performance

As Figure 3-10 shows, WRF performed well for wind speed and wind direction, and reasonably well for temperature. As noted above, the WRF configuration was selected for optimal performance on low-level wind speed since this meteorological variable strongly impacts CAMx performance. Wind speed performance was excellent at the individual monitors, but observed wind direction is less accurate when wind speeds are low, a condition often observed during high ozone days. Table 3-6: *WRF Meteorological Modeling Percent Accuracy for June 2006* provides an additional evaluation of WRF predictions to stricter benchmarks (Emery et al., 2001). The model's ability to replicate wind direction and speed within 20 degrees and 1 m/s on average enhances the confidence in this modeling setup. Appendix A includes more detail on the June, August, and September 2006 WRF modeling performance.

Table 3-6: WRF Meteorological Modeling Percent Accuracy for June 2006

DFW Area Monitor	Wind Direction (°) Error ≤ 30 / 20 / 10	Wind Speed (m/s) Error ≤ 2 / 1 / 0.5	Temperature (°C) Error ≤ 2 / 1 / 0.5
DFW Area Average	91 / 83 / 65	100 / 89 / 64	87 / 39 / 14
Eagle Mountain Lake	79 / 69 / 48	94 / 68 / 40	86 / 44 / 18
Denton	78 / 64 / 35	94 / 64 / 32	86 / 66 / 45
Dallas North	82 / 71 / 42	99 / 83 / 51	48 / 23 / 08
Fort Worth NW	78 / 68 / 42	98 / 83 / 54	58 / 20 / 08
Weatherford	79 / 67 / 42	92 / 66 / 37	83 / 44 / 20

DFW Area Monitor	Wind Direction (°) Error ≤ 30 / 20 / 10	Wind Speed (m/s) Error ≤ 2 / 1 / 0.5	Temperature (°C) Error ≤ 2 / 1 / 0.5
Frisco	84 / 73 / 47	97 / 74 / 42	75 / 35 / 16
Midlothian Tower	84 / 72 / 45	93 / 70 / 41	73 / 41 / 24
Kaufman	80 / 68 / 43	92 / 67 / 34	84 / 46 / 25

3.5 MODELING EMISSIONS

For the stationary emission source types, which consist of point and area sources, routine emission inventories provided the major inputs for the emissions modeling processing. Emissions from mobile and biogenic sources were derived from relevant emission models. Specifically, link-based on-road mobile source emissions were derived from travel demand model (TDM) activity output coupled with the EPA Motor Vehicle Emissions Simulator (MOVES) emission factor model. The point, area, on-road, non-road, and off-road emission estimates were processed to air quality model-ready format using version three of the Emissions Processing System (EPS3; Environ, 2015). Biogenic emissions were derived from version 2.1 of the Model of Emissions of Gases and Aerosols from Nature (MEGAN 2.1), which outputs air quality model-ready emissions (Guenther, et al., 2012).

An overview is provided here of the emission inputs used for the 2006 base case, 2006 baseline, and 2017 future case. These emission inputs were based on the latest available information at the time development work was done for this 2017 DFW AD SIP proposal. Appendix B contains more detail on the development and processing of the emissions using the various EPS3 modules. Table 3-7: *Emissions Processing Modules* summarizes many of the steps taken to prepare chemically speciated, temporally allocated, and spatially distributed emission files needed for the air quality model. Model-ready emissions were developed for the combined 67-day episode. The following sections give a brief description of the development of each emissions source category.

Table 3-7: Emissions Processing Modules

EPS3 Module	Description
PREAM	Prepare area and non-link based area and mobile sources emissions for further processing
LBASE	Spatially allocate link-based mobile source emissions among grid cells
PREPNT	Group point source emissions into elevated and low-level categories for further processing
CNTLEM	Apply controls to model strategies, apply adjustments, make projections, etc.
TMPRL	Apply temporal profiles to allocate emissions by day type and hour
SPCEMS	Chemically speciate emissions into nitrogen oxide, nitrogen dioxide (NO_2), and various Carbon Bond 6 (CB6) VOC species
GRDEM	Spatially distribute emissions by grid cell using source category surrogates
MRGUAM	Merge and adjust multiple gridded files for model-ready input
PIGEMS	Assigns Plume-in-Grid (PiG) emissions and merges elevated point source files

3.5.1 Biogenic Emissions

The TCEQ used MEGAN 2.1 to develop the biogenic emission inputs for CAMx. The MEGAN model requires inputs by model grid cell area of:

- emission factors for nineteen chemical compounds or compound groups;

- plant functional types (PFT);
- leaf area index (LAI) and fractional vegetated leaf area index (LAIv); and
- meteorological information including air and soil temperatures, photosynthetically active radiation (PAR), barometric pressure, wind speed, water vapor mixing ratio, and accumulated precipitation.

The TCEQ used the default emission factors and PFTs that are provided with MEGAN. To process the emission factors and PFTs to the TCEQ air modeling domain structures, gridded layers of each emission factor file were created in ArcMap version 9.3. The TCEQ created 2006-specific LAIv data using the level-4 Moderate-Resolution Imaging Spectroradiometer (MODIS) global LAI MCD15A2 product. For each eight-day period, the satellite tiles covering North America in a Sinusoidal grid were mosaicked together using the MODIS Reprojection Tool. Urban LAI cells, which MODIS excludes, were filled according to a function that follows the North American average for four urban land cover types. The MODIS quality control flags were applied to use only the high quality data from the main retrieval algorithm. The resultant LAI was divided by the percentage of vegetated PFT per grid cell to yield the final LAIv.

The WRF model provided the meteorological data needed for MEGAN input, except for PAR. The episode-specific satellite-based PAR inputs were obtained from the historical data center operated by the Global Energy and Water Cycle Experiment (GEWEX) Continental International Project (GCIP) and GEWEX Americas Prediction Project at the University of Maryland. The PAR data were derived from hourly Geostationary Operational Environmental Satellite (GOES) imagery of cloud cover, which were processed with a solar irradiation model.

The MEGAN model was run for each 2006 episode day. Since biogenic emissions are dependent upon the meteorological conditions on a given day, the same episode-specific emissions for the 2006 baseline were used in the 2017 future case modeling scenarios. The summaries of biogenic emissions for each day of the 67-day combined episode are provided in Appendix B. Figure 3-11: *Sample Biogenic VOC Emissions for June 12, 2006 Episode Day* provides a graphical plot of biogenic VOC emissions distribution at a resolution of 4 km throughout eastern Texas.

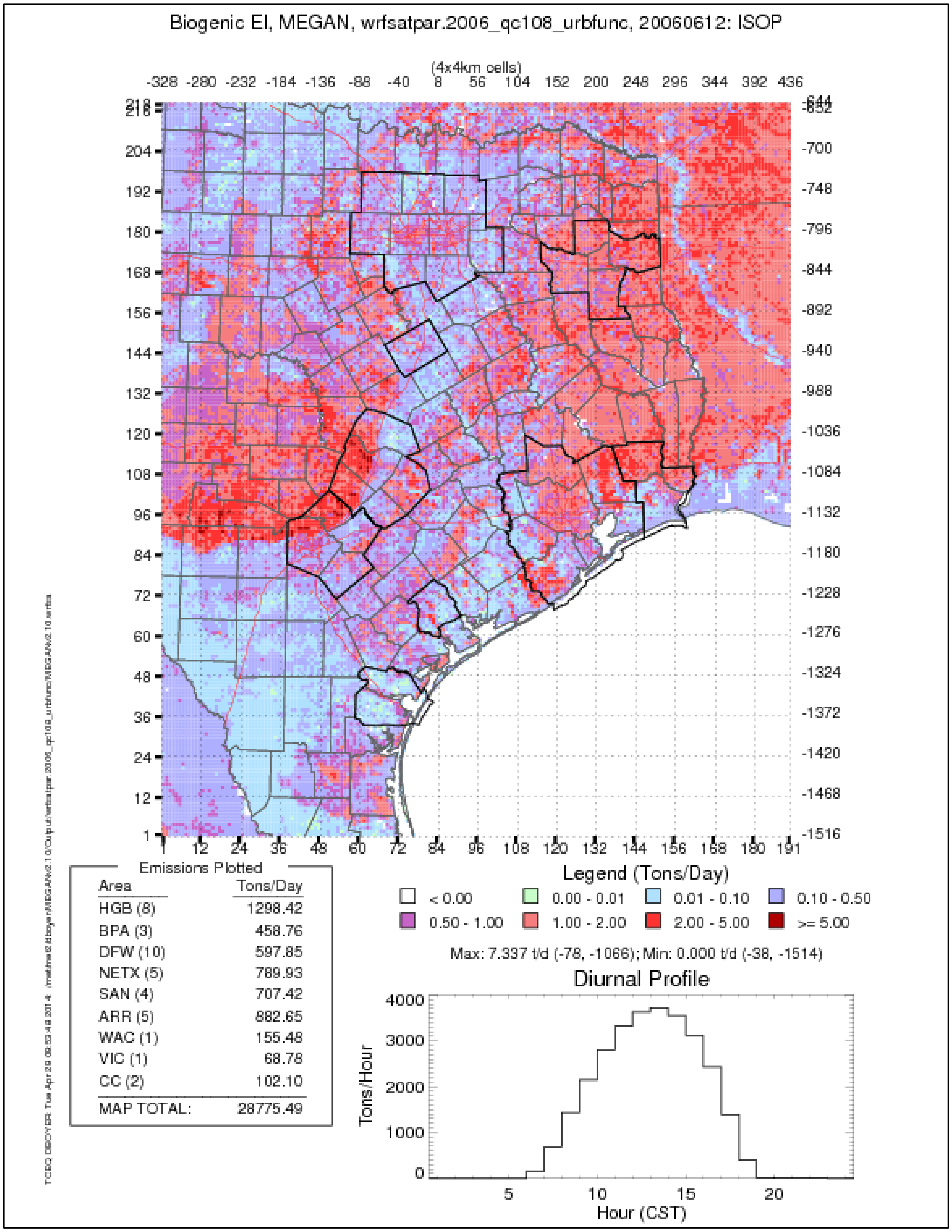


Figure 3-11: Sample Biogenic VOC Emissions for June 12, 2006 Episode Day

3.5.2 2006 Base Case

3.5.2.1 Point Sources

Point source modeling emissions were developed from regional inventories such as the EPA's NEI, the EPA's Air Markets Program Data (AMPD), state inventories including the State of Texas Air Reporting System (STARS), and local inventories. Data were processed with EPS3 to generate model-ready emissions, and similar procedures were used to develop the 67-day base case episode.

Outside Texas

Point source emissions data for the regions of the modeling domains outside of Texas were obtained from a number of different sources. Emissions from point sources in the Gulf of Mexico (e.g., oil and gas production platforms) were obtained from the 2005 Gulf-Wide Emissions Inventory (GWEI) provided by the United States (U.S.) Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE), formerly the Minerals Management Service, as monthly totals. Canadian emissions were obtained from the 2006 National Pollutant Release Inventory from Environment Canada, while 1999 Mexican emissions data were obtained from Phase III of the Mexican NEI. The Gulf of Mexico and 1999 Mexican inventories were not grown to 2006 due to the lack of historical operations data, applied controls, and/or a projection methodology. For the non-Texas U.S. portion of the modeling domain, hourly NO_X emissions for major electric generating units (EGU) were obtained from the AMPD for each hour of each base case episode day. Emissions for non-AMPD sources in states beyond Texas were obtained from the EPA's 2008 NEI-based modeling platform.

Within Texas

Hourly NO_X emissions from EGUs within Texas were obtained from the AMPD for each base case episode day. Emissions from non-AMPD sources were obtained from a STARS database emissions extract for the year 2006. In addition, agricultural and forest fire emissions for 2006 were obtained from the Fire INventory of NCAR (FINN) database, courtesy of Environ's work for the East Texas Council of Governments (Environ, 2008). Fires are treated as point sources.

Table 3-8: *2006 Sample Base Case Point Source Emissions for 10-County DFW* provides a summary of the DFW nonattainment area point source emissions for the Wednesday June 14, 2006 episode day. The EGU emissions are different for each day and hour of the episode based on real-time continuous emissions monitoring data that are reported to the EPA's AMPD. Emission estimates for the remaining non-AMPD point source categories of cement kilns, oil and gas facilities, and "other" do not vary by specific episode day, but are averaged over the entire period of June 1 through August 31, 2006.

Table 3-8: 2006 Sample Base Case Point Source Emissions for 10-County DFW Area

DFW Point Source Category	NO_X tons per day (tpd)	VOC (tpd)	CO (tpd)
Point - EGUs on June 14, 2006	8.42	1.02	3.85
Point - Cement Kilns	22.08	1.94	17.45
Point - Oil and Gas	11.53	21.82	8.74
Point – Other	14.31	25.65	17.26
DFW Nonattainment Area Total	56.34	50.43	47.30

On-Road Mobile Sources

The 2006 on-road mobile source emission inputs were developed using the 2014 version of the MOVES model (MOVES2014). The VMT activity data sets that were used for these efforts are:

- the TDM managed by the North Central Texas Council of Governments (NCTCOG) for the DFW nonattainment area;
- Highway Performance Monitoring System (HPMS) data collected by the Texas Department of Transportation (TxDOT) for the non-DFW portions of Texas contained within the modeling domain; and
- the EPA default information included with the MOVES2014 database for the non-Texas U.S. portions of the modeling domain.

The output from these emission modeling applications were processed through EPS3 to generate the on-road speciated and gridded inputs for photochemical modeling applications.

DFW Nonattainment Area

For the 10-county DFW nonattainment area, link-based on-road emissions were developed by NCTCOG using 2006 TDM output and MOVES2014 emission rates to generate average school and summer season on-road emissions for four day types of Monday-Thursday average weekday, Friday, Saturday, and Sunday. For the June 2006 base case episode, the summer season day-type emissions were used. For the August-September 2006 period, the school season day-type emissions were used.

Non-DFW Portions of Texas

For the Texas counties outside of the DFW nonattainment area, on-road emissions were developed by the Texas Transportation Institute (TTI) using MOVES2014 emission rates and 2006 HPMS VMT estimates for each county. Average school and summer season emissions by vehicle type and roadway type were estimated for the four day types of Monday-Thursday average weekday, Friday, Saturday, and Sunday.

Outside of Texas

For the non-Texas U.S. portions of the modeling domain, the TCEQ used MOVES2014 in default mode to generate 2006 average summer weekday emission estimates for every non-Texas U.S. county. Temporal profiles based on the Texas on-road inventories from TTI and NCTCOG were developed to adjust these summer weekday emissions to the remaining day and season type combinations referenced above.

Table 3-9: *Summary of On-Road Mobile Source Emissions Development* contains additional detail about the on-road mobile inventory development in different regions of the modeling domain.

Table 3-9: Summary of On-Road Mobile Source Emissions Development

On-Road Inventory Development Parameter	DFW	Non-DFW Texas	Non-Texas States/Counties
VMT Source and Resolution	TDM Roadway Links	HPMS Data Sets 19 Roadway Types	MOVES2014 12 Roadway Types
Season Types	School and Summer Seasons	School and Summer Seasons	Summer Season Adjusted to School

On-Road Inventory Development Parameter	DFW	Non-DFW Texas	Non-Texas States/Counties
Day Types	Weekday, Friday, Saturday, and Sunday	Weekday, Friday, Saturday, and Sunday	Weekday Adjusted to Friday, Saturday, and Sunday
Roadway Speed Distribution	Varies by Hour and Link	Varies by Hour and Roadway Type	MOVES2014 Default
MOVES Fuel and Source Use Types	Gasoline and Diesel 13 Source Use Types	Gasoline and Diesel 13 Source Use Types	Gasoline and Diesel 13 Source Use Types

Table 3-10: *2006 Base Case On-Road Modeling Emissions for 10-County DFW* summarizes the on-road mobile source emission estimates for the 2006 base case episode for the 10-county DFW nonattainment area for all combinations of season and day type.

Table 3-10: 2006 Base Case On-Road Modeling Emissions for 10-County DFW Area

Season and Day Type	NO_X (tpd)	VOC (tpd)	CO (tpd)
Summer Weekday	284.27	116.50	1,315.46
Summer Friday	294.54	120.41	1,430.74
Summer Saturday	208.95	107.91	1,228.21
Summer Sunday	188.15	101.29	1,066.20
School Weekday	284.90	116.80	1,320.26
School Friday	292.87	120.07	1,424.23
School Saturday	206.38	107.40	1,216.60
School Sunday	185.99	100.89	1,057.09

3.5.2.2 Non-Road and Off-Road Mobile Sources

Non-road mobile sources include vehicles, engines, and equipment used for construction, agriculture, transportation, recreation, and many other purposes. Off-road mobile sources include aircraft, locomotives, and commercial marine vessels. Non-road and off-road mobile source modeling emissions were developed using Texas NONROAD (TexN) for non-road emissions within Texas, the National Mobile Inventory Model (NMIM) for non-road emissions outside of Texas, the EPA's NEI databases, and data sets from the TCEQ Texas Air Emissions Repository (TexAER). The output from these emission modeling applications and databases were processed through EPS3 to generate the air quality model-ready emission files for non-road and off-road sources.

Outside Texas

For the non-Texas U.S. portion of the modeling domains, the TCEQ used the EPA's NMIM to generate average summer weekday non-road mobile source emissions by county and ran it specifically for 2006. For the off-road categories of aircraft, locomotive, and commercial marine, the TCEQ used the EPA's 2008 NEI to create 2006 average summer weekday off-road emissions for the non-Texas U.S. portions of the modeling domain. Summer weekend day emissions for the non-road and off-road mobile source categories were developed as part of the EPS3 processing using temporal profiles specific to each source category.

Within Texas

The TCEQ used the TexN model to generate average summer weekday non-road mobile source category emissions by county for 2006. Airport ground support equipment (GSE) and oil and gas drilling rig emissions were estimated separately as detailed below. During EPS3 processing, temporal adjustments were made to create Saturday and Sunday non-road emission estimates. Table 3-11: *2006 Base Case Non-Road Modeling Emissions for 10-County DFW* Area summarizes these non-road inputs by day type. The non-road emission estimates in Table 3-11 were developed with version 1.7.1 of TexN.

Table 3-11: 2006 Base Case Non-Road Modeling Emissions for 10-County DFW Area

2006 Day Type	NO_X (tpd)	VOC (tpd)	CO (tpd)
Monday – Friday Average Weekday	98.06	64.69	806.01
Saturday	68.72	94.19	977.67
Sunday	50.08	82.22	823.17

Airport emission inventories were developed with the Federal Aviation Administration (FAA) Emissions Dispersion Modeling System (EDMS). EDMS outputs emission estimates for aircraft engines, auxiliary power units (APUs), and GSE. Table 3-12: *2006 Base Case Airport Modeling Emissions for 10-County DFW* Area summarizes these estimates for DFW International Airport, Love Field, and the remaining smaller regional airports within DFW. Love Field contracted with Leigh-Fisher to develop emission estimates for 2006 using EDMS. The remaining airport specific emission estimates are based on an NCTCOG study done under contract to the TCEQ.

Table 3-12: 2006 Base Case Airport Modeling Emissions for 10-County DFW Area

DFW Nonattainment Area Airport or Airport Group	NO_X (tpd)	VOC (tpd)	CO (tpd)
DFW International	9.84	2.37	16.69
Love Field	1.22	0.57	3.39
Regional Airports	1.72	1.52	28.01
DFW Area Total for All Airports	12.78	4.46	48.09

The 2006 locomotive emission estimates were developed by backcasting 2008 data from an Eastern Research Group (ERG, 2015) trends study done for the years from 2008 through 2040. Emissions were estimated separately for Class I line-haul locomotives, Class II and III line-haul locomotives, and rail yard switcher locomotives. The 2008 emissions were adjusted to 2006 levels based on fleet average emission factors available from the EPA. Table 3-13: *2006 Base Case Locomotive Modeling Emissions for 10-County DFW* Area summarizes the estimates for all locomotive activity in DFW.

Table 3-13: 2006 Base Case Locomotive Modeling Emissions for 10-County DFW

Locomotive Source Classification Description	NO_X (tpd)	VOC (tpd)	CO (tpd)
Line-Haul Locomotives – Class I	16.19	1.00	2.67
Line-Haul Locomotives – Classes II and III	0.39	0.02	0.04
Rail Yard Switcher Locomotives	3.56	0.25	0.44
DFW Nonattainment Area Total	20.14	1.28	3.16

3.5.2.3 Area Sources

Area source modeling emissions were developed using the EPA NEI and the TCEQ's TexAER database. The emissions information in these databases was processed through EPS3 to generate the air quality model-ready area source emission files.

Outside Texas

For the non-Texas U.S. portions of the modeling domain, the TCEQ used the EPA's 2008 NEI to create 2006 daily area source emissions.

Within Texas

The TCEQ obtained emissions data from the 2008 TexAER database (TCEQ, 2011) and backcast these estimates to 2006 using Texas-specific economic growth factors for 2008 to 2006. Temporal profiles were applied with EPS3 to obtain the figures presented in Table 3-14: *2006 Base Case Area Source Emissions for 10-County DFW Area*.

Table 3-14: 2006 Base Case Area Source Emissions for 10-County DFW Area

2006 Day Type	NO_X (tpd)	VOC (tpd)	CO (tpd)
Monday – Friday Average Weekday	29.02	290.46	85.59
Saturday	22.21	136.92	75.57
Sunday	15.41	88.36	65.69

The 2006 county-level drilling rig emissions were based on work done under contract by Eastern Research Group, Inc. (ERG, 2011) using activity data from the Railroad Commission of Texas (RRC), and are summarized in Table 3-15: *2006 Oil and Gas Drilling Rig Emissions for 10-County DFW Area*.

Table 3-15: 2006 Oil and Gas Drilling Rig Emissions for 10-County DFW Area

Equipment Type	NO_X (tpd)	VOC (tpd)	CO (tpd)
Drilling Rigs	18.23	1.16	3.57

For oil and gas production sources, county-specific 2006 oil and gas emissions were calculated based on a TCEQ-contracted research project (ERG, 2010). The emissions were estimated according to 2006 county-specific oil and gas production information from the RRC and emission factors compiled in the 2010 ERG study. Emission estimates by equipment type are summarized in Table 3-16: *2006 Oil and Gas Production Emissions for 10-County DFW Area*.

Table 3-16: 2006 Oil and Gas Production Emissions for 10-County DFW Area

Oil and Gas Production Equipment	NO_X (tpd)	VOC (tpd)	CO (tpd)
Natural Gas 4-Cycle Rich Burn Compressors - 50 To 499 HP	56.19	0.10	2.54
Natural Gas Well Heaters	2.11	0.12	1.77
Natural Gas 2-Cycle Lean Burn Compressors - 50 To 499 HP	1.45	0.14	0.21
Natural Gas 4-Cycle Rich Burn Compressors - 500+ HP w/NSCR	0.84	0.16	7.25
Natural Gas 4-Cycle Lean Burn Compressors - 500+ HP	0.71	1.43	6.77
Oil Production - Artificial Lift	0.32	0.00	0.50
Oil Production - Heater Treater	0.14	0.01	0.11
Natural Gas Well Dehydrators	0.08	1.65	0.23
Oil Production - All Processes	0.00	0.01	0.01
Natural Gas 4-Cycle Rich Burn Compressors - 50 To 499 HP w/NSCR	0.00	0.01	0.61
Natural Gas Condensate - Storage Tanks	0.00	18.06	0.00
Natural Gas Well Pneumatic Devices	0.00	7.07	0.00
Natural Gas Exploration - Well Completion, All Processes	0.00	3.34	0.00
Oil and Gas Production - Produced Water	0.00	2.30	0.00
Natural Gas Fugitives – Other	0.00	2.04	0.00
Natural Gas Fugitives – Valves	0.00	1.73	0.00
Natural Gas Well Venting	0.00	1.19	0.00
Crude Oil Storage Tanks	0.00	1.18	0.00
Natural Gas Condensate - Tank Truck/Railcar Loading	0.00	0.57	0.00
Oil Production – Wellhead	0.00	0.55	0.00
Oil Well Pneumatic Devices	0.00	0.46	0.00
Natural Gas Fugitives – Flanges	0.00	0.28	0.00
Natural Gas Fugitives – Connectors	0.00	0.27	0.00
Oil Well Completion - All Processes	0.00	0.23	0.00
Natural Gas Fugitives - Open Ended Lines	0.00	0.21	0.00
Oil Production Fugitives – Other	0.00	0.15	0.00
Crude Oil Truck/Railcar Loading	0.00	0.11	0.00
Natural Gas Fugitives – Pumps	0.00	0.11	0.00
Oil Production Fugitives – Valves	0.00	0.10	0.00
Oil Production Fugitives – Pumps	0.00	0.05	0.00
Natural Gas Production - Compressor Engines	0.00	0.04	0.06
Oil Production Fugitives – Connectors	0.00	0.04	0.00
Oil Production Fugitives - Open Ended Lines	0.00	0.01	0.00
Natural Gas 2-Cycle Lean Burn Compressors < 50 HP	0.00	0.00	0.01
Oil Production Fugitives – Flanges	0.00	0.00	0.00
Natural Gas 4-Cycle Rich Burn Compressors - <50 HP	0.00	0.00	0.01
Oil and Gas Production Total	61.84	43.72	20.09

Some facilities associated with oil and gas production, such as natural gas processing plants and compressor stations, are required to report to the TCEQ as point sources. Emissions for 2006 from these facilities are not included above within Table 3-16, but are summarized by standard industrial classification (SIC) in Table 3-17: *2006 Point Source Oil and Gas Emissions for 10-County DFW Area*. Table 3-17 provides detail for the "Point - Oil and Gas" category from Table 3-8.

Table 3-17: 2006 Point Source Oil and Gas Emissions for 10-County DFW Area

SIC Description	SIC Code	NO_X (tpd)	VOC (tpd)	CO (tpd)
Crude Petroleum and Natural Gas	1311	4.78	15.67	4.88
Natural Gas Liquids	1321	5.43	2.70	2.58
Natural Gas Transmission	4922	1.03	0.81	0.96
Petroleum Bulk Stations and Terminals	5171	0.08	1.89	0.12
Mixed, Manufactured, LPG Production	4925	0.21	0.00	0.19
Refined Petroleum Pipelines	4613	0.01	0.74	0.02
DFW Nonattainment Area Total	NA	11.53	21.82	8.74

3.5.2.4 Base Case Summary

Table 3-18: *2006 Sample Base Case Anthropogenic Emissions for 10-County DFW Area* summarizes the typical weekday emissions in the 10-county DFW nonattainment area by source type for the base case episode. The EGU emissions presented are specific to the June 14, 2006 episode day, and are different for each of the remaining 66 days in the combined 67-day episode. Table 3-18 is for an average weekday during the June episode, which uses the summer season on-road inventories. For the August-September base case emissions, the school season on-road inventories presented in Table 3-10 were used.

Table 3-18: 2006 Sample Base Case Anthropogenic Emissions for 10-County DFW Area

DFW Nonattainment Area Source Type	NO_X (tpd)	VOC (tpd)	CO (tpd)
On-Road	284.27	116.50	1,315.46
Non-Road	98.06	64.69	806.01
Off-Road – Locomotives	20.14	1.28	3.16
Off-Road – Airports	12.78	4.46	48.09
Area Sources	29.02	290.46	85.59
Oil and Gas – Production	61.84	43.72	20.09
Oil and Gas – Drill Rigs	18.23	1.16	3.57
Point – Oil and Gas	11.53	21.82	8.74
Point – EGUs on June 14, 2006	8.42	1.02	3.85
Point – Cement Kilns	22.08	1.94	17.45
Point – Other	14.31	25.65	17.26
Total	580.68	572.70	2,329.27

3.5.3 2006 Baseline

The baseline modeling emissions are based on typical ozone season emissions, whereas the base case modeling emissions are episode day-specific. The biogenic emissions, dependent on the day-specific meteorology, are an exception in that the same episode day-specific emissions are used in both the 2006 base case and baseline. In addition, the 2006 baseline emissions for on-road, non-road, off-road, oil and gas, and area sources are the same as used for the 2006 base case episode, since they are based on typical ozone season emissions. Unlike the base case, fire emissions were not included in the 2006 baseline as they are not typical ozone season day emissions.

For the non-AMPD point sources, the 2006 baseline emissions are the same as the modeling emissions used for the 67-day episode base case with a couple of exceptions. The 2006 baseline EGU emissions were estimated using the average of the June-September hourly AMPD emissions from 2006 to more accurately reflect EGU emissions during the peak ozone season. The highly reactive VOC (HRVOC) emissions reconciliation in the HGB area developed for the 2006 base case was used for the 2006 baseline. For the Gulf of Mexico, Canada, and Mexico, the 2006 baseline used the same emissions as the base case.

Table 3-19: *2006 Summer Baseline Anthropogenic Emissions for 10-County DFW Area* provides the baseline emissions for an average summer weekday. The non-AMPD emissions are the same as the base case, since they are ozone season day averages. The averaged baseline AMPD emissions are not the same as any specific day in the base case, but typical of the entire episode. The only difference between Table 3-18 and Table 3-19 is that the former has episode day specific EGU emissions of 8.42 NO_X tpd for June 14, 2006 while the latter has a peak ozone season average of 9.63 NO_X tpd. The 2006 August-September baseline has the same emission estimates with the exception of including school season on-road emissions instead of those for summer.

Table 3-19: 2006 Summer Baseline Anthropogenic Emissions for 10-County DFW Area

DFW Nonattainment Area Source Type	NO_X (tpd)	VOC (tpd)	CO (tpd)
On-Road	284.27	116.50	1,315.46
Non-Road	98.06	64.69	806.01
Off-Road – Locomotives	20.14	1.28	3.16
Off-Road – Airports	12.78	4.46	48.09
Area Sources	29.02	290.46	85.59
Oil and Gas – Production	61.84	43.72	20.09
Oil and Gas – Drill Rigs	18.23	1.16	3.57
Point – Oil and Gas	11.53	21.82	8.74
Point – EGUs (Ozone Season Average)	9.63	1.03	4.77
Point – Cement Kilns	22.08	1.94	17.45
Point – Other	14.31	25.65	17.26
Total	581.89	572.71	2,330.19

Table 3-20: *2006 DFW Point Source Baseline Emission Estimates by Industry Type* provides a summary by SIC of the 17 major industrial categories within the DFW nonattainment area that each emitted more than 0.25 NO_X tpd in 2006, with the remaining 73 industry types emitting a

total of 3.26 NO_X tpd. As of 2006, there were 394 point source facilities throughout the DFW nonattainment area with three in the cement kiln category (SIC of 3241), twelve in electric services (SIC of 4911), and 379 that comprise the remaining 88 SIC types. Based on submissions to the TCEQ STARS database, these 379 non-cement kiln non-EGU facilities were estimated to emit 25.84 NO_X tpd in 2006.

Table 3-20: 2006 DFW Point Source Baseline Emission Estimates by Industry Type

SIC Code	SIC Description	NO_X (tpd)	VOC (tpd)	CO (tpd)
3241	Cement, Hydraulic	22.08	1.94	17.45
4911	Electric Services	9.63	1.03	4.77
1321	Natural Gas Liquids	5.43	2.70	2.58
1311	Crude Petroleum and Natural Gas	4.78	15.67	4.88
3274	Lime	3.83	0.02	0.46
3296	Mineral Wool	2.20	0.73	1.69
3312	Blast Furnaces and Steel Mills	1.37	1.00	4.74
4922	Natural Gas Transmission	1.03	0.81	0.96
3221	Glass Containers	0.88	0.04	0.04
2099	Food Preparations	0.57	0.03	0.25
2952	Asphalt Felts and Coatings	0.46	0.60	0.63
4581	Airports, Flying Fields, and Services	0.43	0.24	0.20
3511	Turbines and Turbine Generator Sets	0.40	0.08	0.07
2013	Sausages and Other Prepared Meat Products	0.33	0.01	0.16
3674	Semiconductors and Related Devices	0.32	0.79	0.23
4953	Refuse Systems	0.30	0.47	1.20
3251	Brick and Structural Clay Tile	0.26	0.43	0.99
	Remaining 73 SICs Below 0.25 NO_X tpd	3.26	23.86	6.92
	DFW Area Total for 90 SIC Codes	57.55	50.44	48.21

3.5.4 2017 Future Case Emissions

The biogenic emissions used for the 2017 future case modeling are the same episode day-specific emissions used in the base case. In addition, similar to the 2006 baseline, no wildfire emissions were included in the 2017 future case modeling.

3.5.4.1 Point Sources

Outside Texas

The non-AMPD point source emissions data in the regions outside Texas were derived from the EPA's 2018 emissions modeling platform, which is projected from the 2011 NEI. For non-Texas EGUs, the TCEQ applied Cross-State Air Pollution Rule (CSAPR) caps at the state level. For the Canada and Mexico portions of the modeling domain, the 2017 point source emissions were the same as the emissions used in the 2006 baseline. The Gulf of Mexico emissions for 2017 were based on 2011 estimates, and held constant at 2011 levels for the 2017 future year.

Within Texas

2017 future case EGU emission estimates within Texas were based on the prescribed CSAPR state budgets of 137,701 NO_X tons for an entire calendar year and 65,560 NO_X tons for the five-month ozone season of May through September.[2] Future year operational NO_X caps were based on the ozone season budget and its latest unit level allocations from the EPA. Since electricity generation is higher during the hottest months, operational profiles based on 2014 measurements were used to allocate higher estimates for ozone season modeling purposes. Assignment of ozone season NO_X emissions to EGUs operational in 2014 resulted in a total less than the 2017 CSAPR unit level allocations. The remaining NO_X was combined with the set aside allocations for new units under CSAPR. This NO_X combination was first assigned to the maximum allowable emission levels for newly permitted EGUS, and then spread proportionally among all existing EGUs.

The three cement kilns operating within the DFW nonattainment area were assigned the maximum ozone season caps that are specified in 30 Texas Administrative Code (TAC) §117.3123. Emissions for the remaining non-EGU facilities within the DFW nonattainment area were projected from the 2012 levels reported to STARS by each point source facility. An ERG study (ERG, 2010) entitled *Projection Factors for Point and Area Sources* was used as the basis for providing adjustments to the reported 2012 levels based on a combination of the type of industry and county of operation for each facility. Table 3-21: *2012 DFW Area Point Source Emission Estimates by Industry Type* provides a summary by SIC of the 17 major industries within the DFW nonattainment area that emitted more than 0.1 NO_X tpd in 2012, with the remaining 77 industry types emitting a total of 1.57 NO_X tpd. As of 2012 there were 412 point source facilities throughout the DFW nonattainment area: three in the cement kiln category, 12 in electric services, and 397 that comprise the remaining 92 SIC types. Based on submissions to the TCEQ STARS database, these 397 non-cement kiln non-EGU facilities were estimated to emit 23.54 NO_X tpd in 2012.

Table 3-21: 2012 DFW Area Point Source Emission Estimates by Industry Type

SIC Code	SIC Description	NO_X (tpd)	VOC (tpd)	CO (tpd)
3241	Cement, Hydraulic	9.03	0.86	9.20
4911	Electric Services	8.25	3.16	13.86
1311	Crude Petroleum and Natural Gas	11.00	16.49	9.00
1321	Natural Gas Liquids	4.59	4.94	3.88
3274	Lime	1.43	0.01	0.34
4922	Natural Gas Transmission	1.09	2.26	0.77
3312	Blast Furnaces and Steel Mills	0.88	0.89	4.10

[2] On July 28, 2015, the United States Court of Appeals for the District of Columbia Circuit found that the CSAPR 2014 SO_2 and ozone season NO_X budgets for Texas and certain other states were invalid because the budgets required more emission reductions than were necessary. The court remanded without vacatur to the EPA for reconsideration of the emission budgets. On December 3, 2015, the EPA proposed to address the ozone season NO_X budgets as part of the CSAPR Update Rule for the 2008 eight-hour ozone standard (80 FR 75706). Remanded SO_2 budgets are still to be resolved. Therefore, while the current CSAPR budgets for Texas are still in effect, the budgets may be subject to change in the future after the EPA's reconsideration, finalization of the CSAPR Update Rule, or changes resulting from further appeals.

SIC Code	SIC Description	NO_X (tpd)	VOC (tpd)	CO (tpd)
3296	Mineral Wool	0.57	0.56	1.27
4953	Refuse Systems	0.55	0.67	2.16
2952	Asphalt Felts and Coatings	0.46	0.49	0.59
4581	Airports, Flying Fields, and Services	0.33	0.17	0.05
3711	Motor Vehicles and Car Bodies	0.23	3.78	0.16
3253	Ceramic Wall and Floor Tile	0.20	0.16	0.82
3511	Turbines and Turbine Generator Sets	0.19	0.05	0.05
2631	Paperboard Mills	0.16	0.06	0.17
3341	Secondary Nonferrous Metals	0.16	0.16	1.88
4952	Sewerage Systems	0.15	0.03	0.12
	Remaining 77 SICs Below 0.1 NO_X tpd	1.57	15.16	3.53
	DFW Area Total for 94 SIC Codes	40.82	49.88	51.95

Table 3-22: *2017 DFW Area Point Source Emission Projections by Industry Type* provides a summary of the 2017 point source emission projections by SIC. For the cement kiln and electric utility sources, the required emission caps are modeled in the future year even if historical operational levels have only been roughly 50% of these caps. For example, the cement kilns operated at an average ozone season day level of 9.03 NO_X tpd in 2012, but the 2017 future year is still modeled at the 17.64 NO_X tpd cap. In a similar fashion, the EGUs emitted an average of 8.25 NO_X tpd in 2012, but the 2017 future year is modeled at the CSAPR caps of 13.98 NO_X tpd. This conservative approach of modeling the maximum allowable emission levels ensures that future estimates are not underestimated for these large NO_X sources on high ozone days. Specific caps do not apply to the non-cement kiln non-EGU facilities, which are projected to emit 23.18 NO_X tpd in 2017 after application of the ERG projection factors discussed previously.

Table 3-22: 2017 DFW Area Point Source Emission Projections by Industry Type

SIC Code	SIC Description	NO_X (tpd)	VOC (tpd)	CO (tpd)
3241	Cement, Hydraulic	17.64	0.77	10.92
4911	Electric Services	13.98	0.55	6.87
1311	Crude Petroleum and Natural Gas	10.83	16.56	8.59
1321	Natural Gas Liquids	4.52	4.96	3.36
3274	Lime	1.41	0.01	0.38
4922	Natural Gas Transmission	1.07	2.27	0.78
3312	Blast Furnaces and Steel Mills	0.87	0.89	4.86
3296	Mineral Wool	0.56	0.56	1.59
4953	Refuse Systems	0.54	0.67	2.28
2952	Asphalt Felts and Coatings	0.45	0.49	0.57
4581	Airports, Flying Fields, and Services	0.33	0.17	0.07
3711	Motor Vehicles and Car Bodies	0.22	3.79	0.15

SIC Code	SIC Description	NO_X (tpd)	VOC (tpd)	CO (tpd)
3253	Ceramic Wall and Floor Tile	0.20	0.16	0.86
3511	Turbines and Turbine Generator Sets	0.19	0.05	0.06
2631	Paperboard Mills	0.16	0.06	0.21
3341	Secondary Nonferrous Metals	0.16	0.16	2.05
4952	Sewerage Systems	0.14	0.03	0.14
	Remaining 77 SICs Below 0.1 NO_X tpd	1.54	15.23	3.93
	DFW Area Total for 94 SIC Codes	54.80	47.38	47.68

A similar approach was taken for projecting non-EGU emission levels from 2012 to 2017 in the non-DFW areas of Texas. Within the eight-county HGB area, point source NO_X emissions are limited by the Mass Emissions Cap and Trade Program (MECT), while HRVOC emissions are limited by the HRVOC Emissions Cap and Trade Program (HECT). These MECT and HECT limits were taken into account while projecting 2017 point source levels for both EGUs and non-EGUs operating in the HGB area.

3.5.4.2 On-Road Mobile Sources

The 2017 on-road mobile source inputs were developed using MOVES2014 in combination with the following vehicle activity data sets:

- the TDM managed by NCTCOG for the DFW nonattainment area;
- HPMS data collected by TxDOT for the non-DFW portions of Texas contained within the modeling domain; and
- the EPA default information included with the MOVES2014 database for the non-Texas U.S. portions of the modeling domain.

The output from these emission modeling applications were processed through EPS3 to generate the on-road speciated and gridded inputs for photochemical modeling applications.

DFW and Non-DFW Areas of Texas

For all 254 Texas counties, HPMS-based on-road emissions were developed by TTI for 2017 using MOVES2014. Similar to the approach taken for 2006, 2017 on-road emissions were estimated for the four day types of weekday, Friday, Saturday, and Sunday for both the school and summer seasons. For the 10-county DFW nonattainment area, 2017 link-based on-road emissions were estimated using MOVES2014 and TDM output from NCTCOG.

Outside of Texas

For the non-Texas U.S. portions of the modeling domain, the TCEQ used MOVES2014 in default mode to generate 2017 average summer weekday emissions for every non-Texas county. Temporal profiles based on the Texas on-road inventories from TTI and NCTCOG were developed to adjust these summer weekday emissions to the remaining day and season type combinations referenced above.

Table 3-23: *2017 Future Case On-Road Modeling Emissions for 10-County DFW* summarizes the on-road mobile source emissions for the 2017 future case for the 10-county DFW nonattainment area for all combinations of season and day type.

Table 3-23: 2017 Future Case On-Road Modeling Emissions for 10-County DFW

Season and Day Type	NO_X (tpd)	VOC (tpd)	CO (tpd)
Summer Weekday	130.77	64.91	1,016.95
Summer Friday	134.55	66.63	1,113.21
Summer Saturday	99.46	61.22	948.41
Summer Sunday	92.87	58.90	828.74
School Weekday	131.08	65.04	1,021.32
School Friday	134.11	66.56	1,111.16
School Saturday	98.68	61.08	942.45
School Sunday	91.74	58.67	819.69

For the 10-county DFW nonattainment area, the on-road mobile source NO_X emissions are reduced roughly 54% from the 2006 baseline (284.27 tpd) to the 2017 future case (130.77 tpd). VOC emissions are reduced roughly 44% from the 2006 baseline (116.50 tpd) to the 2017 future case (64.91 tpd). Due to the ongoing fleet turnover effect where older high-emitting vehicles are replaced with newer low-emitting ones, these substantial on-road reductions are projected to occur even with projected growth in VMT between the years of 2006 and 2017.

3.5.4.3 Non- and Off-Road Mobile Sources

Outside Texas

For the non-Texas U.S. portion of the modeling domains, the TCEQ used the EPA's NMIM specifically for 2017 to generate average summer weekday non-road mobile source emission projections by county. For the off-road categories of aircraft, locomotive, and commercial marine, the TCEQ used the EPA's 2011 NEI to create 2017 average summer weekday off-road emissions for the non-Texas U.S. portions of the modeling domain. Summer weekend day emissions for the non-road and off-road mobile source categories were developed as part of the EPS3 processing using temporal profiles specific to each source category.

Within Texas

The TCEQ used the TexN model to generate average summer weekday non-road mobile source category emissions by county for 2017. Airport GSE and oil and gas drilling rig emissions were estimated separately as detailed below. During EPS3 processing, temporal adjustments were made to create Saturday and Sunday non-road emission estimates. Table 3-24: *2017 Future Case Non-Road Modeling Emissions for 10-County DFW* summarizes these non-road inputs by day type. The non-road emission estimates in Table 3-24 were developed with version 1.7.1 of TexN.

For the 10-county DFW nonattainment area, non-road NO_X emissions are reduced by roughly 54% from the 2006 baseline (98.06 tpd) to the 2017 future case (45.54 tpd). VOC emissions are decreased roughly 47% from the 2006 baseline (64.69 tpd) to the 2017 future case (34.01 tpd). Due to the ongoing fleet turnover effect where older high-emitting equipment is replaced with newer low-emitting equipment, these substantial non-road reductions are projected to occur even with expected growth in overall non-road equipment population and activity between the years of 2006 and 2017.

Table 3-24: 2017 Future Case Non-Road Modeling Emissions for 10-County DFW

2017 Day Type	NO_X (tpd)	VOC (tpd)	CO (tpd)
Monday – Friday Average Weekday	45.54	34.01	580.39
Saturday	33.18	49.19	741.99
Sunday	25.23	43.93	642.77

Airport emission inventories were developed with the FAA EDMS tool, which outputs emission estimates for aircraft engines, APUs, and GSE. Table 3-25: *2017 Future Case Airport Modeling Emissions for 10-County DFW* summarizes these estimates for DFW International Airport, Love Field, and the remaining smaller regional airports within DFW. Love Field contracted with Leigh-Fisher to develop emission estimates for 2018 using EDMS, and these were held constant for modeling 2017. The remaining airport specific emission estimates are based on an ERG airport emissions trends study for 2008 through 2040 (ERG, 2015a) done under contract to the TCEQ. A file format conversion error was detected with the 2017 airport emission estimates included with the proposal that has been corrected, resulting in an increase of 0.04 NO_X tpd and 0.10 VOC tpd.

Table 3-25: 2017 Future Case Airport Modeling Emissions for 10-County DFW

DFW Nonattainment Area Airport or Airport Group	NO_X (tpd)	VOC (tpd)	CO (tpd)
DFW International	10.28	2.13	13.06
Love Field	1.70	0.43	2.43
Regional Airports	0.38	0.43	11.80
DFW Area Total	12.36	2.99	27.29

The 2017 locomotive emission estimates were developed from an ERG trends study (ERG, 2015). Emissions were estimated separately for Class I line-haul locomotives, Class II and III line-haul locomotives, and rail yard switcher locomotives. Table 3-26: *2017 Future Case Locomotive Emissions for 10-County DFW* summarizes these estimates for all locomotive activity in DFW.

For the 10-county DFW nonattainment area, the locomotive NO_X emissions are reduced by about 36% from the 2006 baseline (20.14 tpd) to the 2017 future case (12.88 tpd), and the VOC emissions are decreased about 48% from the 2006 baseline (1.28 tpd) to the 2017 future case (0.67 tpd). These substantial locomotive emissions reductions are projected to occur due to the ongoing fleet turnover effect where older high-emitting locomotive diesel engines are replaced with newer low-emitting ones.

Table 3-26: 2017 Future Case Locomotive Emissions for 10-County DFW

Locomotive Source Classification Description	NO_X (tpd)	VOC (tpd)	CO (tpd)
Line-Haul Locomotives – Class I	9.63	0.46	2.51
Line-Haul Locomotives – Classes II and III	0.38	0.02	0.04
Rail Yard Switcher Locomotives	2.87	0.19	0.43
DFW Nonattainment Area Total	12.88	0.67	2.99

3.5.4.4 Area Sources

Outside Texas

For the non-Texas U.S. within the modeling domains, the TCEQ used the EPA's 2011 NEI with to create 2018 daily area source emissions.

Within Texas

The TCEQ used data from the 2014 TexAER database (TCEQ, 2015), and projected these estimates to 2017 using the Texas-specific economic growth factors for 2014 to 2017. Temporal profiles were applied with EPS3 to obtain the figures presented in Table 3-27: *2017 Future Case Area Source Emissions for 10-County DFW*.

Table 3-27: 2017 Future Case Area Source Emissions for 10-County DFW

2017 Day Type	NO_X (tpd)	VOC (tpd)	CO (tpd)
Monday – Friday Average Weekday	26.55	236.70	61.25
Saturday	20.76	133.80	53.72
Sunday	14.98	85.58	46.26

The 2017 county-level drilling rig emission estimates were based on the latest available drilling activity data obtained from the RRC, which are summarized in Table 3-28: *2014 Oil and Gas Drilling Activity for the 10-County DFW Area*. A 2017 drilling rig emission rate for each of the three categories referenced in Table 3-28 was multiplied by the corresponding number of feet drilled. These emission rates for 2012 through 2040 are documented in Chapter 6 of an ERG report entitled *2014 Statewide Drilling Rig Emissions Inventory with Updated Trends Inventories* (ERG, 2015b). The results are summarized in Table 3-29: *2017 Oil and Gas Drilling Rig Emissions for 10-County DFW Area*.

Table 3-28: 2014 Oil and Gas Drilling Activity for the 10-County DFW Area

Type and Depth of 2014 Drilling Levels	2014 Thousands of Feet Drilled
Vertical/Horizontal Drilling	3,256
Vertical Drilling less than 7,000 Feet	540
Vertical Drilling greater than 7,000 Feet	1,467

Table 3-29: 2017 Oil and Gas Drilling Rig Emissions for 10-County DFW Area

Equipment Type	NO_X (tpd)	VOC (tpd)	CO (tpd)
Drilling Rigs	3.07	0.32	1.05

The 2017 future year emission estimates for oil and gas production were projected using 2014 RRC data, which is the latest full year for which such activity information is available. The 2014-to-2017 projection factors were obtained from an ERG study entitled *Forecasting Oil and Gas Activities* (https://www.tceq.texas.gov/assets/public/implementation/air/am/contracts/reports/ei/5821199776FY1212-20120831-erg-forecasting_oild_gas_activities.pdf) (ERG, 2012) where several methodologies were evaluated for the purposes of projecting oil and gas production levels. The recommended approach is based on the Hubbert peak theory that relies on a bell-shaped curve to predict the rate of fossil fuel extraction over time from a specific region. Table 3-30: *Barnett*

Shale Emission Projection Factors from 2014 to 2017 summarizes these projection factors from the ERG study for natural gas, crude oil, and condensate.

Table 3-30: Barnett Shale Emission Projection Factors from 2014 to 2017

Fossil Fuel Type	Barnett Shale Projection Factor from 2014 to 2017
Natural Gas	62.82%
Crude Oil	67.11%
Condensate	29.70%

The 2014 emission estimates based directly on historical RRC data were then multiplied by the projection factors in Table 3-30 to obtain the 2017 emissions estimates by equipment type presented in Table 3-31: *2017 Oil and Gas Production Emissions for 10-County DFW Area*.

Table 3-31: 2017 Oil and Gas Production Emissions for 10-County DFW Area

Oil and Gas Production Equipment	NO_X (tpd)	VOC (tpd)	CO (tpd)
Natural Gas 4-Cycle Rich Burn Compressors 50-499 HP	6.13	0.07	2.36
Natural Gas 4-Cycle Rich Burn Compressors 50-499 HP w/NSCR	1.33	0.06	2.53
Oil and Gas Production - Hydraulic Fracturing Pumps	1.18	0.08	0.00
Natural Gas 4-Cycle Rich Burn Compressors <50 HP	0.82	0.00	0.09
Natural Gas 4-Cycle Rich Burn Compressors 500+ HP w/NSCR	0.81	0.03	1.36
Oil Production - Artificial Lift	0.19	0.00	0.00
Natural Gas 4-Cycle Rich Burn Compressors 500+ HP	0.09	0.00	0.08
Natural Gas 4-Cycle Lean Burn Compressors 50 To 499 HP	0.07	0.04	0.16
Natural Gas 4-Cycle Lean Burn Compressors <50 HP	0.04	0.00	0.01
Natural Gas 2-Cycle Lean Burn Compressors 50 To 499 HP	0.03	0.04	0.08
Natural Gas 2-Cycle Lean Burn Compressors 500+ HP	0.03	0.00	0.00
Natural Gas Well Heaters	0.02	0.00	0.00
Natural Gas Well Dehydrators	0.02	1.85	0.17
Natural Gas 4-Cycle Lean Burn Compressors 500+ HP	0.01	0.01	0.04
Natural Gas Condensate - Storage Tanks	0.01	3.37	0.03
Natural Gas Production - Compressor Engines	0.01	0.01	0.02
Oil Production - All Processes	<0.01	0.01	0.01
Oil Production - Heater Treater	<0.01	0.00	0.00
Crude Oil Storage Tanks	<0.01	0.51	0.00
Natural Gas Condensate - Tank Truck/Railcar Loading	<0.01	0.06	0.00
Crude Oil Truck/Railcar Loading	<0.01	0.04	0.00
Natural Gas Well Pneumatic Devices	0.00	7.69	0.00
Natural Gas Exploration - Well Pneumatic Pumps	0.00	7.37	0.00
Natural Gas Fugitives – Other	0.00	2.70	0.00
Natural Gas Exploration - Mud Degassing	0.00	1.71	0.00
Natural Gas Well Venting	0.00	1.57	0.00
Natural Gas Fugitives – Valves	0.00	1.37	0.00

Oil and Gas Production Equipment	NO_X (tpd)	VOC (tpd)	CO (tpd)
Oil and Gas Production - Produced Water	0.00	1.04	0.00
Natural Gas Fugitives - Flanges	0.00	0.37	0.00
Natural Gas Fugitives - Connectors	0.00	0.36	0.00
Oil Production – Wellhead	0.00	0.33	0.00
Natural Gas Fugitives - Open Ended Lines	0.00	0.28	0.00
Oil Well Pneumatic Devices	0.00	0.25	0.00
Natural Gas Fugitives – Pumps	0.00	0.15	0.00
Oil Well Completion - All Processes	0.00	0.10	0.00
Oil Production Fugitives - Other	0.00	0.09	0.00
Oil Exploration - Mud Degassing	0.00	0.08	0.00
Oil Well Pneumatic Pumps	0.00	0.07	0.00
Oil Production Fugitives - Valves	0.00	0.06	0.00
Oil Production Fugitives - Pumps	0.00	0.03	0.00
Oil Production Fugitives - Connectors	0.00	0.02	0.00
Natural Gas Exploration - Well Completion, All Processes	0.00	0.02	0.00
Oil Production Fugitives - Open Ended Lines	0.00	<0.01	0.00
Oil Production Fugitives - Flanges	0.00	<0.01	0.00
Oil and Gas Production Total	10.80	31.86	6.96

Comparison of the 2006 oil and gas production emission estimates in Table 3-16 with the 2017 projections in Table 3-31 shows that compressor engine emissions are the primary source of NO_X from oil and gas activity in the Barnett Shale, but that the 2017 levels are lower than 2006. This is primarily due to the introduction of TCEQ Chapter 117 rules for compressor engines rated above 50 horsepower, which took effect starting in 2007. Without these rules, the average natural gas compressor engine emission rate would be 7.57 NO_X grams/horsepower-hour (gm/hp-hr). Introduction of this rule lowered this emission rate by roughly 93% to 0.56 NO_X gm/hp-hr.

Some facilities associated with oil and gas production, such as natural gas processing plants and compressor stations, are required to report to the TCEQ as point sources. The 2017 emission projections for these facilities are not included within Table 3-31, but are summarized by SIC in Table 3-32: *2017 Point Source Oil and Gas Emissions for 10-County DFW Area*. The emissions in Table 3-32 are part of the total 2017 emissions detailed in Table 3-22.

Table 3-32: 2017 Point Source Oil and Gas Emissions for 10-County DFW Area

SIC Description	SIC Code	NO_X (tpd)	VOC (tpd)	CO (tpd)
Crude Petroleum and Natural Gas	1311	10.83	16.56	8.59
Natural Gas Liquids	1321	4.52	4.96	3.36
Natural Gas Transmission	4922	1.07	2.27	0.78
Petroleum Bulk Stations and Terminals	5171	0.06	1.64	0.14
Mixed, Manufactured, LPG Production	4925	0.02	0.00	0.11
Refined Petroleum Pipelines	4613	0.01	0.37	0.02
DFW Nonattainment Area Total	NA	16.50	25.80	13.00

Figure 3-12: *Barnett Shale Drilling and Natural Gas Production from 1993-2015* summarizes Barnett Shale drilling and production levels from 1993 through 2015 based on regularly updated information available on the RRC Barnett Shale Information Web page (http://www.rrc.state.tx.us/oil-gas/major-oil-gas-formations/barnett-shale-information/). The blue line in Figure 3-12 is the daily average natural gas production rate from 1993 through 2015. As shown, Barnett Shale natural gas production has followed a bell-shaped curve with production levels peaking in 2012 when the daily average extraction rate was 5,744 million cubic feet (MMcf) per day. From this 2012 peak, the 2013 daily average was 5,354 MMcf/day (7% lower), the 2014 daily average was 4,931 MMcf/day (14% lower), and the 2015 average was 4,366 MMcf/day (24% lower).

The black line in Figure 3-12 is the Henry Hub natural gas spot price, which hovered in the $7-9 range during the Barnett Shale drilling boom years of 2005-2008, and then dropped to the $3-4 range where it has remained since. The red line in Figure 3-12 shows how the number of drilling permits issued reached a peak of roughly 4,000 in 2008, declined steeply through 2009 as natural gas prices fell, and were in the range of roughly 1,000 per year from 2012 through 2014, similar to the pre-drilling boom years of 2001-2004. The RRC reports that there were 184 drilling permits issued for the Barnett Shale in 2015. A University of Texas at Austin (UT-Austin) study entitled *Barnett Study Determines Full-Field Reserves, Production Forecast* (http://www.beg.utexas.edu/info/docs/OGJ_SFSGAS_pt2.pdf) (UT-Austin, 2013) evaluated historical production data per well to determine that the natural gas extraction rate is highest in the first year and then begins to decline exponentially. For an average production span of 25 years per well, roughly 50% of the natural gas is extracted in the first five years, with the remaining 50% extracted within the subsequent twenty years. The decline in natural gas production since 2012 is expected because wells that began producing during the drilling boom years of 2005 through 2008 are now past this five-year mark, and drilling levels from 2009 onwards have not been sufficient to keep production either at or near the 2012 peak. The TCEQ will continue to monitor the monthly updates provided by the RRC to determine if any changes occur in these recent drilling and production trends.

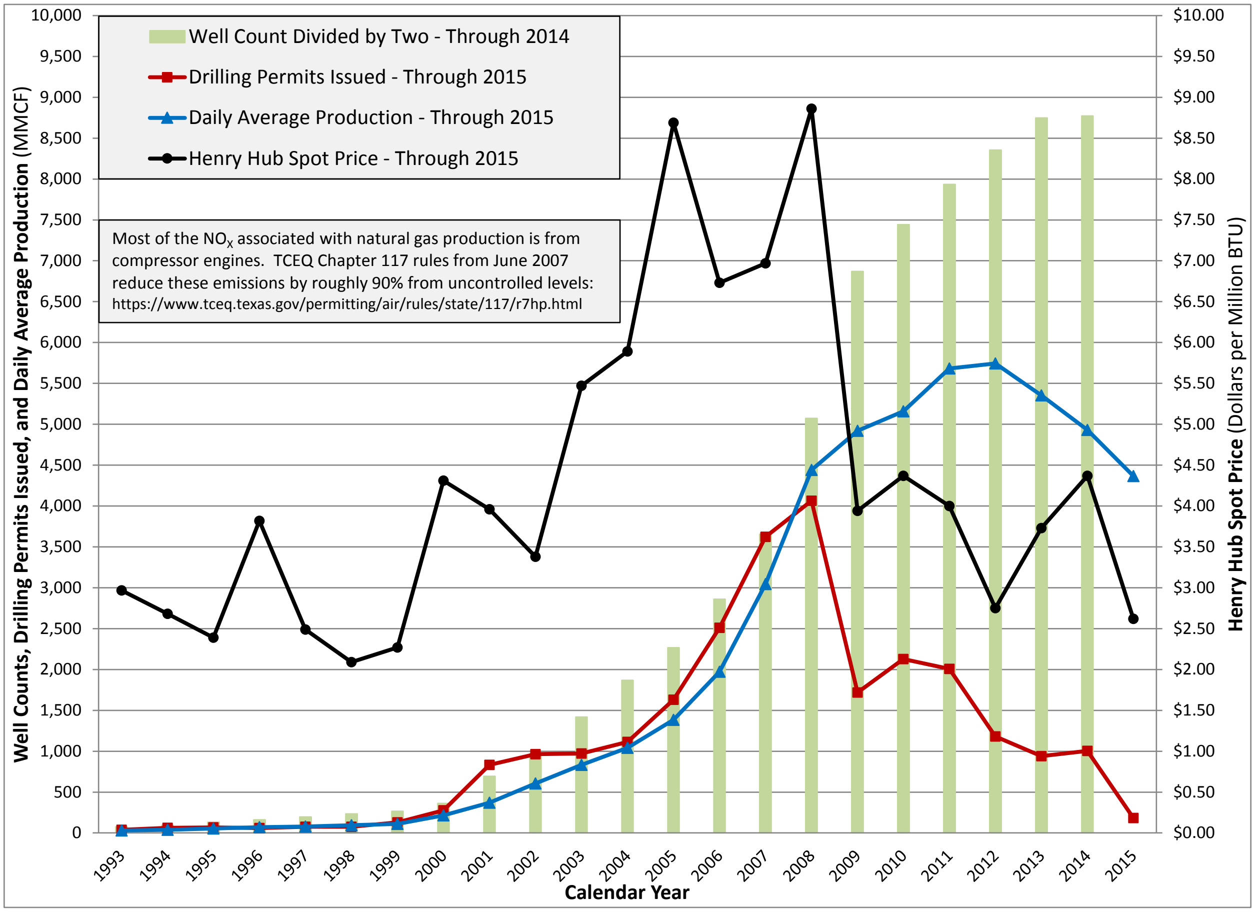


Figure 3-12: Barnett Shale Drilling and Natural Gas Production from 1993 through 2015

3.5.4.5 Future Base Summary

Table 3-33: *2017 Future Case Anthropogenic Emissions for 10-County DFW* summarizes the typical summer weekday emissions in the 10-county DFW nonattainment area by source type for the 2017 future case modeling. A file format conversion error was detected with the 2017 airport emission estimates included with the proposal that has been corrected, resulting in an increase of 0.04 NO_X tpd and 0.10 VOC tpd.

Table 3-33: 2017 Future Case Anthropogenic Emissions for 10-County DFW

DFW Nonattainment Area Source Type	NO_X (tpd)	VOC (tpd)	CO (tpd)
On-Road	130.77	64.91	1,016.96
Non-Road	45.54	34.01	580.39
Off-Road – Locomotives	12.88	0.67	2.99
Off-Road – Airports	12.36	2.99	27.29
Area Sources	26.55	236.70	61.25
Oil and Gas – Production	10.80	31.86	6.96
Oil and Gas – Drill Rigs	3.07	0.32	1.05
Point – Oil and Gas	16.50	25.80	13.00
Point – EGUs (Peak Ozone Season Average)	13.98	0.55	6.87
Point – Cement Kilns	17.64	0.77	10.92
Point – Other	6.68	20.26	16.88
Total	296.77	418.84	1,744.56

3.5.5 2006 and 2017 Modeling Emissions Summary for DFW

Table 3-34: *2006 Baseline and 2017 Future Modeling Emissions for DFW Area* provides side-by-side comparisons of the NO_X and VOC emissions by major source category from Table 3-19 and Table 3-33 for an average summer weekday. The total 10-county DFW nonattainment area anthropogenic NO_X emissions are projected to be reduced by roughly 49% from 2006 (581.89 tpd) to 2017 (296.77 tpd). The total 10-county DFW nonattainment area anthropogenic VOC emissions are projected to be reduced by 27% from 2006 (572.71 tpd) to 2017 (418.84 tpd).

Table 3-34: 2006 Baseline and 2017 Future Modeling Emissions for DFW Area

DFW Nonattainment Area Source Type	2006 NO_X (tpd)	2017 NO_X (tpd)	2006 VOC (tpd)	2017 VOC (tpd)
On-Road	284.27	130.77	116.50	64.91
Non-Road	98.06	45.54	64.69	34.01
Off-Road – Locomotives	20.14	12.88	1.28	0.67
Off-Road – Airports	12.78	12.36	4.46	2.99
Area Sources	29.02	26.55	290.46	236.70
Oil and Gas – Production	61.84	10.80	43.72	31.86
Oil and Gas – Drill Rigs	18.23	3.07	1.16	0.32
Point – Oil and Gas	11.53	16.50	21.82	25.80
Point – EGUs (Ozone Season Average)	9.63	13.98	1.03	0.55
Point – Cement Kilns	22.08	17.64	1.94	0.77
Point – Other	14.31	6.68	25.65	20.26
Total	581.89	296.77	572.71	418.84

Figure 3-13: *2006 Baseline and 2017 Future Modeling Emissions for DFW Area* graphically compares the anthropogenic NO_X and VOC emission estimates presented in Table 3-34.

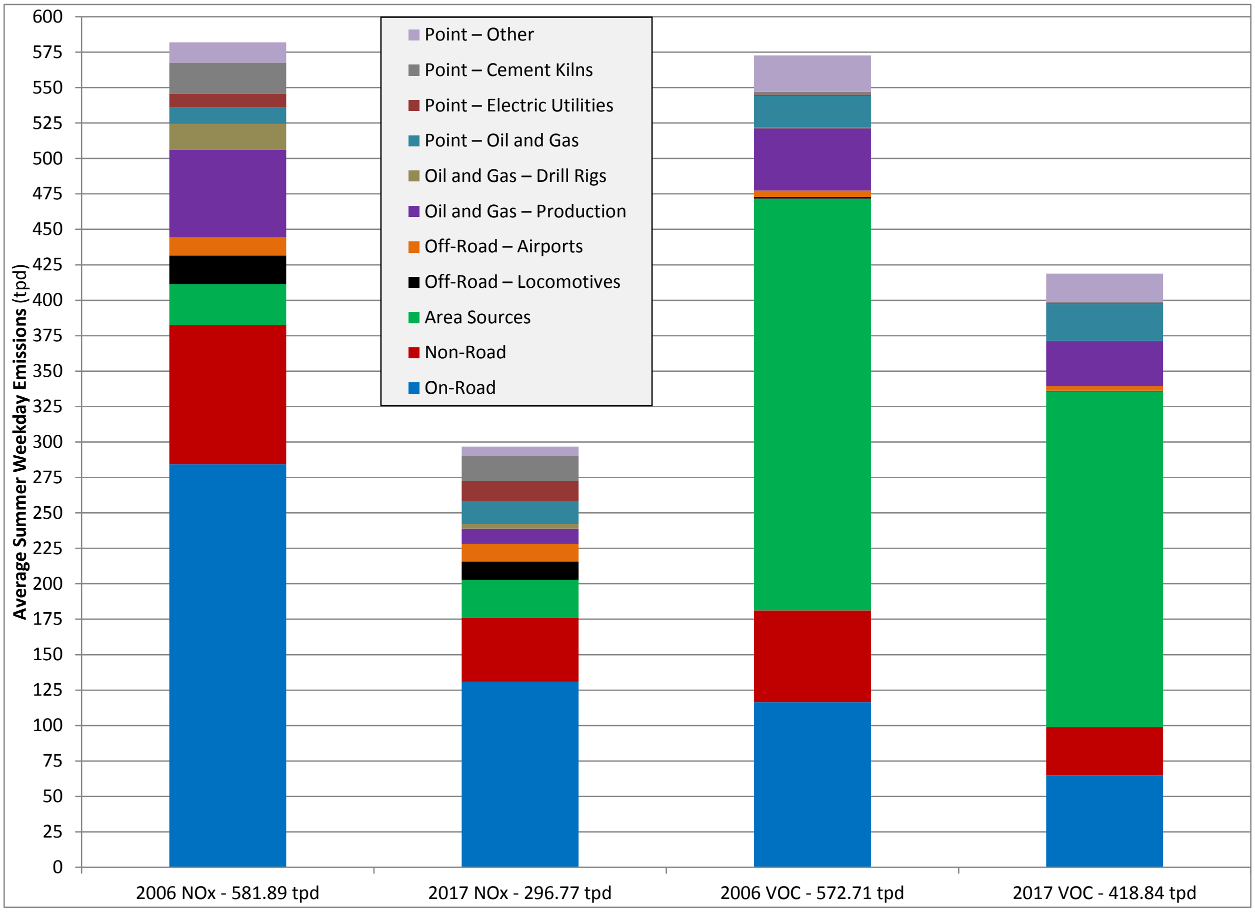


Figure 3-13: 2006 Baseline and 2017 Future Modeling Emissions for DFW Area

3.6 PHOTOCHEMICAL MODELING

To ensure that a modeling study can be successfully used as technical support for an AD SIP revision, the air quality model must be scientifically sound and appropriate for the intended application and freely accessible to all stakeholders. In a regulatory environment, it is crucial that oversight groups (e.g., the EPA), the regulated community, and the public have access to and have reasonable assurance of the suitability of the model. The following three prerequisites were identified for selecting the air quality model to be used in the DFW AD. The model must:

- have a reasonably current, peer-reviewed, scientific formulation;
- be available at no or low cost to stakeholders; and
- be consistent with air quality models being used for Texas SIP development.

The only model to meet all three of these criteria is CAMx. The model is based on well-established treatments of advection, diffusion, deposition, and chemistry. Another important feature is that NO_X emissions from large point sources can be treated with the PiG submodel, which helps avoid the artificial diffusion that occurs when large, hot, point source emissions are introduced into a grid volume. The model software, including the PiG submodel, and the CAMx user's guide are publicly available (Environ, 2015a). In addition, the TCEQ has many years of experience with CAMx as it was used for the modeling conducted in the HGB ozone nonattainment area, the Beaumont-Port Arthur ozone maintenance area, previous DFW ADs, and modeling being conducted in other areas of Texas (e.g., Austin and San Antonio).

3.6.1 Modeling Domains and Horizontal Grid Cell Size

Figure 3-14: *CAMx Modeling Domains* and Table 3-35: *CAMx Modeling Domain Definitions* depict and define the fine resolution 4 km domain covering eastern Texas, a medium resolution 12 km domain covering all of Texas plus some or all of surrounding states, and a coarse resolution 36 km domain covering the continental U.S. plus southern Canada and northern Mexico. The 4 km domain is nested within the 12 km domain, which in turn is nested within the 36 km domain. All three domains were projected in a Lambert Conformal Conic (LCC) projection with the origin at 97 degrees west and 40 degrees north.

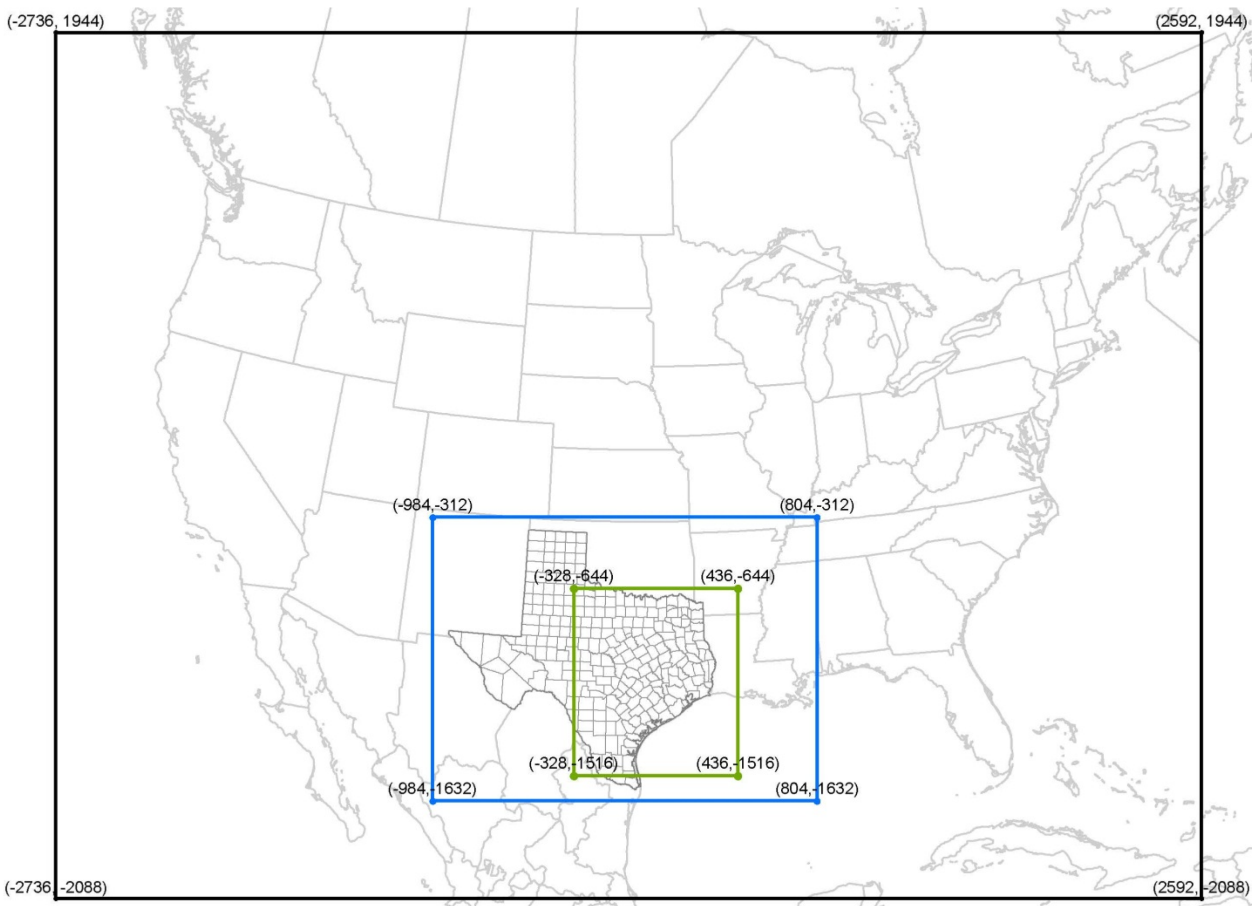


Figure 3-14: CAMx Modeling Domains

Table 3-35: CAMx Modeling Domain Definitions

Domain Code	Domain Cell Size	Dimensions (grid cells)	Lower left-hand corner	Upper right-hand corner
36 km	36 x 36 km	148 x 112	(-2736,-2088)	(2592,1944)
12 km	12 x 12 km	149 x 110	(-984,-1632)	(804,-312)
4 km	4 x 4 km	191 x 218	(-328,-1516)	(436,-644)

3.6.2 Vertical Layer Structure

The vertical configuration of the CAMx modeling domains consists of 28 layers of varying depths in units of meters (m) AGL as shown in Table 3-36: *CAMx Vertical Layer Structure*.

Table 3-36: CAMx Vertical Layer Structure

CAMx Layer	WRF Layer	Top (m AGL)	Center (m AGL)	Thickness (m)
28	38	15,179.1	13,637.9	3,082.5
27	36	12,096.6	10,631.6	2,930.0
26	32	9,166.6	8,063.8	2,205.7
25	29	6,960.9	6,398.4	1,125.0
24	27	5,835.9	5,367.0	937.9
23	25	4,898.0	4,502.2	791.6
22	23	4,106.4	3,739.9	733.0
21	21	3,373.5	3,199.9	347.2
20	20	3,026.3	2,858.3	335.9
19	19	2,690.4	2,528.3	324.3
18	18	2,366.1	2,234.7	262.8
17	17	2,103.3	1,975.2	256.2
16	16	1,847.2	1,722.2	249.9
15	15	1,597.3	1,475.3	243.9
14	14	1,353.4	1,281.6	143.6
13	13	1,209.8	1,139.0	141.6
12	12	1,068.2	998.3	139.7
11	11	928.5	859.5	137.8
10	10	790.6	745.2	90.9
9	9	699.7	654.7	90.1
8	8	609.7	565.0	89.3
7	7	520.3	476.1	88.5
6	6	431.8	387.9	87.8
5	5	344.0	300.5	87.1
4	4	256.9	213.8	86.3
3	3	170.6	127.8	85.6
2	2	85.0	59.4	51.0
1	1	33.9	17.0	33.9

3.6.3 Model Configuration

The TCEQ used CAMx version 6.20, which includes a number of upgrades and features from previous versions. The following CAMx 6.20 options were employed:

- revised gridded file formats for meteorology inputs, initial/boundary conditions, emission inputs, output concentration values, and deposition fields;
- photolysis rate updates based on inputs for surface albedo, height above ground, terrain height, solar zenith, clouds, temperature, and barometric pressure; and

- new gas-phase chemistry mechanisms for CB6 speciation and CB6 "revision 2" (CB6r2), which revises isoprene and aromatics extensively, and has additional NO_X recycling from organic nitrates.

In addition to the CAMx inputs developed from the meteorological and emissions modeling, inputs are needed for initial and boundary conditions, spatially resolved surface characteristic parameters, spatially resolved albedo/haze/ozone (i.e., opacity) and photolysis rates, and a chemistry parameters file. The TCEQ contracted with Environ (Environ, 2012) to derive episode-specific boundary conditions from the Goddard Earth Observing Station global atmospheric model with Chemistry (GEOS-Chem) model runs for 2006 and 2018. The 2018 boundary conditions were applied to the 2017 future case. Boundary conditions were developed for each grid cell along all four edges of the outer 36 km modeling domain at each of the 28 vertical layers for each episode hour. This work also produced initial conditions for each of the 67 days within both episodes. The TCEQ used these episode-specific initial and lateral boundary conditions for this modeling study.

Surface characteristic parameters, including topographic elevation, LAI, vegetative distribution, and water/land boundaries are input to CAMx via a land-use file. The land-use file provides the fractional contribution (0 to 1) of 26 land-use categories, as defined by Zhang et al (2003). For the 36 km domain, the TCEQ developed the land-use file using version 3 of the Biogenic Emissions Landuse Database (BELD3) for areas outside the U.S. and the 2006 National Land Cover Dataset (NLCD) for the U.S. For the 4 km and 12 km domains, the TCEQ used updated land-use files developed by Texas A&M University (Popescu et al., 2012), which were derived from more highly resolved data collected by the Texas Parks and Wildlife Department, Landscape Fire and Resource Management Planning Tools Project (LANDFIRE), LandSat, National Institute of Statistics and Geography (INEGI), and the NLCD. Monthly averaged LAI was created from the eight-day 1 km resolution MODIS MCD15A2 product.

Spatially-resolved opacity and photolysis rates are input to CAMx via a photolysis rates file and an opacity file. These rates, which are specific to the chemistry parameters file for the CB6 mechanism, are also input to CAMx. The TCEQ used episode-specific satellite data from the Total Ozone Mapping Spectrometer to prepare the clear-sky photolysis rates and opacity files. Photolysis rates are internally adjusted by CAMx according to cloud and aerosol properties using the inline Troposheric Ultraviolet Visible model.

3.6.4 Model Performance Evaluation

The CAMx model configuration was applied to the 2006 base case using the episode-specific meteorological parameters, biogenic emission inputs, and anthropogenic emission inputs. The CAMx modeling results were compared to the measured ozone and ozone precursor concentrations at all regulatory monitoring sites, which resulted in a number of modeling iterations to implement improvements to the meteorological modeling, emissions modeling, and subsequent CAMx modeling. A detailed performance evaluation for the 2006 base case modeling episode is included in Appendix C. In addition, all performance evaluation products are available on the TCEQ modeling files File Transfer Protocol (FTP) site (ftp://amdaftp.tceq.texas.gov/pub/TX/).

3.6.4.1 Performance Evaluations Overview

The performance evaluation of the base case modeling demonstrates the adequacy of the model to correctly replicate the relationship between meteorological conditions, emissions of NO_X and VOC precursors, and the levels of ozone formed. The model's ability to suitably replicate this relationship is necessary to have confidence in the model's prediction of the future year ozone and the response to various control measures. As recommended in the 2007 modeling guidance, the TCEQ has incorporated the recommended eight-hour performance measures into its evaluations but also focuses on one-hour performance analyses, especially in the DFW nonattainment area. The localized small-scale (i.e., high resolution) meteorological and emissions features characteristic of the DFW nonattainment area require model evaluations to be performed at the highest resolution possible to determine whether or not the model is getting the right answer for the right reasons.

3.6.4.2 Operational Evaluations

Statistical measures including the Unpaired Peak Accuracy (UPA), the Mean Normalized Bias (MNB), and the Mean Normalized Gross Error (MNGE) were calculated by comparing monitored (measured) and four-cell bi-linearly interpolated modeled ozone concentrations for all episode days and monitors. For one-hour ozone comparisons, the EPA recommends ranges of ±20% for UPA and ±15% for MNB, and a 30% level for MNGE, which is always positive because it is an absolute value. There are no recommended eight-hour ozone criteria for UPA, MNB, and MNGE. Graphical measures including time series and scatter plots of hourly measured and bi-linearly interpolated modeled ozone were developed. For monitoring locations where specific measurements were available, similar graphical plots were developed for ozone precursors such as nitrogen oxide, NO_2, ethylene, and isoprene. In addition, plots of modeled daily maximum eight-hour ozone concentrations were developed and overlaid with the measured daily maximum eight-hour ozone concentrations. Detailed operational evaluations for the 2006 base case modeling episode are included in Appendix C.

Statistical Evaluations

Figure 3-15: *DFW Observed versus Modeled Peak Eight-Hour Ozone for June Episode* compares the observed and modeled daily maximum eight-hour ozone concentrations for each of the 33 days in the June episode. Although there are no recommended criteria for the eight-hour UPA, error bars of ±20% are shown. In general, ozone concentrations are over-estimated on most days, but the majority of modeled maximum values fall within the ±20% range. Nine of the 33 episode days are out of this ±20% range, but seven of these nine days had monitored peak ozone values between 40-70 ppb, which is well below the 75 ppb level. Figure 3-16: *DFW Observed versus Modeled Peak Eight-Hour Ozone for August-September Episode* compares the observed and modeled daily maximum eight-hour ozone concentrations for each of the 34 days in the August-September episode. Compared with the June model performance, there is greater over-estimation of peak eight-hour ozone levels in the August-September episode. Twenty-one of the 34 days fall outside of the ±20% range, but 14 of these 21 days had peak eight-hour ozone levels below 75 ppb.

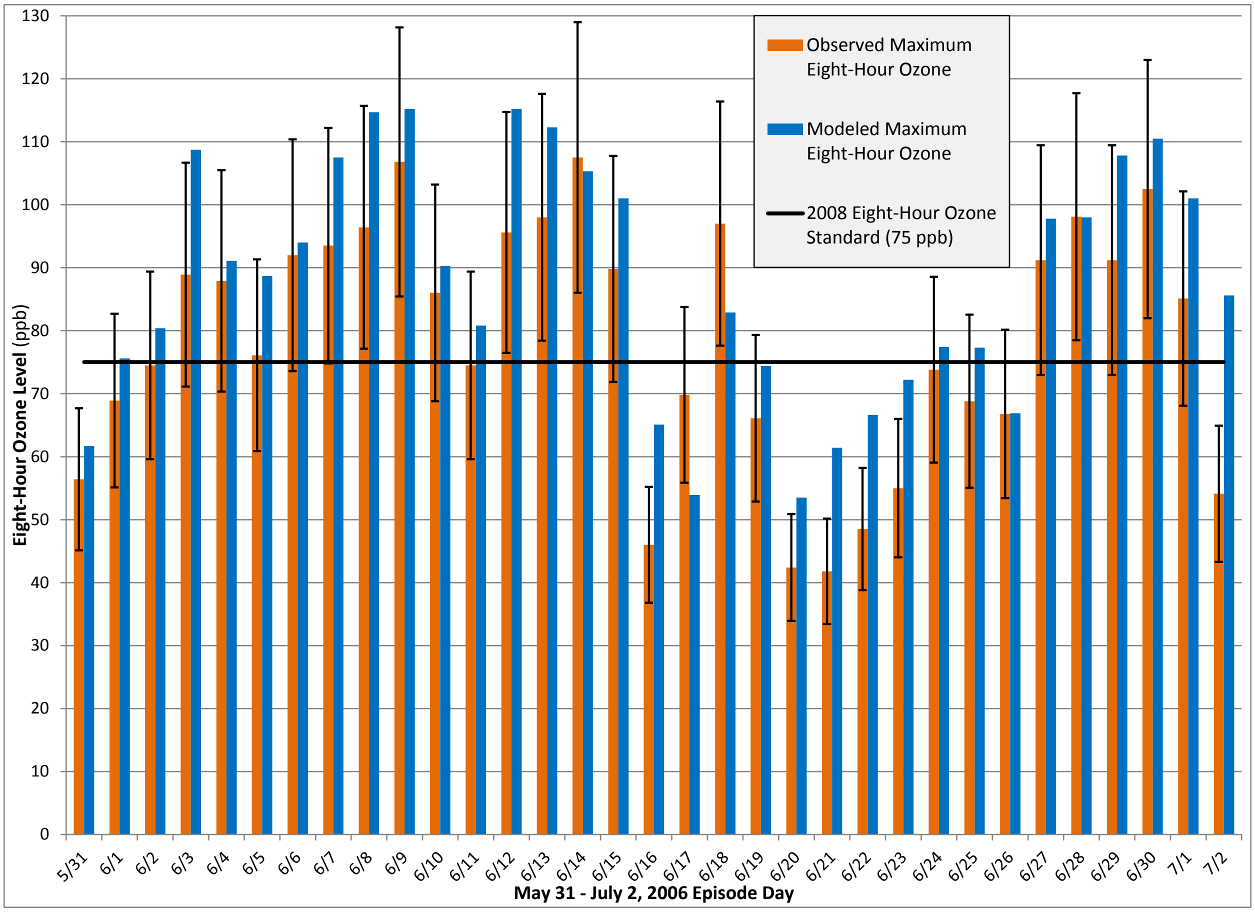


Figure 3-15: DFW Observed versus Modeled Peak Eight-Hour Ozone for June Episode

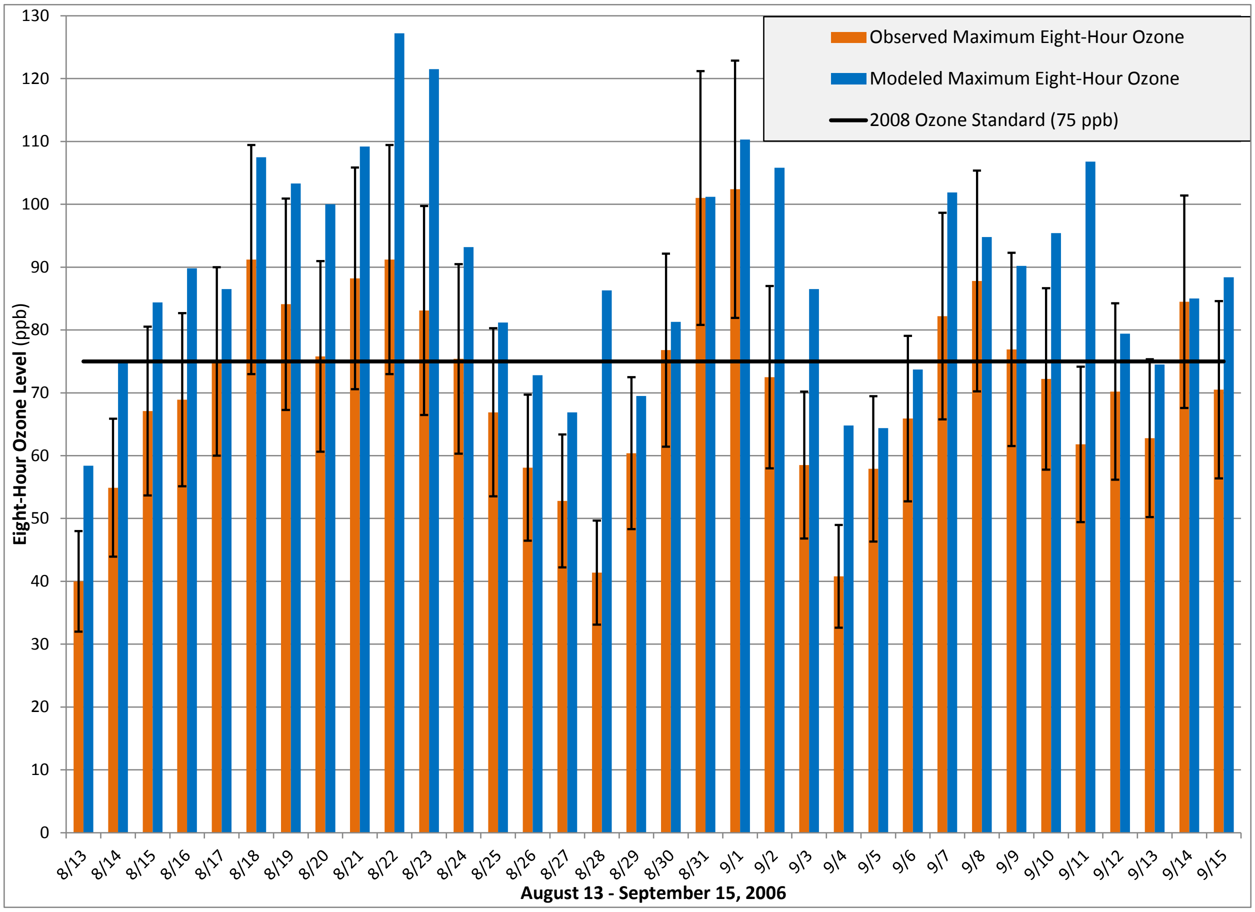


Figure 3-16: DFW Observed versus Modeled Peak Eight-Hour Ozone for August-September Episode

Figure 3-17: *MNB and MNGE Hourly Ozone Statistics for June Episode Days* presents the hourly MNB and MNGE results from May 31 through July 2, 2006. The EPA recommended criteria of ±15% for MNB and 30% for MNGE are shown as the black and red bars, respectively. Three of the 33 days in this episode are out of the recommended MNB range, while two exceed the recommended MNGE level. June 17 is one of the three days exceeding the MNB range, but its peak eight-hour ozone level was below 75 ppb. The remaining two days out of the MNB range are June 18 and July 1. June 18 experienced a slow-moving frontal passage, which was difficult for the meteorological model to replicate. July 1 was a cloudy day, which limited ozone production, but the meteorological model predicted fewer clouds and thus more ozone.

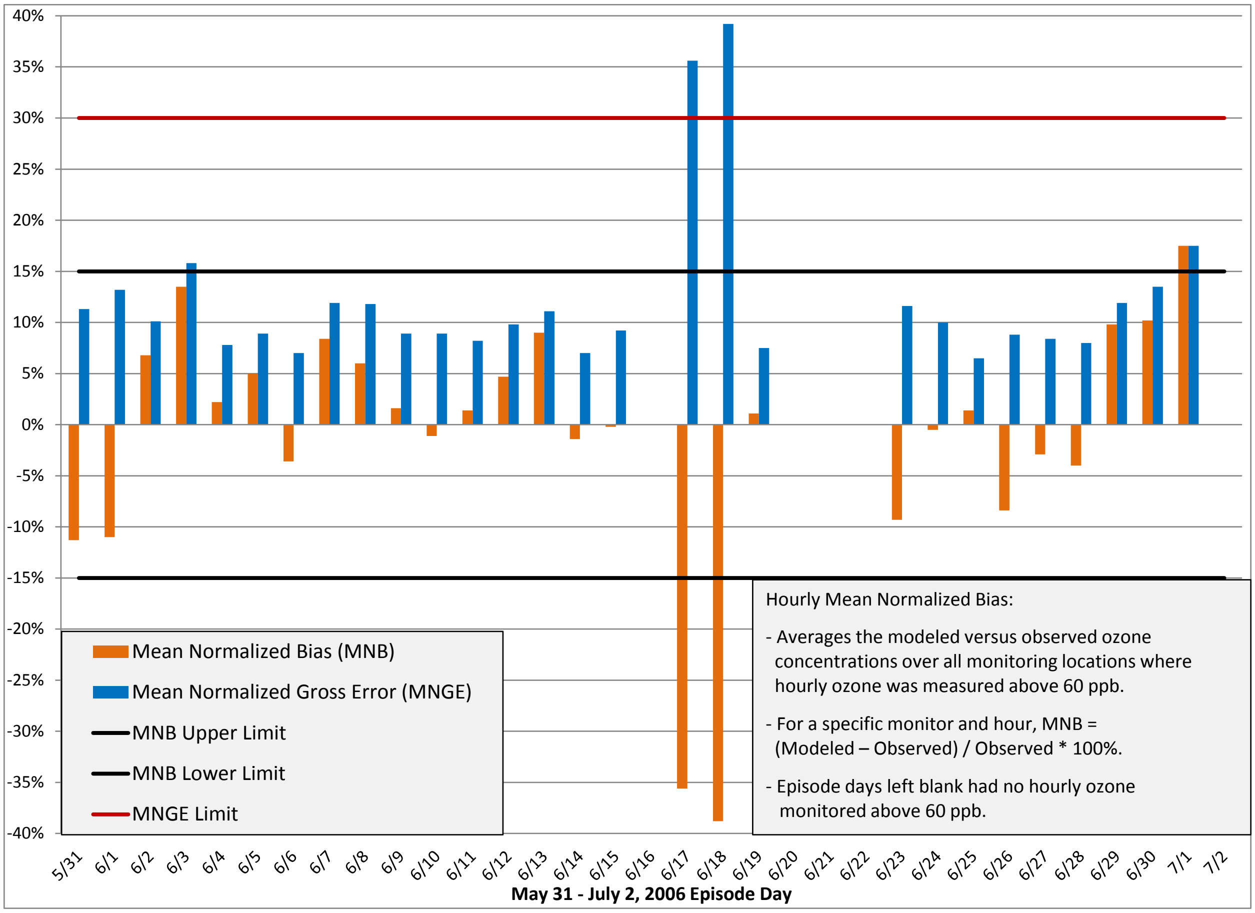


Figure 3-17: MNB and MNGE Hourly Ozone Statistics for June Episode Days

Figure 3-17: *MNB and MNGE Hourly Ozone Statistics for June Episode Days* presents the hourly MNB and MNGE results for August 13 through September 15, 2006. Similar to Figure 3-16, Figure 3-18: *MNB and MNGE Hourly Ozone Statistics for August-September Days* demonstrates the consistent over-prediction of modeled ozone during this episode, particularly for days when peak eight-hour ozone was monitored below 75 ppb. Twelve of the 34 episode days are out of the recommended MNB range, while three exceed the recommended MNGE level. Eight of the 12 episode days out of the MNB range are when peak eight-hour ozone was monitored below 75 ppb.

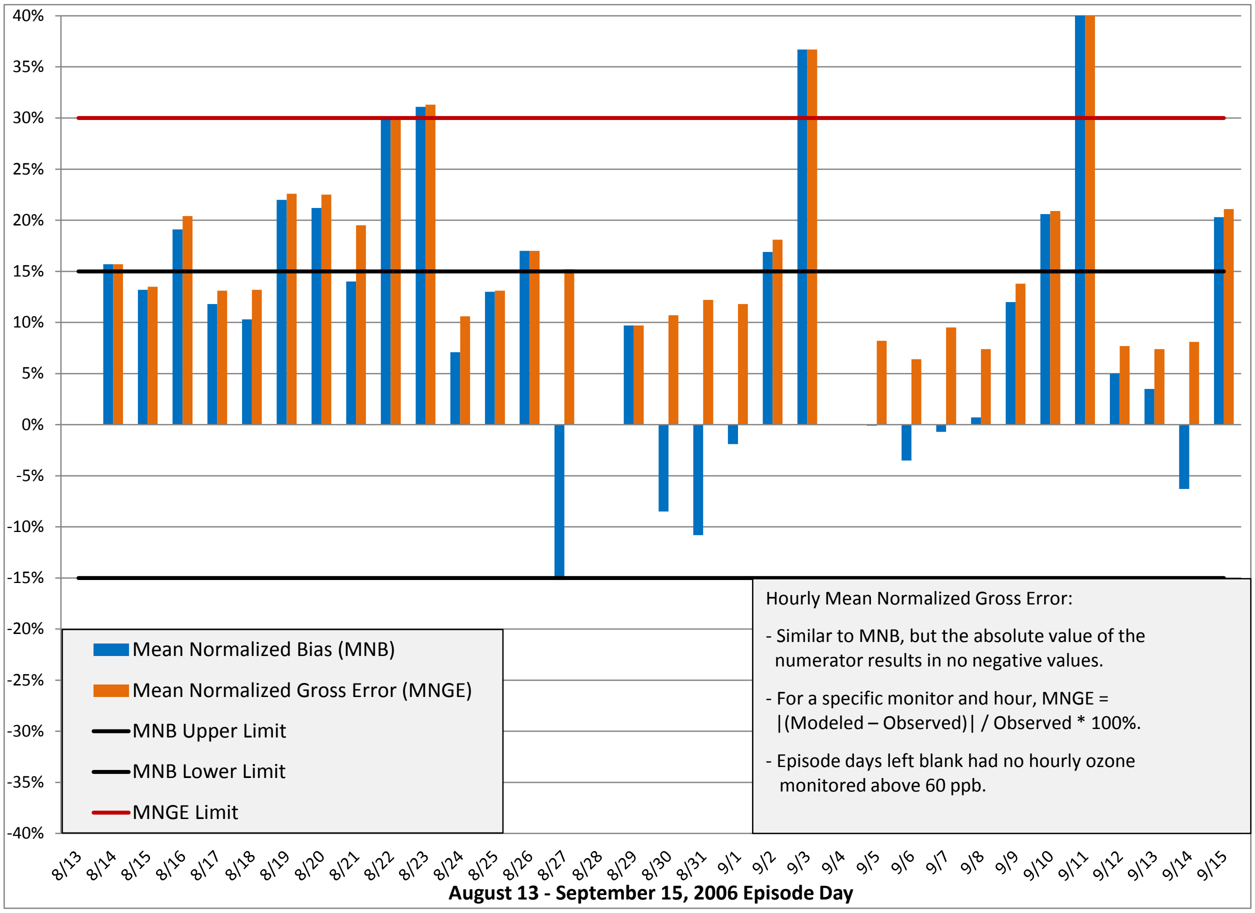


Figure 3-18: MNB and MNGE Hourly Ozone Statistics for August-September Days

In general, the modeling over-predicts monitored ozone for both the June and August-September episodes, but the effect tends to be more pronounced on low ozone days. For the June episode, 15 of the 33 days (45%) had peak eight-hour monitored levels below 75 ppb, while the August-September episode had 19 of 34 days (56%) with peak eight-hour monitored levels below 75 ppb. Compared with the June episode, the August-September episode also had more frontal passages and varying cloud conditions to simulate, both of which are challenging for meteorological modeling.

Combining the 67 days from both episodes, there are 34 days with peak eight-hour ozone levels below 75 ppb and 33 days above. Of these 33 days above 75 ppb from the combined episode, 9 are out of the ±20% UPA range and 6 are out the ±15% MNB range. Those days that exceed the MNGE level of 30% are included within the 6 out of the MNB range. Considering that the majority of eight-hour days above 75 ppb from the combined episodes meet the recommended performance criteria, the model suitably simulates the frequency and magnitude of daily maximum eight-hour ozone concentrations at area monitors.

Graphical Evaluations

A selection of graphical evaluations of modeling results is presented here, but more detail is contained in Appendix C where five representative monitoring locations were chosen for detailed evaluation. Time series and scatterplots are ideal for examining model performance at specific monitoring locations. Time series plots offer the opportunity to follow ozone formation through the course of a day, while scatter plots provide a visual means to see how the model performs across the range of observed ozone and precursor concentrations.

As shown in Figure 3-3, the Kaufman monitor is located in the far southeastern corner of the DFW nonattainment area. Since it is primarily upwind during most of the ozone season, Kaufman is usually one of the monitors recording the lowest ozone levels in DFW. Figure 3-19: *Kaufman June Episode Time Series and Scatter Plots* presents time series of hourly ozone and NO_X concentrations from May 31 through July 2, 2006. Observed concentrations are shown as red dots and the blue lines are modeled concentrations. In general, the model well replicates the diurnal pattern of higher ozone during the day and decreasing at night. On average the model over-predicts ozone concentrations, particularly when monitored concentrations are quite low, such as the 20-40 ppb range that often occurs during the night and early morning hours. This is also evident in the ozone scatter plot, which shows improved correlation of modeled versus observed ozone at higher levels versus lower ones. Figure 3-20: *Kaufman August-September Episode Time Series and Scatter Plots* presents similar information at the Kaufman monitor for August 13 through September 15, 2006. The same pattern is shown here where the overall diurnal pattern and ozone peaks are relatively well modeled, but that lower levels of ozone during the night and early morning hours are over-predicted.

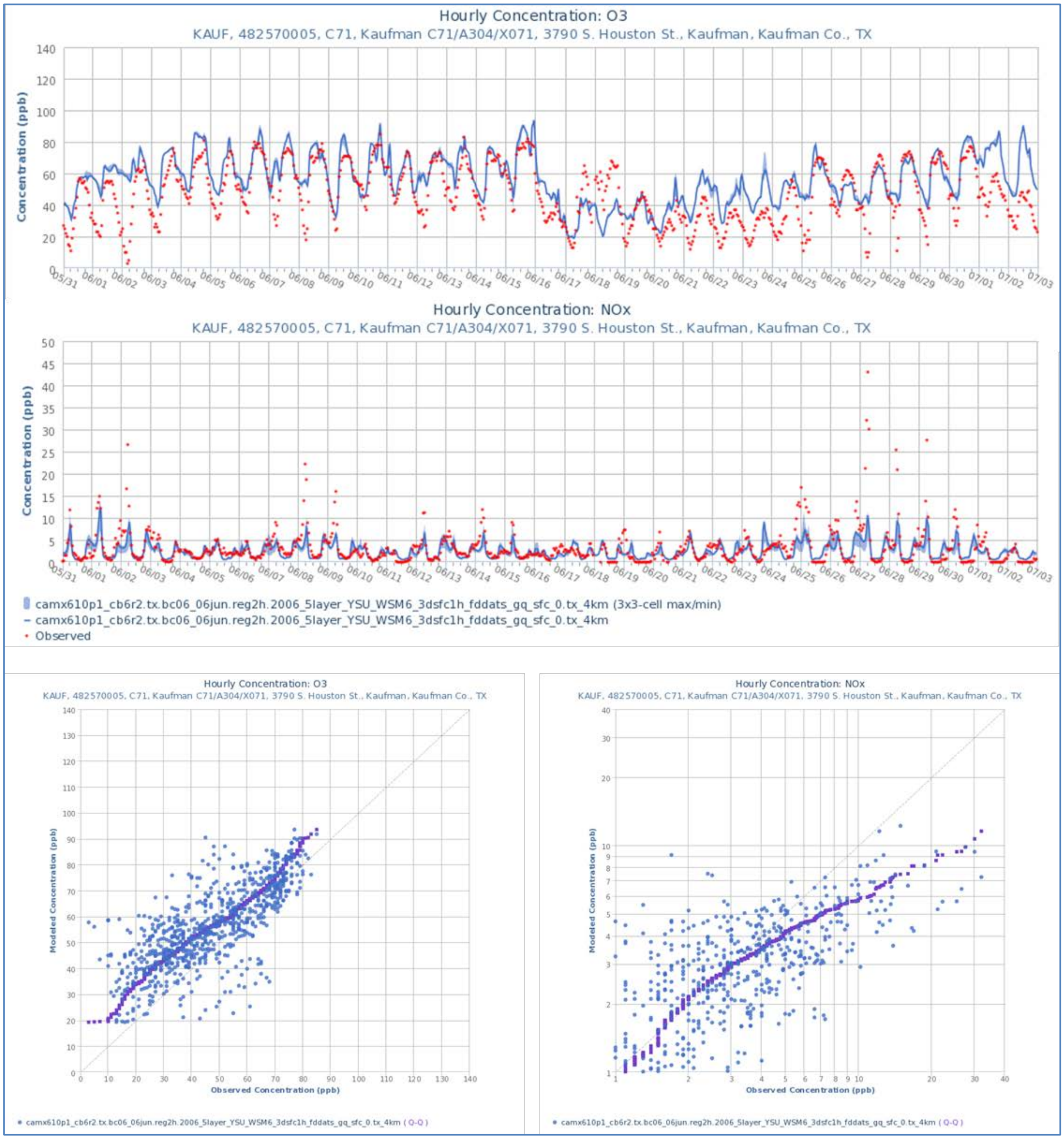


Figure 3-19: Kaufman June Episode Time Series and Scatter Plots

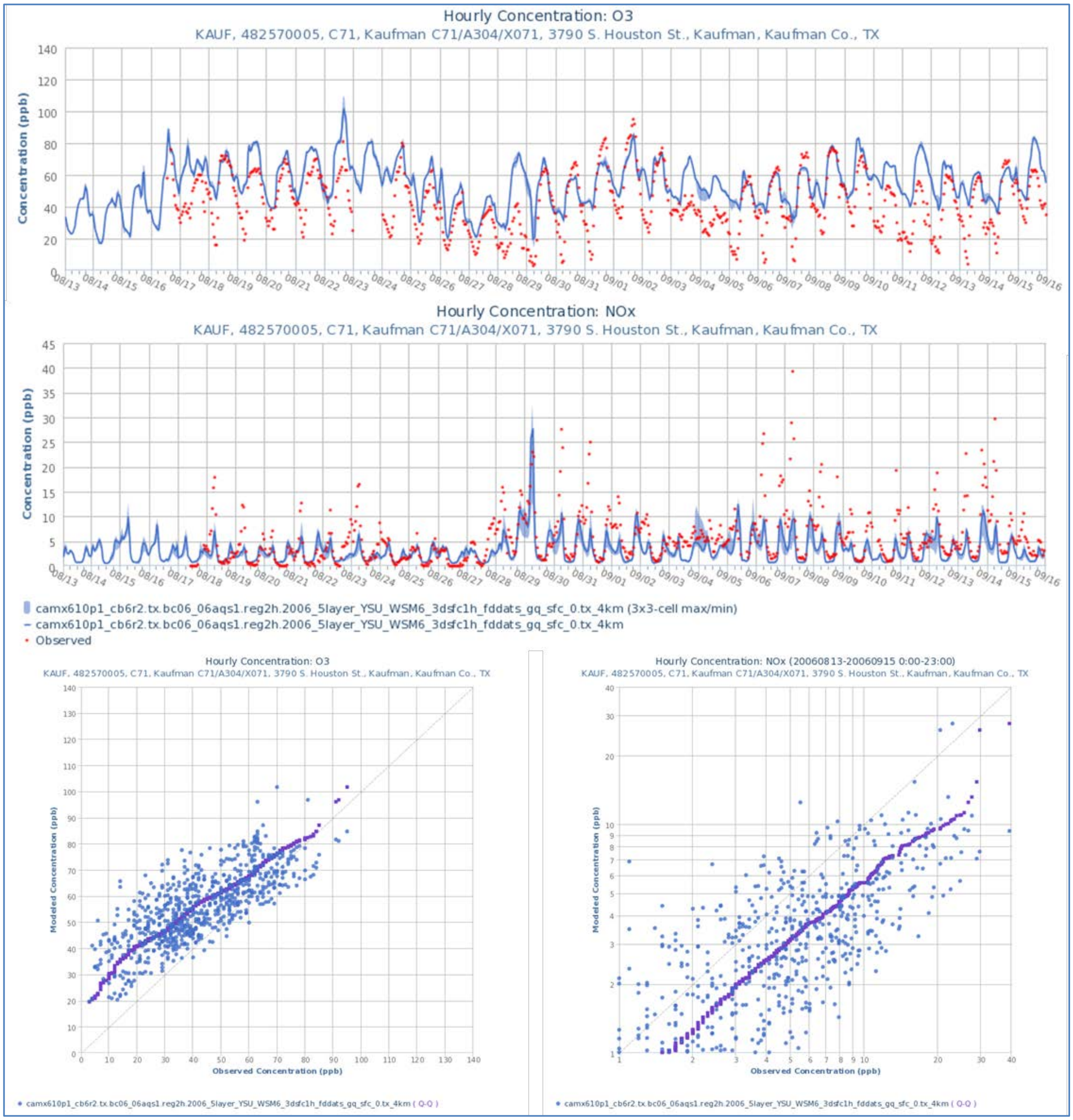


Figure 3-20: Kaufman August-September Episode Time Series and Scatter Plots

As shown in Figure 3-3, the Denton Airport South monitor is located in the far northwestern corner of the DFW nonattainment area. Since it is primarily downwind of the urban core during most of the ozone season, Denton Airport South is usually one of the monitors recording the highest ozone levels in DFW. Comparisons of hourly modeled versus observed ozone are presented in Figure 3-21: *Denton June Episode Time Series and Scatter Plots* and Figure 3-22: *Denton August-September Episode Time Series and Scatter Plots*. As with the Kaufman performance presented in Figure 3-19 and Figure 3-20, the model does a reasonable job at Denton Airport South of replicating the diurnal peaks during both episodes with some over-prediction apparent, particularly at low ozone levels during the night and early morning hours. The model significantly under-predicted only one day (June 18) when eight-hour ozone was measured above 75 ppb, which was due to the previously mentioned difficulty that the meteorological model encountered in replicating a slow moving frontal passage.

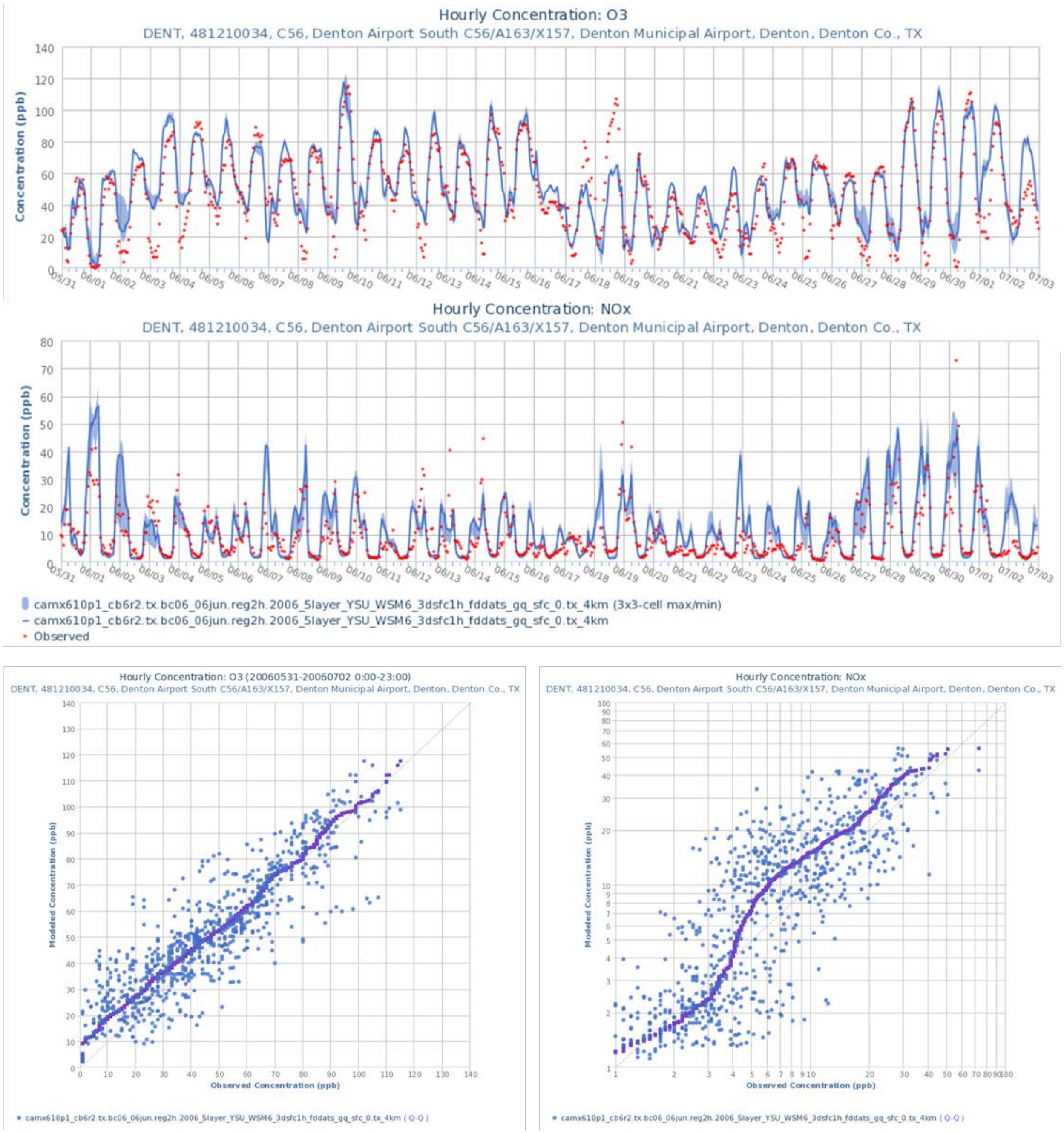


Figure 3-21: Denton June Episode Time Series and Scatter Plots

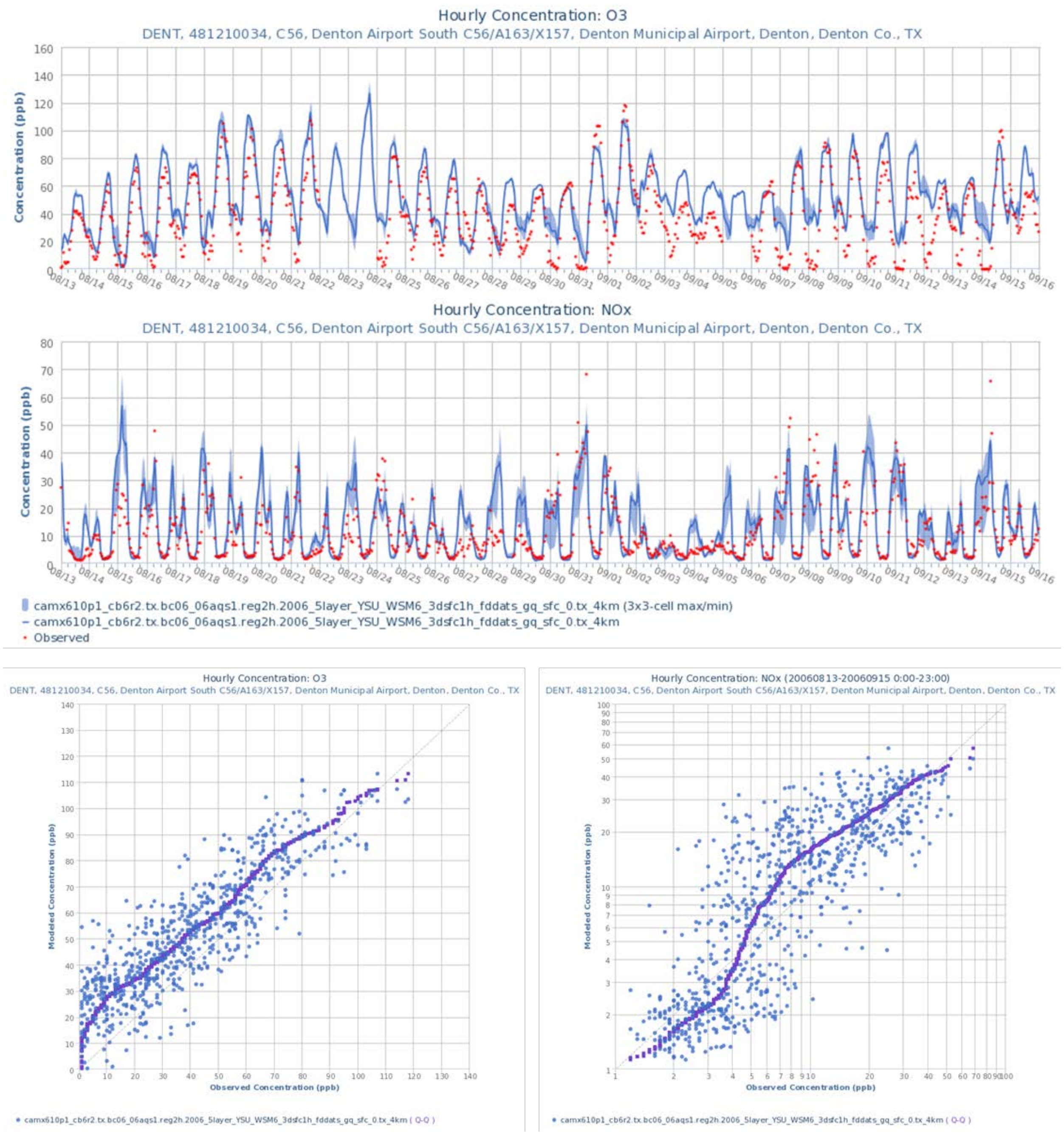


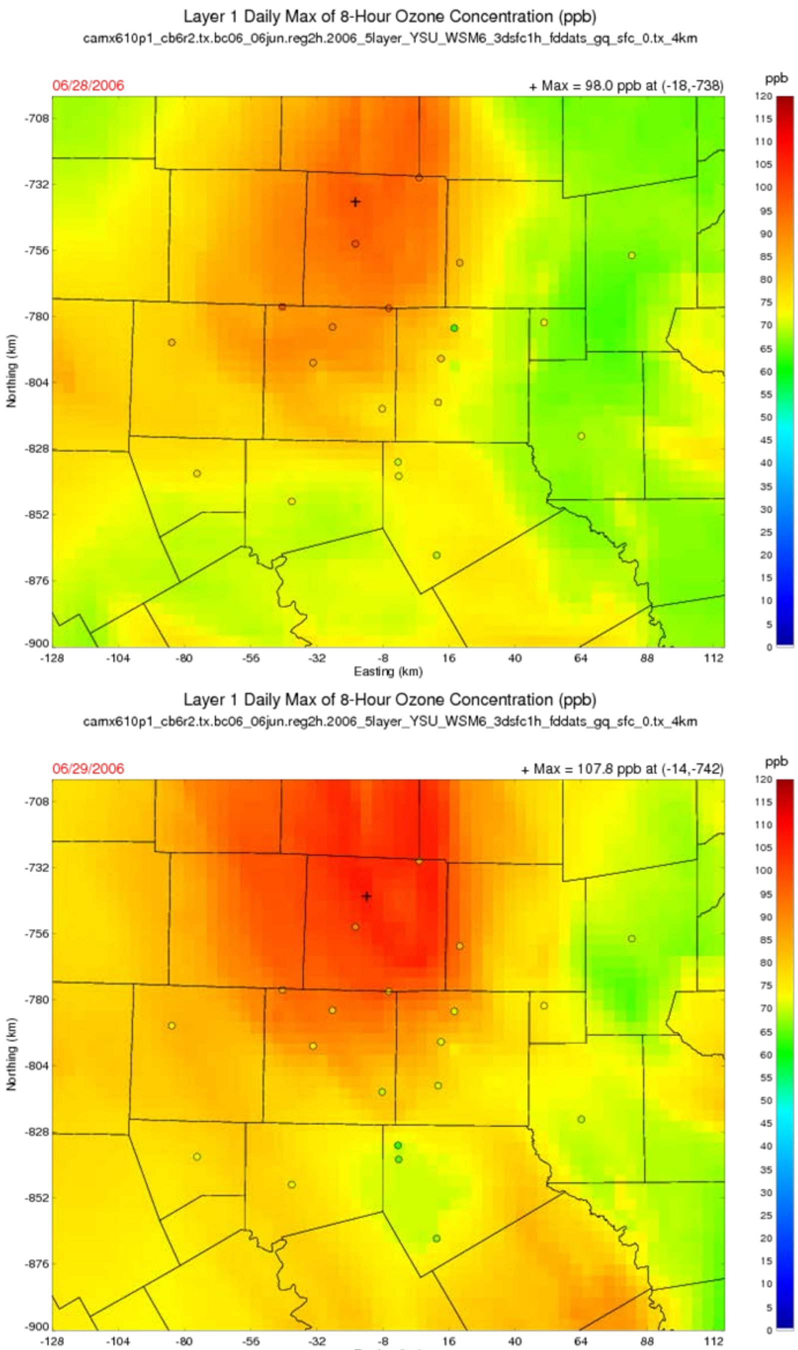
Figure 3-22: Denton August-September Episode Time Series and Scatter Plots

The Kaufman and Denton Airport South monitors were chosen as examples for discussing model performance because they generally represent the farthest upwind and downwind locations during ozone season, which roughly corresponds to the lowest and highest monitoring locations, respectively. Appendix C provides more detail with time series and scatter plots for the additional monitoring locations of Dallas Hinton Street, Eagle Mountain Lake, and Fort Worth Northwest. Comparison of modeled versus observed concentrations of VOC are presented for the Dallas Hinton Street and Fort Worth Northwest monitors because these locations are equipped with auto-GC instrumentation. In general, estimation of isoprene concentrations is quite good at Dallas Hinton Street, but weaker at Fort Worth Northwest.

Conversely, estimation of concentrations for alkanes, ethylene, and olefins is better at Fort Worth Northwest than at Dallas Hinton Street.

When evaluating model performance, the TCEQ also employs graphical plots showing the daily peak ozone across the modeling domain. This plot is akin to the contour plots often used to display terrain elevations, and is a good tool for visually comparing the modeled peak ozone across the domain with observations. The plots are not snapshots in time, but instead show the maximum eight-hour ozone value for each grid cell regardless of when it occurred during the day. Areas downwind of the urban core will generally have ozone peaks that occur later in the day than upwind areas.

Appendix C contains these graphical plots for each episode day where observed maximum daily average eight-hour ozone was above 75 ppb. These days are June 3 through 10, June 12 through 14, June 18, June 27 through July 1, August 17 through 24, August 30 through September 1, September 7 through 9, and September 14. Example plots for four of these episode days are presented here in Figure 3-23: *Modeled versus Observed Maximum Ozone on June 28 and 29* and Figure 3-24: *Modeled versus Observed Maximum Ozone on August 30 and 31.* Observed maximum daily average eight-hour ozone concentrations are represented by small circles at the monitor locations. When the color of the dot matches closely the surrounding colors, the model is predicting the observed maximum values well. In general, the model performed very well during the June 2006 episode with a few days exhibiting weaker performance. The August-September 2006 episode is characterized by more over-prediction, particularly in August and early September. However, a few days in this latter episode do show good performance. In both episodes, the model locates the plumes of highest ozone concentration very well with a few exceptions.



June 28, 2006

MDA8 Ozone
Obs: 98.1 ppb (EMTL)
Mod: 98.0 ppb

June 29, 2006

MDA8 Ozone
Obs: 91.2 ppb (DENT)
Mod: 107.8 ppb

Figure 3-23: Modeled versus Observed Maximum Ozone on June 28 and 29

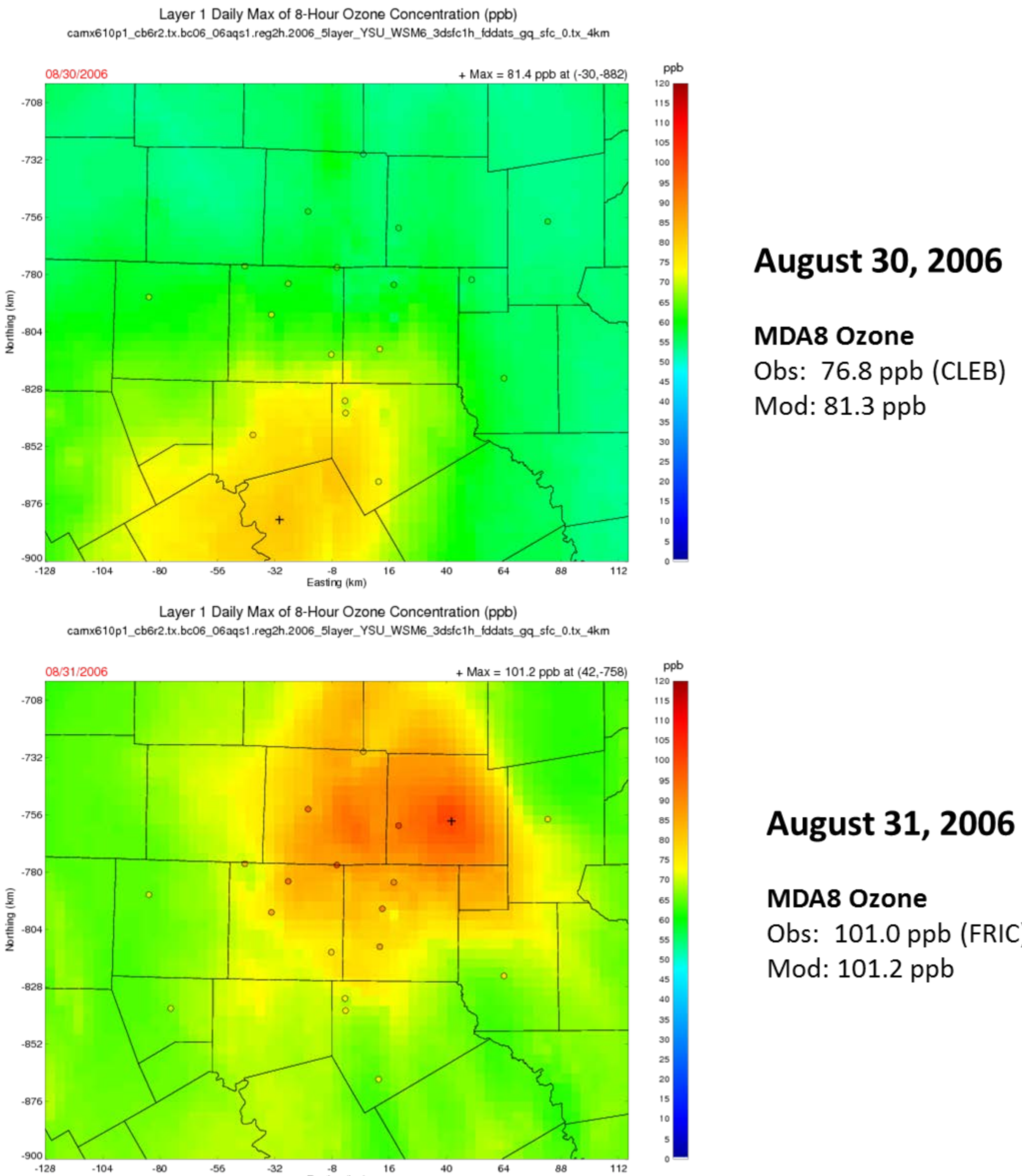


Figure 3-24: Modeled versus Observed Maximum Ozone on August 30 and 31

Evaluations Based on TexAQS II Rural Monitoring Network Data

The TCEQ also evaluated how well the model predicted ozone and precursor concentrations at rural sites located upwind of the DFW nonattainment area during the episodes. A brief discussion is presented here, but more detail and references are provided in Appendix C. Figure 3-25: *Rural Monitoring Sites Used for Performance Evaluation* shows the locations of these sites as red dots. They are Italy High School (ITHS, C60) about 30 miles south of Dallas, Palestine (PLTN, C647) about 80 miles southeast of Dallas, Clarksville (CLVL, C648) about 100 miles northeast of Dallas, and San Augustine (SAGA, C646) about 160 miles from Dallas near the Louisiana border.

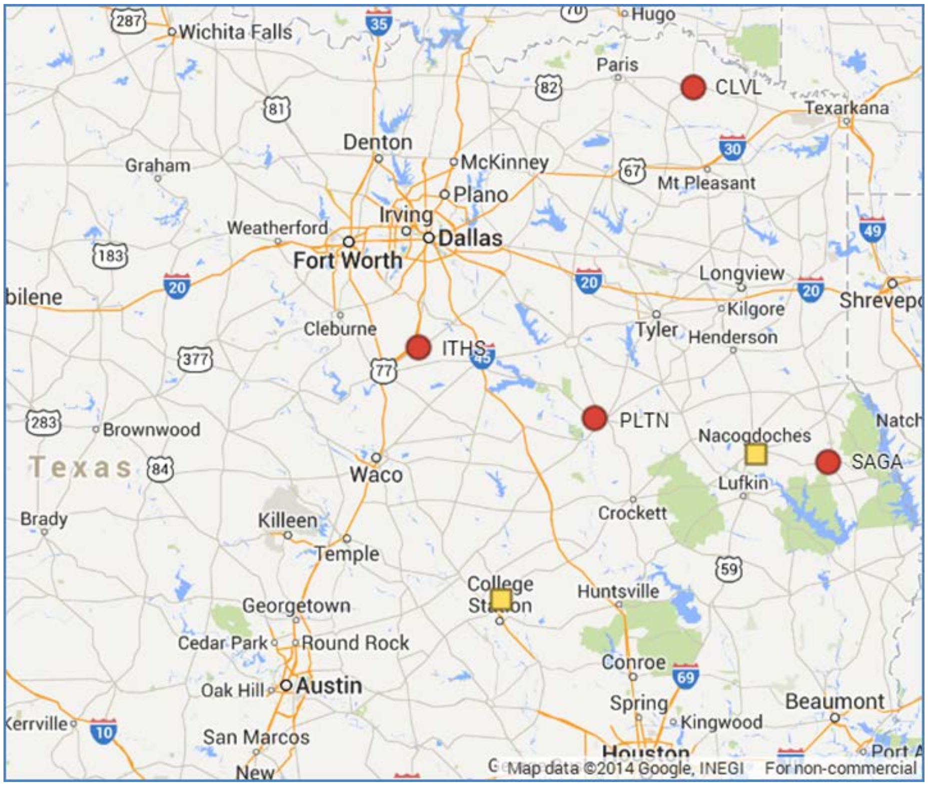


Figure 3-25: Rural Monitoring Sites Used for Performance Evaluation

In general, peak ozone during the June episode was well predicted at Italy High School and Clarksville, with moderate over-prediction at Palestine and San Augustine. During the August-September episode, Italy High School model performance was good, with over-prediction at the remaining three monitors, although the model predicted the peaks on some days quite well. Similar to the ozone monitors within or near the urban core, the model generally over-predicted overnight and early morning ozone concentrations during both episodes.

The yellow squares in Figure 3-25 show locations near College Station and Nacogdoches where instrumented balloons to measure ozone (ozonesondes) were launched during the June 2006 episode as part of the Tropospheric Ozone Pollution Project, which was conducted as part of the TexAQS II study (Morris, 2006). The ozonesonde data provided a unique and valuable means for assessing the model's performance. Besides simply allowing modeled concentrations to be compared with measurements aloft, the detailed profiles provided insight into how well the model characterizes vertical mixing compared to the real atmosphere. The most striking difference between observed and modeled vertical ozone profiles is the wide variability in ozone concentrations with altitude observed on most days. The model tends to vary much more slowly, which is not unexpected since it tends to organize wind flow and vertical motion, and also because the model's vertical resolution becomes coarser with increasing elevation.

Another aspect of the TexAQS II study included aircraft measurements of ozone and precursors within the DFW nonattainment area on September 13, 2006 (Gulf of Mexico Atmospheric Composition and Climate Study, National Oceanic & Atmospheric Administration [NOAA], 2006). The instrumented aircraft flew at an elevation of around 500 meters from 1:30-4:00 PM on this day. Analysis of the aircraft measurements indicates that the model predicted the observed ozone quite well except for a small over-prediction as the aircraft passed through the urban plume downwind of the DFW metropolitan area. The modeled winds are more southerly than the observations, and showed little variability through the sampling period. Appendix C contains more detail than presented here on the evaluation of rural monitors, ozonesonde data, and aircraft flight measurements.

3.6.4.3 Diagnostic Evaluations

While most model performance evaluation (MPE) focuses on how well the model reproduces observations in the base case, a second and perhaps more important aspect of model performance is how well the model predicts changes as a result of modifications to its inputs (Smith, 2010). The former type of MPE is static in the sense that it is based on a fixed set of observations that never change, while evaluating the model's response to perturbations in its inputs is dynamic in the sense that the change in the model's output is evaluated. Dynamic MPE is performed much less often than static MPE, simply because there is often little observational data available that can be directly related to quantifiable changes in model inputs. Since the AD is based on modeling the future by changing the model's inputs due to growth and controls, it is beneficial to pursue dynamic MPE. The 2007 and draft guidance documents recommend assessing the model's response to emission changes. Two such dynamic MPEs are described below: prospective modeling analysis and weekday/weekend analysis.

Prospective Modeling – Revised 2012 Future Case Analysis

The purpose of this diagnostic analysis is to test the model in a forecast mode where the answer is known in advance. For the DFW AD SIP revision in December 2011, a retrospective analysis was performed where 1999 ozone concentrations were estimated with 1999 anthropogenic emission inputs run with the June 2006 base case meteorological and biogenic inputs. These 1999 anthropogenic emission inputs were already available from the DFW AD SIP revision adopted in May 2007. These 1999 anthropogenic inputs cannot be used with the current 2006 modeling configuration because of incompatibility with the new modeling domains described in Table 3-35.

The TCEQ has started developing a 2012 base case episode on the newer domains shown in Figure 3-14, but has not yet obtained satisfactory model performance with it. However, the latest available 2012 anthropogenic emission inputs from these efforts were available to perform a prospective future case analysis with the 2006 base case meteorology and biogenic inputs. Ozone season emission inputs for the 2012 future year were needed for the DFW AD SIP revision adopted in December 2011. At the time that work was performed, the latest available scientific tools and inputs were used for modeling attainment in the 2012 future year. Table 3-37: *Summary of Ozone Modeling Platform Changes* summarizes these older tools and inputs, and compares them to the latest ones currently being used.

Table 3-37: Summary of Ozone Modeling Platform Changes

Modeling Platform Category	December 2011 AD SIP Revision	Proposed 2016 AD SIP Revision
4 km Fine Grid Modeling Domain	DFW nonattainment area and adjacent counties	All of eastern Texas plus some non-Texas counties
12 km Medium Grid Modeling Domain	Eastern Texas plus some adjacent states	All of Texas plus some adjacent states
36 km Coarse Grid Modeling Domain	Eastern half of continental U.S.	All of continental U.S. plus southern Canada and northern Mexico

Modeling Platform Category	December 2011 AD SIP Revision	Proposed 2016 AD SIP Revision
Meteorological Model	MM5 3.7.3	WRF 3.2
CAMx Version	CAMx 5.20.1	CAMx 6.20
Chemical Mechanism	Carbon Bond 05 (CB05)	Carbon Bond 6 (CB6)
Boundary Conditions	Model for Ozone and Related Chemical Tracers (MOZART) Model	GEOS-Chem Model
Biogenics Model	Global Biosphere Emissions and Interactions System (GloBEIS)	MEGAN 2.10

A prospective 2012 future case analysis was run with the June 2006 episode, but relied on all of the newer tools and inputs referenced in the far right column of Table 3-37. Table 3-38: *2012 Future Case with June 2006 Episode on Old and New Platforms* summarizes these results. For reference purposes, the 2012 future design value (DV_F) results from the December 2011 AD SIP are included and truncated in accordance with the 2007 modeling guidance. In Table 3-38, comparing the older 2012 DV_F figures (second column) with the DV_F figures from the new modeling platform (third column) indicates that the current projected eight-hour ozone design values are 4-8 ppb higher with the results varying by individual monitor. These results can only be presented for monitors that were operational during 2006. The 2012 DV_B and measured regulatory design value (DV_R) values cannot be provided for the Midlothian Tower monitor, which is no longer operational.

Table 3-38 also includes the 2012 DV_R (fourth column) and 2012 DV_B (last column) for each monitor. The 2012 DV_R is obtained by truncating the average of the fourth-highest eight-hour observation for each year over the full three years of 2010, 2011, and 2012. The DV_R is used to determine if the area is either in nonattainment or has reached attainment of the NAAQS. As was shown in Figure 3-1, a DV_B is an average of three years of DV_R values. These 2012 DV_B figures were obtained by averaging the 2012 DV_R, 2013 DV_R, and 2014 DV_R per monitor. The attainment test of multiplying an RRF by a DV_B essentially predicts a future year DV_B, even though the DV_R in the future year is the final metric for determining attainment of the NAAQS.

Table 3-38: 2012 Future Case with June 2006 Episode on Old and New Platforms

2006 DFW Area Monitor and CAMS Code	2011 AD DV_F for 2012 (ppb)	Current DV_F for 2012 (ppb)	2012 DV_R (ppb)	2012 DV_B (ppb)
Denton Airport South - C56	77	84	83	83.67
Eagle Mountain Lake - C75	78	82	82	80.67
Grapevine Fairway - C70	76	82	86	84.00
Keller - C17	76	81	87	83.00
Fort Worth Northwest - C13	75	80	79	80.00
Frisco - C31	74	79	83	81.67
Dallas North #2 - C63	71	77	81	80.33
Parker County - C76	72	78	78	77.00

2006 DFW Area Monitor and CAMS Code	2011 AD DV_F for 2012 (ppb)	Current DV_F for 2012 (ppb)	2012 DV_R (ppb)	2012 DV_B (ppb)
Dallas Executive Airport - C402	70	77	81	78.00
Cleburne Airport - C77	70	76	79	78.00
Arlington Municipal Airport - C61	70	75	83	79.33
Dallas Hinton Street - C401	67	74	82	81.33
Granbury - C73	69	74	77	76.67
Midlothian Tower - C94	66	73	Not Operating	Not Operating
Pilot Point - C1032	67	73	82	81.67
Rockwall Heath - C69	63	70	77	75.67
Midlothian OFW - C52	62	68	76	74.67
Greenville - C1006	59	67	72	71.67
Kaufman - C71	60	67	70	71.33

Note: DV_F and DV_R figures are typically truncated, while DV_B figures are reported to two decimal places.

Table 3-39: *2012 Future Case with 67-Day Episode on Old and New Platforms* presents similar information as Table 3-38, but for the entire 67-day episode from both June 2006 and August-September 2006. Similar to the results shown in Table 3-38, the 2012 DV_F figures for the current modeling platform are 4-8 ppb higher than the older one with results varying by monitor. The results in both Table 3-38 and Table 3-39 demonstrate that the current modeling platform with a 2006 base case does a satisfactory job of forecasting ozone design values with anthropogenic emission inputs for alternate years. More detail on this analysis is included in Appendix C.

Table 3-39: 2012 Future Case with 67-Day Episode on Old and New Platforms

2006 DFW Area Monitor and CAMS Code	2011 AD DV_F for 2012 (ppb)	Current DV_F for 2012 (ppb)	2012 DV_R (ppb)	2012 DV_B (ppb)
Denton Airport South - C56	77	83	83	83.67
Eagle Mountain Lake - C75	78	82	82	80.67
Grapevine Fairway - C70	76	81	86	84.00
Keller - C17	76	81	87	83.00
Fort Worth Northwest - C13	75	79	79	80.00
Frisco - C31	74	79	83	81.67
Dallas North #2 - C63	71	77	81	80.33
Parker County - C76	72	77	78	77.00
Dallas Executive Airport - C402	70	76	81	78.00
Cleburne Airport - C77	70	75	79	78.00
Arlington Municipal Airport - C61	70	74	83	79.33
Dallas Hinton Street - C401	67	73	82	81.33
Granbury - C73	69	73	77	76.67

2006 DFW Area Monitor and CAMS Code	2011 AD DV_F for 2012 (ppb)	Current DV_F for 2012 (ppb)	2012 DV_R (ppb)	2012 DV_B (ppb)
Midlothian Tower - C94	66	72	Not Operating	Not Operating
Pilot Point - C1032	67	72	82	81.67
Rockwall Heath - C69	63	70	77	75.67
Midlothian OFW - C52	62	67	76	74.67
Greenville - C1006	59	67	72	71.67
Kaufman - C71	60	66	70	71.33

Note: DV_F and DV_R figures are typically truncated, while DV_B figures are reported to two decimal places.

Observational Modeling – Weekday/Weekend

Weekend emissions of NO_X and VOC in urban areas tend to be lower than weekday emissions because of fewer vehicle miles driven. The effect is most pronounced on weekend mornings, especially Sundays, since there is significantly reduced commuting for work purposes. Figure 3-26: *2006 DFW Area 6 AM Anthropogenic Emissions by Day of Week* shows a comparison of modeled 6 AM NO_X and VOC emissions for Wednesdays, Saturdays, and Sundays. The on-road mobile sources are the largest contributor to differences in emissions for weekdays and weekends. 6 AM was chosen because a more stable comparison of emission estimates and monitored concentrations can be made prior to the commencement of photochemical processes in the presence of sunlight.

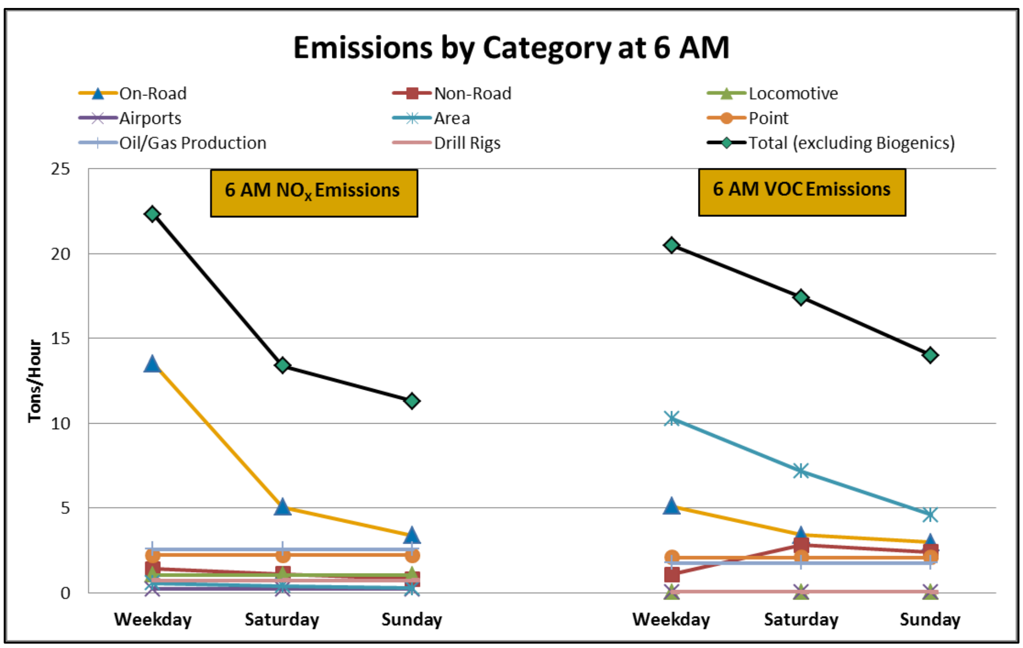


Figure 3-26: 2006 DFW Area 6 AM Anthropogenic Emissions by Day of Week

Early morning emissions tend to be especially important in determining peak eight-hour ozone levels (MacDonald, 2010), so the weekday/weekend differences should manifest themselves noticeably in the relative levels of weekday and weekend ozone concentrations. Since there are relatively few Saturdays, Sundays, and Wednesdays (chosen to represent typical weekdays) in the episode, the TCEQ employed a novel approach by applying Saturday, Sunday, and Wednesday emissions inputs to the meteorological inputs for each day of the episode, which resulted in a total of 67 episode days modeled for the 2006 baseline with anthropogenic emission estimates for each of these three day types. This approach is possible since meteorology is independent of the day of week. By replacing the emissions of any episode day with those for just a Wednesday, just a Saturday, and just a Sunday, a representation of the day of week effects can be obtained.

For comparison with the modeled emissions from each of these 67-day scenarios by inventory day type, median monitored 6:00 AM NO_X concentrations were calculated for every Wednesday, Saturday, and Sunday from May 15 through October 15 for the years 2004 through 2008. Within each year, a total of 79 to 133 observations were observed for this timeframe at 11 NO_X monitoring sites in DFW. Figure 3-27: *Mean 6 AM NO_X Concentrations by Monitor Relative to Wednesday* presents these results and compares them to the change in modeled concentrations from the Wednesday, Saturday, and Sunday day type modeling scenarios. All sites show observed NO_X concentrations declining from Wednesday to Saturday, and then from Saturday to Sunday. The modeled values show greater variability than their observed counterparts, with all sites having modeled decreases between 37% and 67% from Wednesday to Sunday. The observed decreases at all sites were in the range of 40% and 70%.

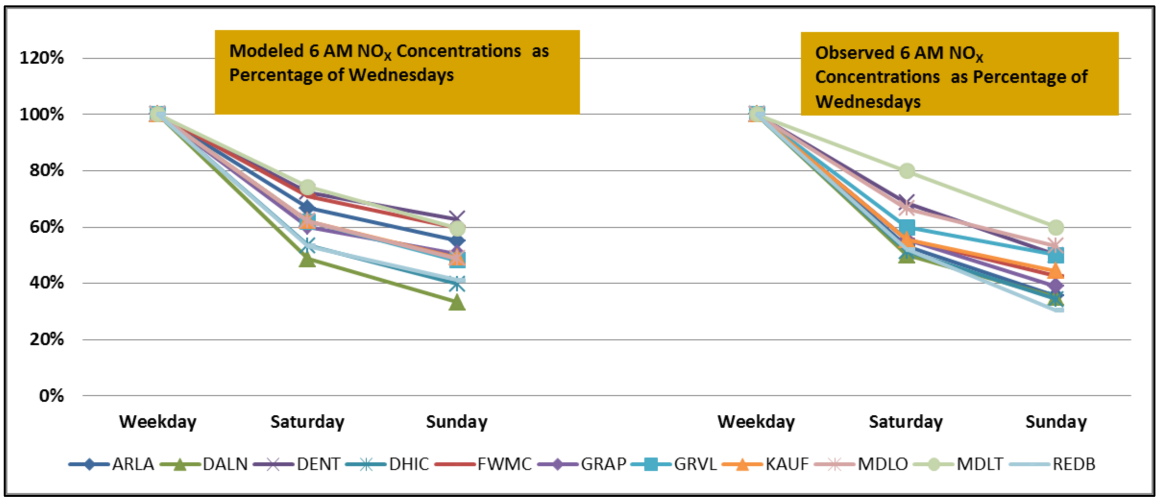


Figure 3-27: Mean 6 AM NO_X Concentrations by Monitor Relative to Wednesday

Figure 3-28: *Observed and Modeled 95th Percentile Peak Ozone by Day Type* compares the median observed concentrations for high ozone days with the modeled concentrations by day of week for 19 DFW area monitors. The observed 95th percentile concentrations range between a 1% increase to a 10% decrease on Saturday compared with Wednesday, while all sites showed a Sunday decrease between 6% and 16% compared with Wednesday. The modeled values consistently decreased between 2% and 6% on Saturday compared with Wednesday, and between 2% and 11% on Sunday compared with Wednesday. The model is satisfactorily replicating the observed weekday-weekend NO_X and ozone differences, especially for the higher ozone days. More detail on this analysis is included in Appendix C.

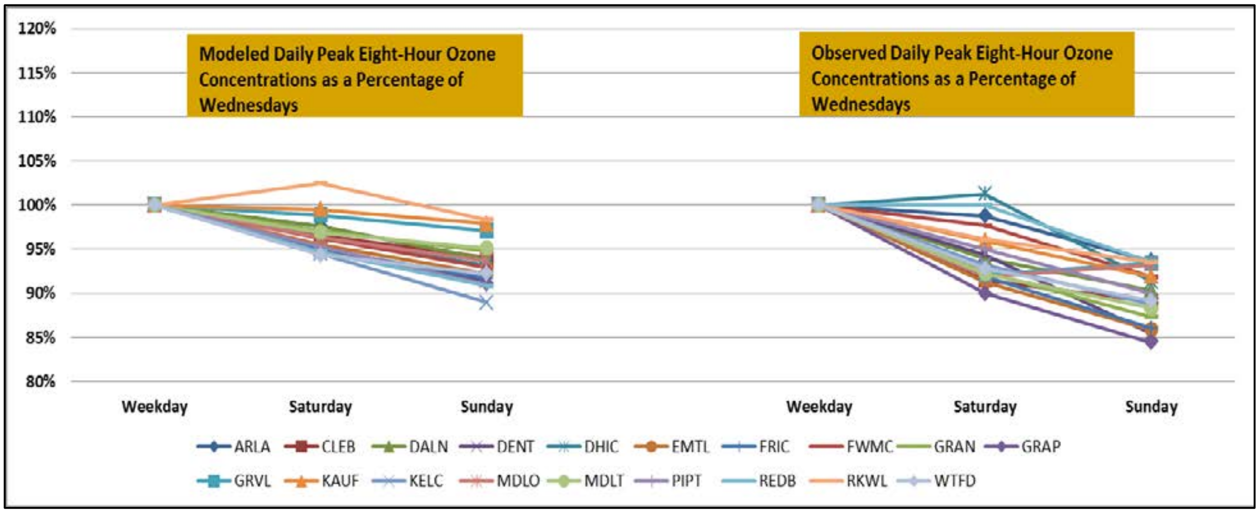


Figure 3-28: Observed and Modeled 95th Percentile Peak Ozone by Day Type

3.7 2006 BASELINE AND 2017 FUTURE CASE MODELING

3.7.1 2006 Baseline Modeling

The TCEQ selected 2006 as the baseline year for conducting the attainment modeling. The 2006 baseline emissions discussed in Section 3.5.3: *2006 Baseline* were used as model inputs. All 2006 baseline episode days with modeled eight-hour maximum concentrations above 75 ppb were used for the modeled attainment test. Since there were more than 10 days for each monitor modeled above 75 ppb in the 2006 baseline, there was no need to fall back on a lower threshold, such as the 70 ppb level suggested in the 2007 modeling guidance. Figure 3-29: *Location of DFW Ozone Monitors with 4 km Grid Cell Array* shows the proximity of each monitor to adjacent ones within the 4 km fine grid domain. The EPA's default recommendation for a 4 km domain in the 2007 guidance is to use an array of seven-by-seven cells for application of the attainment test. This process is suitable for areas where ozone monitors are separated by several kilometers, but would lead to a significant blending of the results among monitors in the more dense DFW area network. The maximum concentrations from an array of three-by-three grid cells surrounding each monitor was chosen for the DFW area attainment test so that better resolution could be obtained in the results for individual monitors. The EPA's draft modeling guidance currently recommends a three-by-three array for the attainment test.

For each DFW area ozone monitor operational in 2006, Table 3-40: *2006 Baseline Design Value Summary for the All Days Attainment Test* details the DV_B, the modeled average of episode days above 75 ppb, and the total number of days from the 67-day episode when eight-hour ozone concentrations were modeled above 75 ppb.

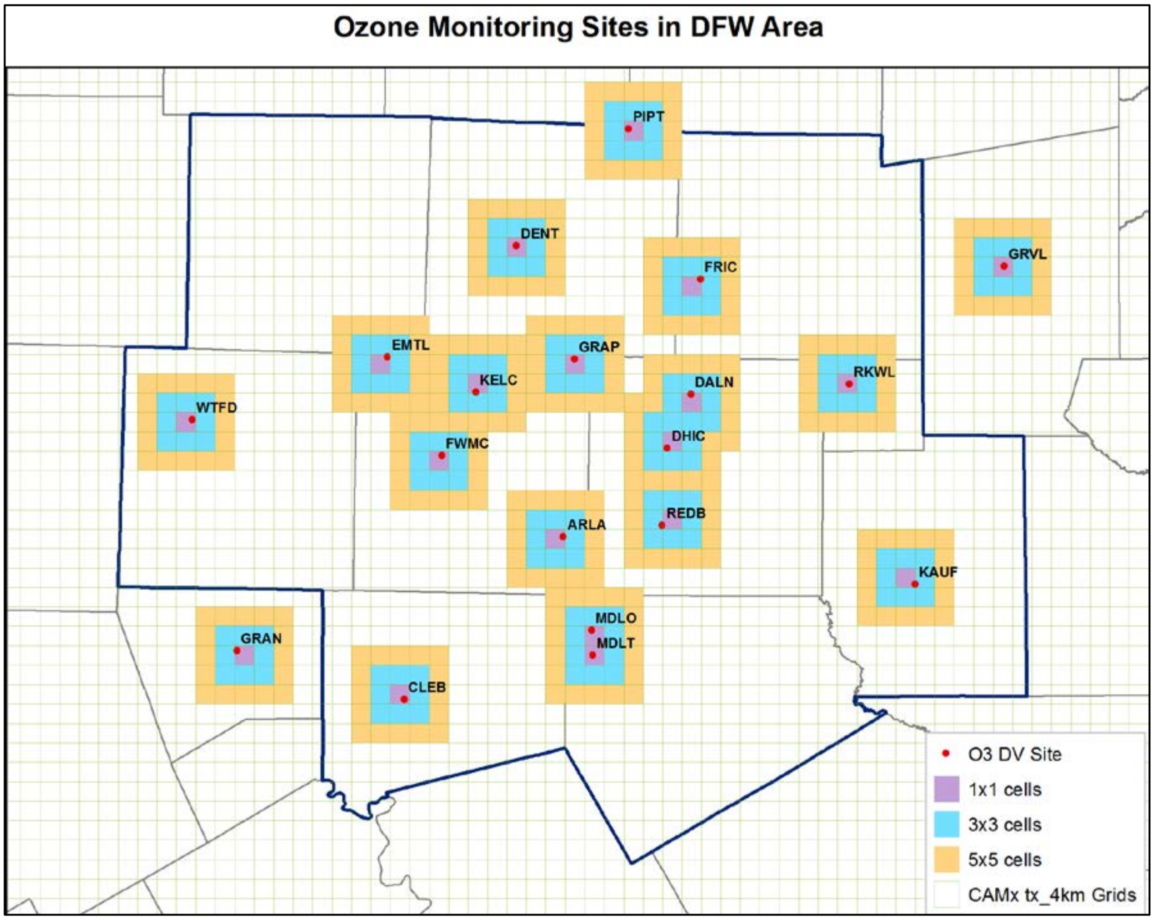


Figure 3-29: Location of DFW Ozone Monitors with 4 km Grid Cell Array

Table 3-40: 2006 Baseline Design Value Summary for the All Days Attainment Test

2006 DFW Area Monitor and CAMS Code	DFW Area Monitor Alpha Code	2006 DV_B (ppb)	Modeled Average of Days >75 ppb	Number of Modeled Days > 75ppb
Denton Airport South - C56	DENT	93.33	88.07	35
Eagle Mountain Lake - C75	EMTL	93.33	87.50	28
Grapevine Fairway - C70	GRAP	90.67	90.83	33
Keller - C17	KELC	91.00	89.07	32
Fort Worth Northwest - C13	FWMC	89.33	89.13	27
Frisco - C31	FRIC	87.67	86.83	34
Dallas North #2 - C63	DALN	85.00	85.65	31
Dallas Executive Airport - C402	REDB	85.00	84.46	27
Parker County - C76	WTFD	87.67	84.37	20
Cleburne Airport - C77	CLEB	85.00	83.06	16
Dallas Hinton Street - C401	DHIC	81.67	85.38	31
Arlington Municipal Airport - C61	ARLA	83.33	85.20	30
Granbury - C73*	GRAN	83.00	82.86	17

2006 DFW Area Monitor and CAMS Code	DFW Area Monitor Alpha Code	2006 DV_B (ppb)	Modeled Average of Days >75 ppb	Number of Modeled Days > 75ppb
Midlothian Tower - C94†	MDLT	80.50	83.74	19
Pilot Point - C1032†	PIPT	81.00	86.41	33
Rockwall Heath - C69	RKWL	77.67	82.21	26
Midlothian OFW - C52†	MDLO	75.00	83.86	22
Kaufman - C71	KAUF	74.67	79.28	16
Greenville - C1006*	GRVL	75.00	79.16	16

* Granbury and Greenville are located outside of the 10-County DFW nonattainment area.

† Midlothian OFW, Midlothian Tower, and Pilot Point did not measure enough data from 2004 through 2008 to calculate a complete DV_B. The DV_B shown uses all available data.

3.7.2 Future Baseline Modeling

Similar to the 2006 baseline modeling, 2017 future case modeling was conducted for each of the 67 episode days using the anthropogenic emission inputs discussed in Section 3.5.4: *2017 Future Case Emissions*. Using the same days from the 2006 baseline where eight-hour ozone concentrations were modeled above 75 ppb, the RRF for each monitor was calculated by dividing the 2017 modeled peak eight-hour ozone average by the 2006 peak eight-hour modeled ozone average. For example, there were a total of 35 days in the 67-day episode where the Denton Airport South monitor was modeled above 75 ppb in the 2006 baseline. Table 3-40 shows that the 2006 baseline average of the maximum eight-hour modeled ozone for these 35 days is 88.07 ppb. The 2017 future case average for the same 35 days is 73.47 ppb. The Denton Airport South RRF is obtained by dividing the 73.47 ppb future year average by the 88.07 ppb baseline average to obtain 0.8342. A summary for all monitors is provided in Table 3-41: *RRF Calculations from the 2006 Baseline and 2017 Future Case for the All Days Attainment Test.*

Table 3-41: RRF Calculations from the 2006 Baseline and 2017 Future Case for the All Days Attainment Test

2006 DFW Area Monitor and CAMS Code	DFW Area Monitor Alpha Code	2006 Average of Days >75 ppb	2017 Average of Days >75 ppb	Relative Response Factor (RRF)
Denton Airport South - C56	DENT	88.07	73.47	0.8342
Eagle Mountain Lake - C75	EMTL	87.50	72.68	0.8306
Grapevine Fairway - C70	GRAP	90.83	77.33	0.8514
Keller - C17	KELC	89.07	75.14	0.8436
Fort Worth Northwest - C13	FWMC	89.13	75.77	0.8501
Frisco - C31	FRIC	86.83	73.69	0.8487
Dallas North #2 - C63	DALN	85.65	73.91	0.8629
Dallas Executive Airport - C402	REDB	84.46	71.76	0.8496
Parker County - C76	WTFD	84.37	69.45	0.8231
Cleburne Airport - C77	CLEB	83.06	69.47	0.8364
Dallas Hinton Street - C401	DHIC	85.38	74.18	0.8689
Arlington Municipal Airport - C61	ARLA	85.20	72.15	0.8469

2006 DFW Area Monitor and CAMS Code	DFW Area Monitor Alpha Code	2006 Average of Days >75 ppb	2017 Average of Days >75 ppb	Relative Response Factor (RRF)
Granbury - C73	GRAN	82.86	68.61	0.8281
Midlothian Tower - C94	MDLT	83.74	70.49	0.8418
Pilot Point - C1032	PIPT	86.41	71.90	0.8321
Rockwall Heath - C69	RKWL	82.21	69.49	0.8452
Midlothian OFW - C52	MDLO	83.86	70.64	0.8423
Kaufman - C71	KAUF	79.28	65.87	0.8309
Greenville - C1006	GRVL	79.16	65.20	0.8237

The RRF is then multiplied by the 2006 DV_B to obtain the 2017 DV_F for each ozone monitor. In accordance with the 2007 guidance, the final DV_F is obtained by rounding to the tenths digit and truncating to zero decimal places. These results are presented in Table 3-42: *Summary of 2017 Future Ozone Design Values for the All Days Attainment Test*. Application of the all days attainment test results in the Denton Airport South, Eagle Mountain Lake, Grapevine Fairway, and Keller monitors above the 2008 eight-hour ozone standard of 75 ppb. The 2007 guidance for the 84 ppb standard states that when the maximum future design value falls within 82 through 87 ppb, a WoE "demonstration should be conducted to determine if aggregate supplemental analyses support the modeled attainment test." Application of the 82 through 87 ppb WoE range to the 75 ppb standard indicates that the currently applicable WoE range would be 73 through 78 ppb. As the DV_F for these four monitors falls within this range, a WoE demonstration is included in Chapter 5: *Weight of Evidence* of this 2017 DFW AD SIP revision.

Table 3-42: Summary of 2017 Future Ozone Design Values for the All Days Attainment Test

2006 DFW Area Monitor and CAMS Code	DFW Area Monitor Alpha Code	2006 DV_B (ppb)	2017 DV_F (ppb)	2017 Truncated DV_F (ppb)
Denton Airport South - C56	DENT	93.33	77.86	77
Eagle Mountain Lake - C75	EMTL	93.33	77.52	77
Grapevine Fairway - C70	GRAP	90.67	77.20	77
Keller - C17	KELC	91.00	76.77	76
Fort Worth Northwest - C13	FWMC	89.33	75.94	75
Frisco - C31	FRIC	87.67	74.40	74
Dallas North #2 - C63	DALN	85.00	73.35	73
Dallas Executive Airport - C402	REDB	85.00	72.21	72
Parker County - C76	WTFD	87.67	72.17	72
Cleburne Airport - C77	CLEB	85.00	71.10	71
Dallas Hinton Street - C401	DHIC	81.67	70.96	71
Arlington Municipal Airport - C61	ARLA	83.33	70.57	70
Granbury - C73	GRAN	83.00	68.73	68
Midlothian Tower - C94	MDLT	80.50	67.77	67

2006 DFW Area Monitor and CAMS Code	DFW Area Monitor Alpha Code	2006 DV_B (ppb)	2017 DV_F (ppb)	2017 Truncated DV_F (ppb)
Pilot Point - C1032	PIPT	81.00	67.40	67
Rockwall Heath - C69	RKWL	77.67	65.65	65
Midlothian OFW - C52	MDLO	75.00	63.17	63
Kaufman - C71	KAUF	74.67	62.04	62
Greenville - C1006	GRVL	75.00	61.78	61

The EPA draft modeling guidance recommends the attainment test be performed for each monitor on the 10 episode days from the baseline with the highest modeled eight-hour ozone. A summary of how the RRF is obtained for each monitor using this approach is provided in Table 3-43: *RRF Calculations Using the 10 Highest Days*. Please note that the Denton Airport South RRF with the top 10 days test is 0.8171 instead of the 0.8342 value from the all days test referenced in Table 3-41.

Table 3-43: RRF Calculations Using the 10 Highest Days

2006 DFW Area Monitor and CAMS Code	DFW Area Monitor Alpha Code	2006 Average of 10 Highest Days	2017 Average of 10 Highest Days	Relative Response Factor (RRF)
Denton Airport South - C56	DENT	100.52	82.13	0.8171
Eagle Mountain Lake - C75	EMTL	96.29	78.98	0.8202
Grapevine Fairway - C70	GRAP	104.34	87.06	0.8344
Keller - C17	KELC	100.68	83.36	0.8280
Fort Worth Northwest - C13	FWMC	98.91	82.80	0.8371
Frisco - C31	FRIC	97.57	82.19	0.8424
Dallas North #2 - C63	DALN	95.68	81.30	0.8497
Dallas Executive Airport - C402	REDB	94.52	80.13	0.8477
Parker County - C76	WTFD	89.39	73.82	0.8258
Cleburne Airport - C77	CLEB	87.26	71.71	0.8218
Dallas Hinton Street - C401	DHIC	96.73	82.10	0.8487
Arlington Municipal Airport - C61	ARLA	97.26	81.54	0.8384
Granbury - C73	GRAN	87.02	71.73	0.8242
Midlothian Tower - C94	MDLT	90.04	75.43	0.8378
Pilot Point - C1032	PIPT	97.75	80.37	0.8222
Rockwall Heath - C69	RKWL	88.46	74.95	0.8473
Midlothian OFW - C52	MDLO	91.51	76.34	0.8342
Kaufman - C71	KAUF	81.28	67.60	0.8318
Greenville - C1006	GRVL	81.17	67.21	0.8279

The RRF from the top 10 days methodology is then multiplied by the 2006 DV_B for each monitor to obtain the revised 2017 DV_F figures presented in Table 3-44: *Summary of 2017 Future Ozone*

Design Values for the Top 10 Days Attainment Test. Similar to the 2007 guidance, the draft guidance recommends rounding the final DV_F to the tenths digit and truncating to zero decimal places. The results from Tables 3-42 and 3-44 are graphically displayed in Figure 3-30: *2017 Future Design Values by DFW Monitoring Location for All Days Test (top) and Top 10 Days Test (bottom)*. The draft guidance from December 2014 also recommends inclusion of WoE in an attainment demonstration, but does not specify a numeric DV_F range. Instead, the draft guidance requires that the DV_F figures be "close to the NAAQS" for the purposes of demonstrating attainment.

Table 3-44: Summary of 2017 Future Ozone Design Values for the Top 10 Days Attainment Test

2006 DFW Area Monitor and CAMS Code	DFW Area Monitor Alpha Code	2006 DV_B (ppb)	2017 DV_F (ppb)	2017 Truncated DV_F (ppb)
Denton Airport South - C56	DENT	93.33	76.26	76
Eagle Mountain Lake - C75	EMTL	93.33	76.55	76
Grapevine Fairway - C70	GRAP	90.67	75.65	75
Keller - C17	KELC	91.00	75.35	75
Fort Worth Northwest - C13	FWMC	89.33	74.78	74
Frisco - C31	FRIC	87.67	73.85	73
Dallas North #2 - C63	DALN	85.00	72.23	72
Dallas Executive Airport - C402	REDB	85.00	72.05	72
Parker County - C76	WTFD	87.67	72.40	72
Cleburne Airport - C77	CLEB	85.00	69.86	69
Dallas Hinton Street - C401	DHIC	81.67	69.31	69
Arlington Municipal Airport - C61	ARLA	83.33	69.86	69
Granbury - C73	GRAN	83.00	68.41	68
Midlothian Tower - C94	MDLT	80.50	67.44	67
Pilot Point - C1032	PIPT	81.00	66.60	66
Rockwall Heath - C69	RKWL	77.67	65.81	65
Midlothian OFW - C52	MDLO	75.00	62.57	62
Kaufman - C71	KAUF	74.67	62.11	62
Greenville - C1006	GRVL	75.00	62.09	62

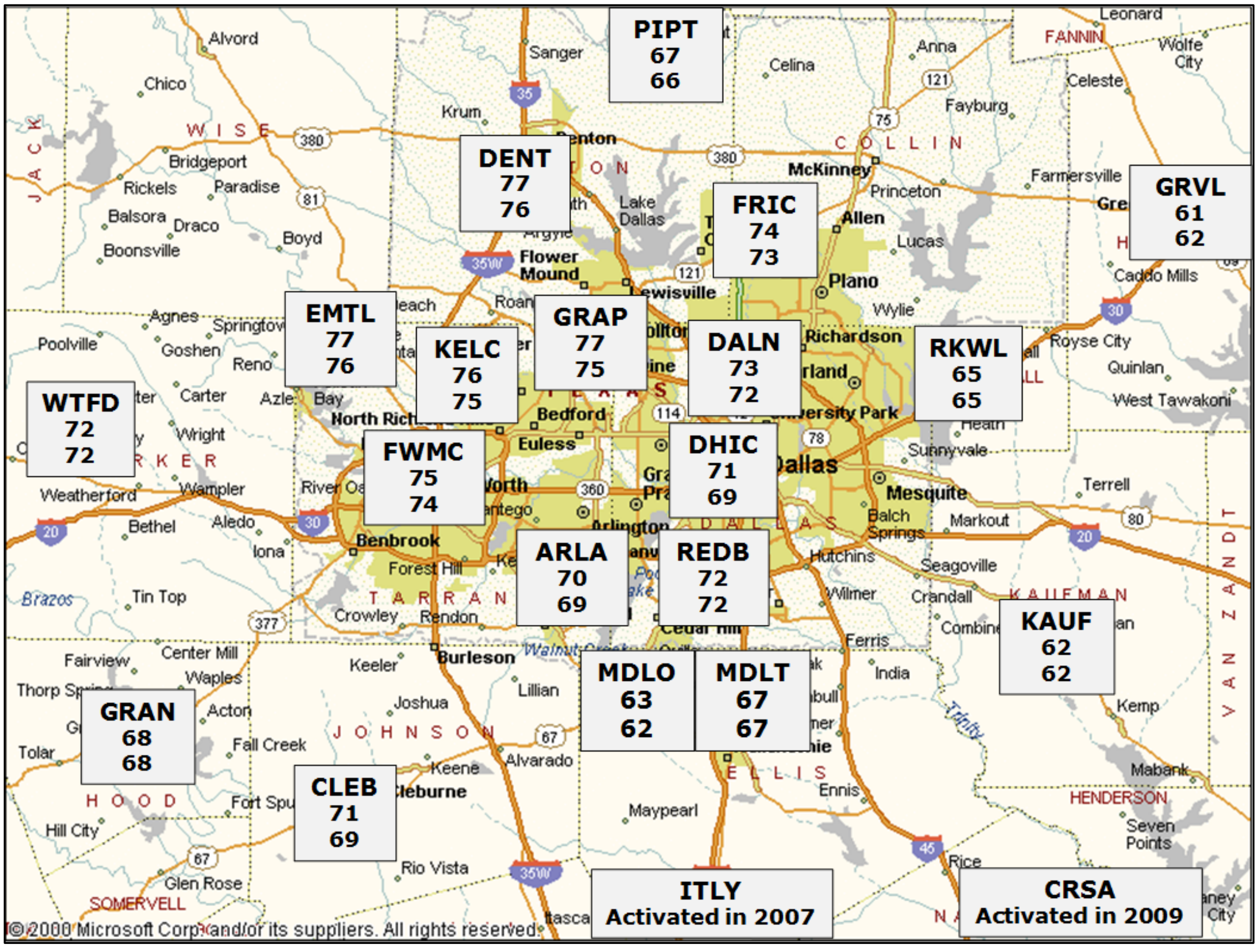


Figure 3-30: 2017 Future Design Value by DFW Monitoring Location for All Days Test (top) and Top 10 Days Test (bottom)

3.7.3 Ozone Source Apportionment Tool and Anthropogenic Precursor Culpability Analysis

A source apportionment analysis was conducted on the 2017 future case modeling. The two techniques of Anthropogenic Precursor Culpability Assessment (APCA) and Ozone Source Apportionment Technology (OSAT) were used to analyze contributions by different emission source categories in selected regions to the 2017 modeled ozone concentrations. Both APCA and OSAT keep track of the origin of the NO_X and VOC precursors creating the ozone during the model run, which can then be apportioned to specific user-defined geographic regions and source categories. A key difference between APCA and OSAT is that APCA recognizes that the biogenic source category is not controllable. Where OSAT would apportion ozone production to biogenic emissions, APCA reallocates that ozone production to the controllable or anthropogenic emissions that combined with the biogenic emissions to create ozone. Only ozone created from both biogenic NO_X and VOC precursors is apportioned to the biogenic emission source group by APCA.

For the APCA analysis, the three geographic regions of 10-county DFW, non-DFW Texas, and non-Texas were chosen. For display purposes, the anthropogenic emissions were divided into eight source categories for DFW, five for non-DFW Texas, and one aggregate category for non-Texas. The highest level of resolution in the anthropogenic emission categories that can be obtained for APCA analyses is driven by the number of separate EPS3 processing streams for

CAMx input. For example, the on-road emissions processing with EPS3 is not split between streams for passenger cars and heavy-duty diesel trucks, so an APCA analysis is not able to provide separate ozone contribution estimates for these categories. Use of APCA requires tracking of biogenic emissions, initial conditions, and boundary conditions, but these are not allocated to any specific geographic area. Table 3-45: *APCA Geographic Region and Source Category Combinations* summarizes these 17 groups.

Table 3-45: APCA Geographic Region and Source Category Combinations

Geographic Region	Source Category
10-County DFW	On-Road
10-County DFW	Non-Road
10-County DFW	Off-Road - Airports and Locomotives
10-County DFW	Area Sources
10-County DFW	Oil and Gas Drilling and Production
10-County DFW	Point - Electric Utilities
10-County DFW	Point - Cement Kilns
10-County DFW	Point - Oil and Gas and Other *
Non-DFW Texas	On-Road
Non-DFW Texas	Non-Road, Off-Road, and Area Sources
Non-DFW Texas	Oil and Gas Drilling and Production
Non-DFW Texas	Point - Electric Utilities
Non-DFW Texas	Point - Cement Kilns, Oil and Gas, and Other
Non-Texas	All Anthropogenic
All Geographic Areas	Biogenic
NA	Boundary Conditions
NA	Initial Conditions

* For the 2017 future year, oil and gas point source NO_X is 16.50 tpd and the remaining "other" is 6.68 NO_X tpd.

The full 67-day combined episode was run with APCA for the 2017 future case to estimate the geographic region and source category contributions to the ozone formed for each hour and day. The APCA output was processed to obtain these contributions for each monitor within the DFW area. Graphical results for the Denton Airport South monitor are presented in Figure 3-31: *2017 Ozone Contributions for Denton Airport South from May 31 through June 16* and Figure 3-32: *2017 Ozone Contributions for Denton Airport South from August 13 through 27*. These time periods represent the first half of the June and August-September episodes, respectively. The photochemical model must be run with initial conditions that become less important once the earlier part of the episode has finished. Each peak represents the higher mid-day levels of modeled ozone, while each valley represents the nighttime low. Differing amounts of ozone are formed each day, and the contribution from each geographic region and source category combination varies due to changing meteorological conditions by day and hour. The gray, green, and pink colors towards the bottom of the charts reflect the boundary conditions, biogenic, and non-Texas anthropogenic contributions, respectively.

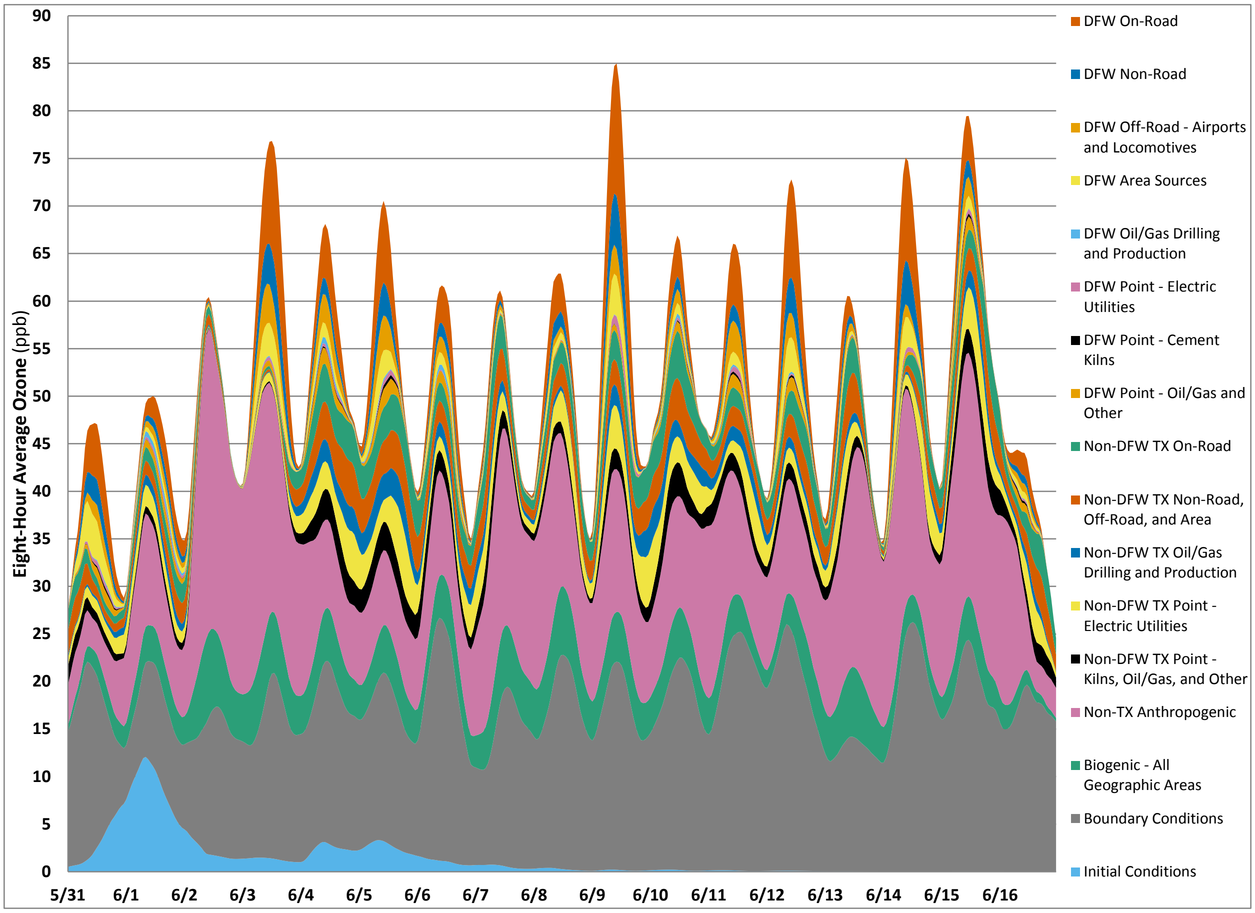


Figure 3-31: 2017 Ozone Contributions for Denton Airport South from May 31 through June 16

Figure 3-31 and Figure 3-32 present the ozone contributions for each day of the respective time periods, but not all of these days were used in the RRF calculations presented in Tables 3-40 through 3-44. For each monitor, the maximum eight-hour ozone contributions from the APCA output were aggregated for the episode days used in the RRF calculations. A distribution by geographic area and source type was obtained by averaging the ozone contributions across the RRF days, and that distribution was then applied to the 2017 DV_F for each monitor. This approach was done separately for the all days attainment test and the top 10 days attainment test.

The results for the all days analysis are presented in Figure 3-33: *2017 Ozone Contributions for the Denton, Parker, and Kaufman Monitors Based on the All Days Design Values*. The Denton Airport South monitor was chosen for review because it has the highest 2017 DV_F and is located in the far northwestern downwind portion of the DFW nonattainment area, so its APCA results represent the maximum total ozone contribution from DFW nonattainment area precursors. The Kaufman monitor was chosen for review because it has a low 2017 DV_F and is located in the far southeastern upwind portion of the DFW nonattainment area, so its APCA results can best represent the background contribution. The Parker County monitor was chosen to evaluate ozone impacts of oil and gas operations because it is located in the far western portion of the DFW nonattainment area downwind of prevalent drilling and production activity.

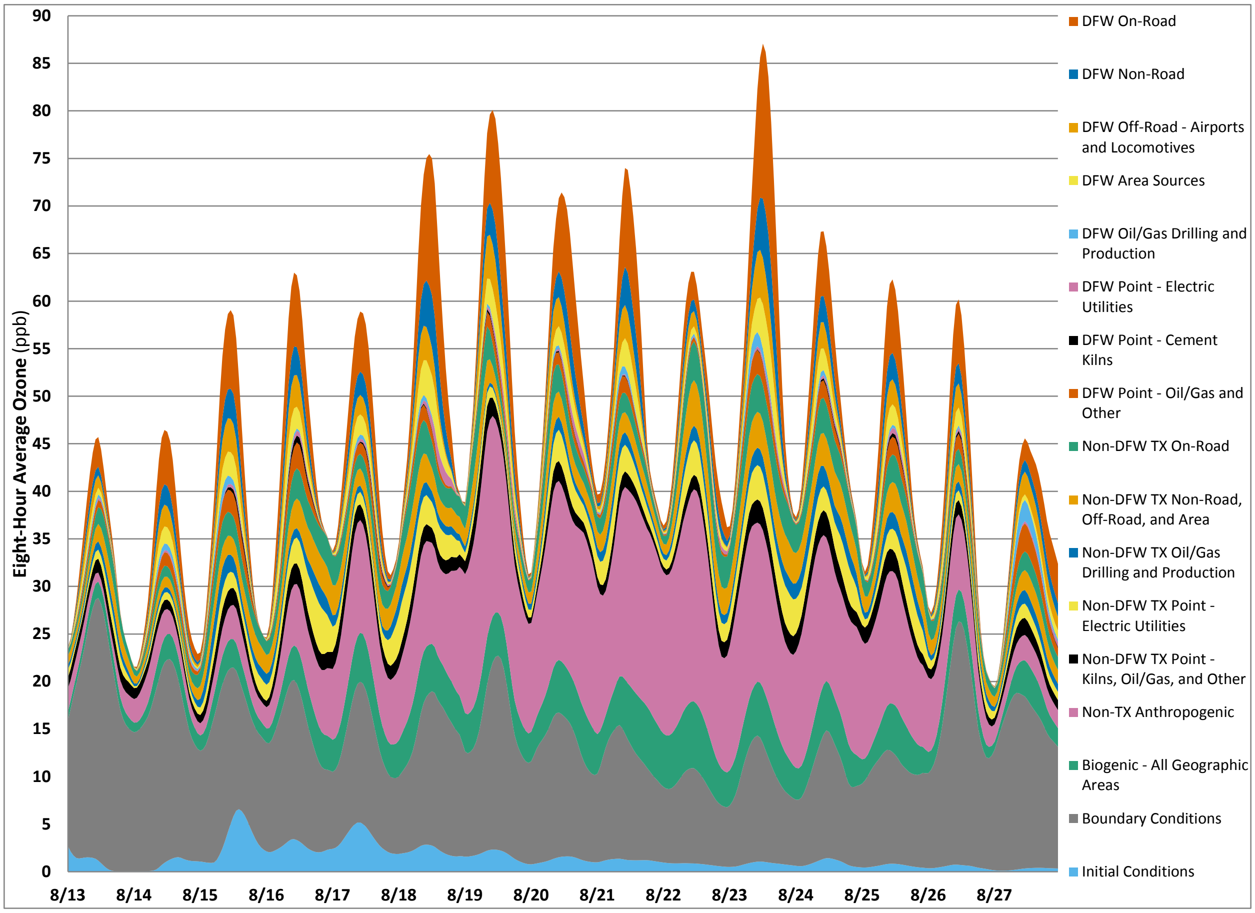


Figure 3-32: 2017 Ozone Contributions for Denton Airport South from August 13 through 27

Table 3-46: *2017 Ozone Contributions for the Denton, Parker, and Kaufman Monitors Based on the All Days Design Values* presents the numeric results for each of the geographic area and source categories referenced in Figure 3-33. Table 3-47: *2017 Aggregate Ozone Contributions for the Denton, Parker, and Kaufman Monitors Based on the All Days Design Values* groups the anthropogenic source category results from Table 3-46 into 10-County DFW, non-DFW Texas, and non-Texas areas. The southeastern upwind Kaufman monitor reflects the lowest DFW nonattainment area ozone contribution of 2.70 ppb to its DV_F, while the northwestern downwind Denton Airport South monitor reflects the highest DFW nonattainment area ozone contribution of 21.11 ppb. While the peak ozone at Kaufman is 15.81 ppb lower than at Denton Airport South, a greater portion of its ozone can be attributed to non-DFW Texas (16.38 ppb) and non-Texas (20.90 ppb) sources. The comparative non-DFW Texas and non-Texas anthropogenic contributions for Denton Airport South are 11.37 ppb and 18.61 ppb, respectively. As Tables 3-46 and 3-47 indicate, the remaining portions of the DV_F for each monitor are from biogenic sources, initial conditions for the start of the episode, and boundary conditions assigned to the borders of the modeling domain.

As shown in Table 3-46, the Parker monitor reflects higher ozone contributions from oil and gas operations compared with other DFW nonattainment area monitors. This is to be expected due its location downwind of much of this activity during ozone season. As noted in Table 3-45, the DFW nonattainment area point source contributions are divided into electric utilities, cement kilns, and a remaining category that combines oil and gas operations with "other". The 2017 figures in Table 3-22 and Table 3-32 show that the oil and gas portion is 16.50 NO_X tpd with 6.68 NO_X tpd comprising the remainder of the total 23.18 NO_X tpd for non-cement kiln non-EGUs. Appendix C contains more detail on the APCA analyses presented here.

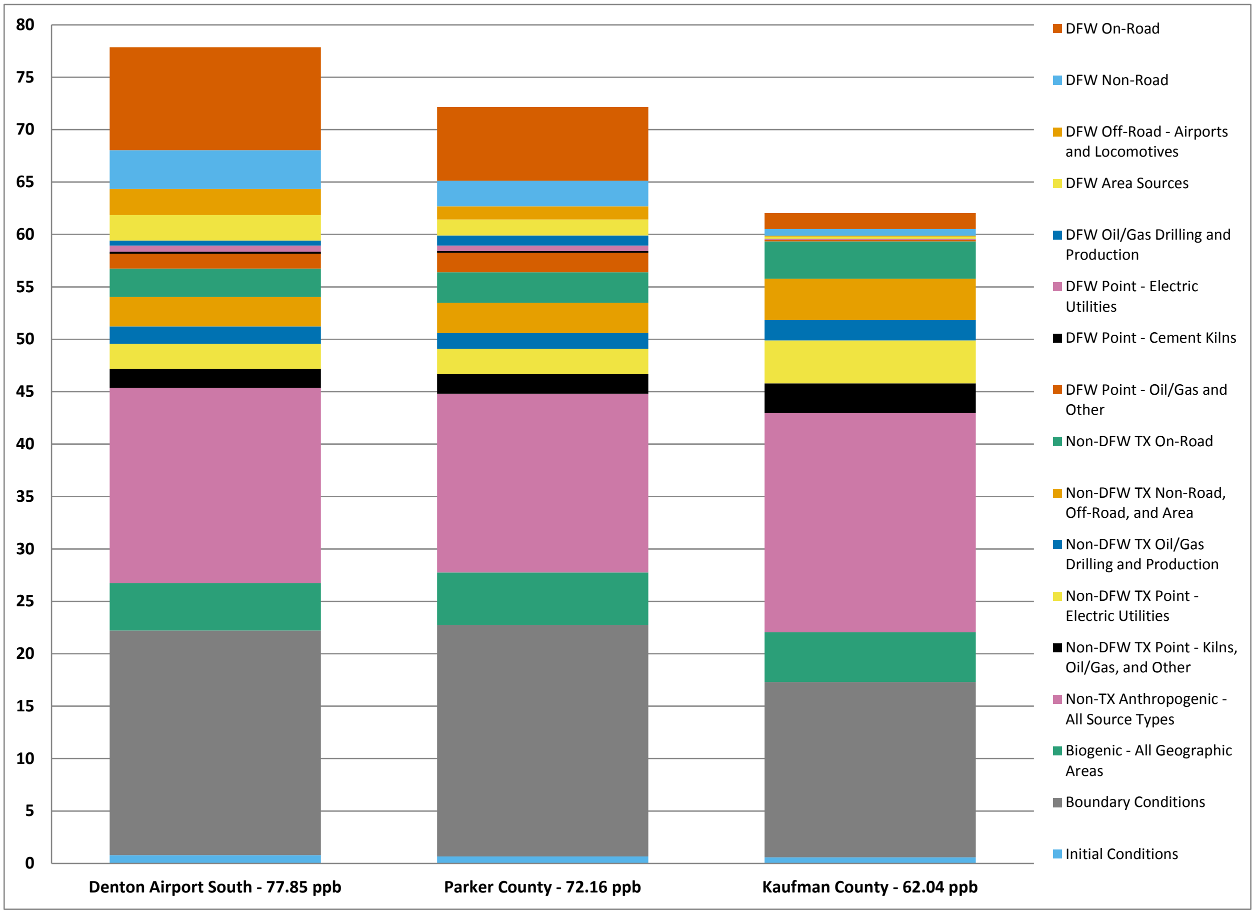


Figure 3-33: 2017 Ozone Contributions for the Denton, Parker, and Kaufman Monitors Based on the All Days Design Values

Table 3-46: 2017 Ozone Contributions for the Denton, Parker, and Kaufman Monitors Based on the All Days Design Values

Geographic Area and Source Type	Denton Airport South (ppb)	Parker County (ppb)	Kaufman County (ppb)
DFW On-Road	9.82	7.04	1.53
DFW Non-Road	3.69	2.44	0.63
DFW Off-Road - Airports and Locomotives	2.51	1.26	0.09
DFW Area Sources	2.43	1.52	0.20
DFW Oil/Gas Drilling and Production	0.47	0.95	0.02
DFW Point - Electric Utilities	0.58	0.53	0.10
DFW Point - Cement Kilns	0.19	0.16	0.01
DFW Point - Oil/Gas and Other	1.42	1.87	0.12

Geographic Area and Source Type	Denton Airport South (ppb)	Parker County (ppb)	Kaufman County (ppb)
Non-DFW TX On-Road	2.72	2.91	3.56
Non-DFW TX Non-Road, Off-Road, and Area Sources	2.80	2.87	3.94
Non-DFW TX Oil/Gas Drilling and Production	1.65	1.52	1.94
Non-DFW TX Point - Electric Utilities	2.40	2.43	4.10
Non-DFW TX Point - Cement Kilns, Oil/Gas, and Other	1.80	1.85	2.84
Non-TX Anthropogenic - All Source Types	18.61	17.05	20.90
Biogenic - All Geographic Areas	4.54	5.01	4.76
Boundary Conditions	21.43	22.10	16.71
Initial Conditions	0.80	0.66	0.59
2017 Future Design Value	77.86	72.17	62.04

Table 3-47: 2017 Aggregate Ozone Contributions for the Denton, Parker, and Kaufman Monitors Based on the All Days Design Values

Aggregated Geographic Area and Source Type	Denton Airport South (ppb)	Parker County (ppb)	Kaufman County (ppb)
DFW Anthropogenic - All Source Types	21.11	15.77	2.70
Non-DFW Texas Anthropogenic - All Source Types	11.37	11.58	16.38
Non-Texas Anthropogenic - All Source Types	18.61	17.05	20.90
Biogenic - All Geographic Areas	4.54	5.01	4.76
Boundary and Initial Conditions	22.23	22.76	17.30
2017 Future Design Value	77.86	72.17	62.04

Table 3-48: *2017 Ozone Contributions for the Denton, Parker, and Kaufman Monitors Based on the Top 10 Days Design Values* is similar to Table 3-46 but presents the results for the newer top 10 attainment test. Table 3-49: *2017 Aggregate Ozone Contributions for the Denton, Parker, and Kaufman Monitors Based on the Top 10 Days Design Values* presents similar information at Table 3-47 but for the newer top 10 attainment test. The bar charts presented above in Figure 3-33 for the all days attainment test are not repeated for the top 10 results because the numeric differences are not large enough to show much distinction in bar charts. For the Denton Airport South monitor, Table 3-49 shows that DFW anthropogenic sources contribute 24.98 ppb for the top 10 days DV_F, which is 3.87 ppb higher than the 21.11 ppb contribution for the all days DV_F shown in Table 3-47. According to the EPA's draft guidance, this is expected because "on days with high ozone concentrations, there is a relatively higher percentage of locally generated ozone compared to days with low base concentrations. Days with low ozone concentrations are more likely to have a high percentage of ozone due to background and boundary conditions."

Table 3-48: 2017 Ozone Contributions for the Denton, Parker, and Kaufman Monitors Based on the Top 10 Days Design Values

Geographic Area and Source Type	Denton Airport South (ppb)	Parker County (ppb)	Kaufman County (ppb)
DFW On-Road	11.81	10.07	1.68
DFW Non-Road	4.68	3.49	0.66
DFW Off-Road - Airports and Locomotives	3.13	1.87	0.11
DFW Area Sources	2.93	2.40	0.22
DFW Oil/Gas Drilling and Production	0.39	0.96	0.02
DFW Point - Electric Utilities	0.58	0.77	0.14
DFW Point - Cement Kilns	0.17	0.23	0.02
DFW Point - Oil/Gas and Other	1.29	2.11	0.15
Non-DFW TX On-Road	2.24	1.92	3.43
Non-DFW TX Non-Road, Off-Road, and Area Sources	2.21	1.91	3.98
Non-DFW TX Oil/Gas Drilling and Production	1.36	1.21	1.86
Non-DFW TX Point - Electric Utilities	2.27	2.08	4.20
Non-DFW TX Point - Cement Kilns, Oil/Gas, and Other	1.45	1.21	3.06
Non-TX Anthropogenic - All Source Types	17.44	14.98	21.92
Biogenic - All Geographic Areas	4.52	4.49	4.67
Boundary Conditions	18.90	22.16	15.31
Initial Conditions	0.89	0.53	0.68
2017 Future Design Value	76.26	72.40	62.11

Table 3-49: 2017 Aggregate Ozone Contributions for the Denton, Parker, and Kaufman Monitors Based on the Top 10 Days Design Values

Aggregated Geographic Area and Source Type	Denton Airport South (ppb)	Parker County (ppb)	Kaufman County (ppb)
DFW Anthropogenic - All Source Types	24.98	21.91	3.00
Non-DFW Texas Anthropogenic - All Source Types	9.53	8.33	16.53
Non-Texas Anthropogenic - All Source Types	17.44	14.98	21.92
Biogenic - All Geographic Areas	4.52	4.49	4.67
Boundary and Initial Conditions	19.79	22.69	15.99
2017 Future Design Value	76.26	72.40	62.11

3.7.4 Future Case Modeling Sensitivities

Section 3.7.2 presented the 2017 future design values obtained from the running the photochemical model with the 2006 baseline and 2017 future case emission inventories discussed in Sections 3.5.3 and 3.5.4, respectively. When a future case sensitivity analysis is performed, the future year anthropogenic emission inventory inputs are modified while the baseline emission inventories are typically held constant. For each future case sensitivity test, the RRF analysis is performed and the revised future case design values for each monitor are compared to the future baseline levels.

3.7.4.1 2017 Clean Air Interstate Rule (CAIR) Phase II Sensitivity

On July 28, 2015, the D.C. Circuit Court found that the CSAPR 2014 sulfur dioxide (SO_2) and ozone season NO_X budgets for Texas and certain other states were invalid because the budgets required more emission reductions than were necessary. The court remanded the rule without vacatur to the EPA for reconsideration of the emission budgets. Therefore, while the current CSAPR budgets for Texas are still in effect, the budgets may be subject to change in the future after the EPA's reconsideration or changes resulting from further appeals.

As described in Section 3.5.4.1, the 2017 future case EGU emissions for this 2017 DFW AD SIP revision were projected based on the latest available CSAPR unit level allocations from the EPA. The TCEQ performed a 2017 sensitivity analysis that replaced the 2017 EGU emission estimates based on CSAPR with those that would apply if the CAIR Phase II allocations were still in effect. The modeled 2017 ozone impacts for the DFW area monitors are presented in Table 3-50: *2017 Future Design Value Changes from CAIR II Instead of CSAPR for the All Days Attainment Test*. The maximum modeled reduction of 0.45 ppb is at the Fort Worth Northwest monitor, while the maximum modeled increase of 0.43 ppb is at the Rockwall Heath monitor located northeast of Dallas.

Table 3-50: 2017 Future Design Value Changes from CAIR II Instead of CSAPR for the All Days Attainment Test

2006 DFW Area Monitor and CAMS Code	DFW Area Monitor Alpha Code	2017 DV_F for CSAPR (ppb)	2017 DV_F for CAIR II (ppb)	2017 DV_F Change (ppb)
Denton Airport South - C56	DENT	77.86	77.75	-0.11
Eagle Mountain Lake - C75	EMTL	77.52	77.29	-0.23
Grapevine Fairway - C70	GRAP	77.20	77.12	-0.08
Keller - C17	KELC	76.77	76.59	-0.18
Fort Worth Northwest - C13	FWMC	75.94	75.49	-0.45
Frisco - C31	FRIC	74.40	74.51	+0.11
Dallas North #2 - C63	DALN	73.35	73.49	+0.14
Dallas Executive Airport - C402	REDB	72.21	72.38	+0.17
Parker County - C76	WTFD	72.17	72.13	-0.04
Cleburne Airport - C77	CLEB	71.10	70.99	-0.11
Dallas Hinton Street - C401	DHIC	70.96	71.06	+0.10
Arlington Municipal Airport - C61	ARLA	70.57	70.59	+0.02
Granbury - C73	GRAN	68.73	68.78	+0.05
Midlothian Tower - C94	MDLT	67.77	67.95	+0.18
Pilot Point - C1032	PIPT	67.40	67.39	-0.01
Rockwall Heath - C69	RKWL	65.65	66.08	+0.43
Midlothian OFW - C52	MDLO	63.17	63.35	+0.18
Kaufman - C71	KAUF	62.04	62.39	+0.35

2006 DFW Area Monitor and CAMS Code	DFW Area Monitor Alpha Code	2017 DV_F for CSAPR (ppb)	2017 DV_F for CAIR II (ppb)	2017 DV_F Change (ppb)
Greenville - C1006	GRVL	61.78	61.86	+0.08

The modeled 2017 ozone impacts for this same scenario using the top 10 days test are included in Table 3-51: *2017 Future Design Value Changes from CAIR II Instead of CSAPR for the Top 10 Days Attainment Test*. This approach has the maximum modeled reduction of 0.33 ppb at the Fort Worth Northwest monitor, while the maximum modeled increase of 0.37 ppb is at the Kaufman monitor located southeast of Dallas.

Table 3-51: 2017 Future Design Value Changes from CAIR II Instead of CSAPR for the Top 10 Days Attainment Test

2006 DFW Area Monitor and CAMS Code	DFW Area Monitor Alpha Code	2017 DV_F for CSAPR (ppb)	2017 DV_F for CAIR II (ppb)	2017 DV_F Change (ppb)
Denton Airport South - C56	DENT	76.26	76.34	+0.08
Eagle Mountain Lake - C75	EMTL	76.55	76.34	-0.21
Grapevine Fairway - C70	GRAP	75.65	75.68	+0.03
Keller - C17	KELC	75.35	75.30	-0.05
Fort Worth Northwest - C13	FWMC	74.78	74.45	-0.33
Frisco - C31	FRIC	73.85	74.05	+0.20
Dallas North #2 - C63	DALN	72.23	72.45	+0.22
Dallas Executive Airport - C402	REDB	72.05	72.18	+0.13
Parker County - C76	WTFD	72.40	72.24	-0.16
Cleburne Airport - C77	CLEB	69.86	69.60	-0.26
Dallas Hinton Street - C401	DHIC	69.31	69.53	+0.22
Arlington Municipal Airport - C61	ARLA	69.86	69.73	-0.13
Granbury - C73	GRAN	68.41	68.47	+0.06
Midlothian Tower - C94	MDLT	67.44	67.66	+0.22
Pilot Point - C1032	PIPT	66.60	66.61	+0.01
Rockwall Heath - C69	RKWL	65.81	66.00	+0.19
Midlothian OFW - C52	MDLO	62.57	62.76	+0.19
Kaufman - C71	KAUF	62.11	62.48	+0.37
Greenville - C1006	GRVL	62.09	62.13	+0.04

3.7.5 Unmonitored Area Analysis

The 2007 modeling guidance recommends that areas within or near nonattainment counties but not adjacent to monitoring locations (unmonitored areas (UMA)) be subjected to a UMA analysis to demonstrate that these areas are expected to reach attainment by the required future year. The standard attainment test is applied only at monitor locations, and the UMA analysis is intended to identify any areas not near a monitoring location that are at risk of not meeting the attainment date. Recently, the EPA provided Modeled Attainment Test Software (MATS), which can be used to conduct UMA analyses but has not specifically recommended using its software in the 2007 guidance, instead stating that “States will be able to use the EPA-provided software or are free to develop alternative techniques that may be appropriate for their areas or situations.”

The TCEQ chose to use its own procedure to conduct the UMA analysis instead of MATS for several reasons. Both procedures incorporate modeled predictions into a spatial interpolation procedure. However, the TCEQ Attainment Test for Unmonitored areas (TATU) is already integrated into the TCEQ’s model post-processing stream while MATS requires that modeled concentrations be exported to a personal computer-based platform. Additionally, MATS requires input in latitude/longitude, while TATU works directly off the LCC projection data used in TCEQ modeling applications. Finally, MATS uses the Voronoi Neighbor Averaging (VNA) technique for spatial interpolation, while TATU relies on the more familiar kriging geospatial interpolation technique. More information about TATU is provided in Appendix C.

Figure 3-34: *Spatially Interpolated Ozone Design Values for the 2006 Baseline and 2017 Future Case* shows two color contour maps of ozone concentrations produced by TATU, one for the 2006 baseline (bottom) and one for the 2017 future case (top). The 2006 plot shows that the maximum modeled baseline design value is in cell 78 in the X-direction and cell 191 in the Y-direction (78-X/191-Y) which is the same 4 km cell where the Denton Airport South monitor is located. The 2017 plot shows the extent and magnitude of the expected improvements in ozone design values compared with the 2006 baseline, with few grid cells at or above 76 ppb. The 2017 plot indicates that the maximum 2017 design value in the domain is 78.6 ppb, which is located in cell 79-X/186-Y between the Grapevine Fairway and Denton Airport South monitors. This value of 78.6 ppb is 0.7 ppb higher than the Denton Airport South future design value of 77.9 reported in Table 3-42.

Figure 3-29 shows the location of all ozone monitors within the entire 4 km grid cell array for DFW. The five monitors that typically record the highest ozone levels in DFW are located north and west of Fort Worth: Denton Airport South, Eagle Mountain Lake, Fort Worth Northwest, Grapevine Fairway, and Keller. Both the 2006 baseline and 2017 future case modeling for this 67-day episode are properly capturing the geographic locations of the monitored peaks.

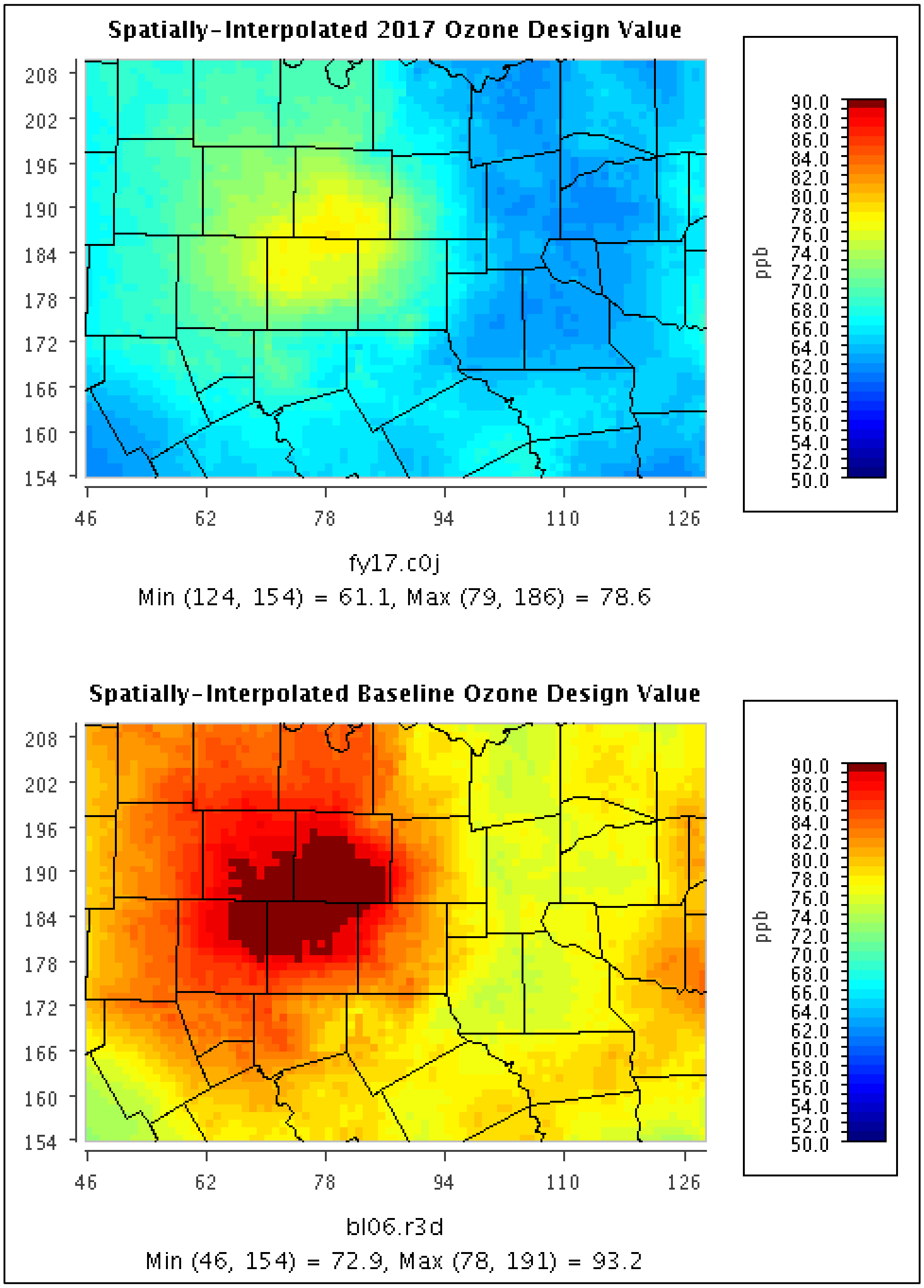


Figure 3-34: Spatially Interpolated Ozone Design Values for the 2006 Baseline and 2017 Future Case

3.8 MODELING ARCHIVE AND REFERENCES

3.8.1 Modeling Archive

The TCEQ has archived all modeling documentation and modeling input/output files generated as part of the 2017 DFW AD SIP revision modeling analysis. Interested parties can contact the TCEQ for information regarding data access or project documentation. Most modeling files and performance evaluation products may be found on the TCEQ modeling FTP site, (ftp://amdaftp.tceq.texas.gov/pub/TX/camx/).

3.8.2 Modeling References

Browning, J., Tinker, S., Ikonnikova, S., Gulen, G., Potter, E., Fu, Q., Horvath, S., Patzek, T., Male, F., Fisher, W., Roberts, F., Medlock, K., 2013, Barnett Study Determines Full-Field Reserves, Production Forecast, Oil & Gas Journal, September 2013, http://www.beg.utexas.edu/info/docs/OGJ_SFSGAS_pt2.pdf.

Emery, C., E. Tai, and G. Yarwood, 2001. Enhanced Meteorological Modeling and Performance Evaluation for Two Texas Ozone Episodes, Final Report to the Texas Natural Resource Conservation Commission under TNRCC Umbrella Contract No. 582-0-31984, Environ International Corporation, Novato, CA.

Environ, 2008. Boundary Conditions and Fire Emissions Modeling, Final Report to the Texas Commission on Environmental Quality (TCEQ), Contract No. 582-7-84005-FY08-06, Environ International Corporation, Novato, CA.

Environ, 2015. EPS3 User's Guide Emissions Processor, Version 3.22, Environ International Corporation, July 2015.

Environ, 2015a. User's Guide Comprehensive Air Quality Model with Extensions (CAMx), Version 6.2, Environ International Corporation, March 2015, http://www.camx.com/files/camxusersguide_v6-20.pdf.

Environ, 2011. Improving the Representation of Vertical Mixing Processes in CAMx, Final Report to the Texas Commission on Environmental Quality (TCEQ), Contract No. 582-11-10365-FY11-02, http://www.tceq.texas.gov/assets/public/implementation/air/am/contracts/reports/pm/5821110365FY1102-20110822-environ-vertical_mixing_final_report.pdf, Environ International Corporation, Novato, CA.

EPA, 2007. Guidance on the Use of Models and Other Analyses for Demonstrating Attainment of Air Quality Goals for Ozone, $PM_{2.5}$, and Regional Haze, EPA-454/B-07-002, April 2007, http://www.epa.gov/ttn/scram/guidance/guide/final-03-pm-rh-guidance.pdf.

EPA, 2008. Approval and Promulgation of Air Quality Implementation Plans; Texas; Dallas/Fort Worth 1-Hour Ozone Nonattainment Area; Determination of Attainment of the 1-Hour Ozone Standard, http://edocket.access.gpo.gov/2008/pdf/E8-24592.pdf.

EPA, 2010. Determination of Nonattainment and Reclassification of 1997 8-hour Ozone Nonattainment Areas: Dallas/Fort Worth, TX, http://www.regulations.gov/search/Regs/home.html#documentDetail?R=0900006480b2c08e

EPA, 2014. Air Quality Modeling Technical Support Document: Tier 3 Motor Vehicle Emission and Standards, EPA-454/R-14-002, February 2014, http://www.epa.gov/otaq/documents/tier3/454r14002.pdf.

EPA, 2014a. The Effects of Ultra-Low Sulfur Gasoline on Emissions from Tier 2 Vehicles in the In-Use Fleet, EPA-420-R-14-002, March 2014, http://www.epa.gov/otaq/models/moves/documents/420r14002.pdf.

EPA, 2014b. Draft Modeling Guidance for Demonstrating Attainment of Air Quality Goals for Ozone, $PM_{2.5}$, and Regional Haze, December 2014, http://www.epa.gov/ttn/scram/guidance/guide/Draft_O3-PM-RH_Modeling_Guidance-2014.pdf.

ERG, 2010. Characterization of Oil and Gas Production Equipment and Develop a Methodology to Estimate Statewide Emissions, November 2010, http://www.tceq.state.tx.us/assets/public/implementation/air/am/contracts/reports/ei/5820784003FY1026-20101124-ergi-oilGasEmissionsInventory.pdf.

ERG, 2010. Projection Factors for Point and Area Sources, August 2012. Available within TCEQ TexAER system at http://www5.tceq.texas.gov/texaer/.

ERG, 2012. Forecasting Oil and Gas Activities, August 2012, http://www.tceq.state.tx.us/assets/public/implementation/air/am/contracts/reports/ei/5821199776FY1212-20120831-erg-forecasting_oild_gas_activities.pdf.

ERG, 2014. Specified Oil and Gas Well Activities Emissions Inventory Update, August 2014, http://www.tceq.state.tx.us/assets/public/implementation/air/am/contracts/reports/ei/5821199776FY1426-20140801-erg-oil_gas_ei_update.pdf.

Feldman, M.S., T. Howard, E. McDonald-Buller, G. Mullins, D.T. Allen, A. Webb, Y. Kimura, 2007. Applications of Satellite Remote Sensing Data for Estimating Dry Deposition in Eastern Texas. Atmospheric Environment, 41(35): 7562-7576.

ERG, 2015. 2014 Texas Statewide Locomotive Emissions Inventory and 2008 through 2040 Trend Inventories, August 2015.

ERG, 2015a. Aircraft Emissions Inventory for Texas Statewide 2014 AERR Inventory and 2008 to 2040 Trend Analysis Years, July 2015.

ERG, 2015b. 2014 Statewide Drilling Rig Emissions Inventory with Updated Trends Inventories, July 2015.

Grell, G., J. Dudhia, and D. Stauffer, 1994. A Description of the Fifth Generation Penn State/NCAR Mesoscale Model (MM5), Technical Report NCAR/TN-398+STR, National Center of Atmospheric Research (NCAR) Tech Note.

Guenther, A., Jiang, X., Heald, C., Sakulyanontvittaya, T., Duhl, T., Emmons, L., et al., 2012. The Model of Emissions of Gases and Aerosols from Nature version 2.1 (MEGAN2.1): an extended and updated framework for modeling biogenic emissions. Geoscientific Model Development, 1471-1492.

Kinnee et al., 1997. United States Land Use Inventory for Estimating Biogenic Ozone Precursor Emissions. Ecological Applications 7(1): 46-58.

MacDonald, Nicole and Hakami, A, 2010. Temporal Source Apportionment of Policy-Relevant Air Quality Metrics, Presented at the 9th CMAS Conference Oct. 11-13, 2010, Chapel, Hill, N.C.

Mellor, G. L., and T. Yamada, 1974: A hierarchy of turbulence closure models for planetary boundary layers. J. Atmos. Sci., 31, 1791–1806.

Morris, G., 2006. Tropospheric Ozone Pollution Project, http://physics.valpo.edu/ozone/houstondata_2004_2007.htm#2006, Valparaiso University, Indiana, and the University of Houston, Texas.

NCAR, 2005. MM5 On-line Tutorial Home Page, http://www2.mmm.ucar.edu/mm5/On-Line-Tutorial/mm5/mm5.html, NCAR, Colorado.

NCEP, 2009. Global Energy and Water Cycle Experiment (GEWEX) Continental International Project (GCIP) National Centers for Environmental Prediction (NCEP) Eta Model Output, Computational and Information Systems Laboratory (CISL) Research Data Archive (RDA): ds609.2 Home Page, http://rda.ucar.edu/datasets/ds609.2/, NCEP.

NCTCOG, 2011. Development of Annual Emissions Inventories and Activity Data for Airports in the 12-County Dallas-Fort Worth Area, Report to TCEQ, North Central Texas Council of Governments Transportation Department, ftp://amdaftp.tceq.texas.gov/pub/Offroad_EI/Airports/DFW/NCTCOG_DFW_Airport_EI_Report_August_2011.pdf.

NOAA, 2006. Texas Air Quality Study – Gulf of Mexico Atmospheric Composition and Climate Study 2006, http://www.esrl.noaa.gov/csd/projects/2006/, NOAA.

Popescu, Sorin C., Jared Stukey, Mark Karnauch, Jeremiah Bowling, Xuesong Zhang, William Booth, and Nian-Wei Ku, 2008. The New Central Texas Land Use Land Cover Classification Project, Final Report to the TCEQ, Contract No. 582-5-64593-FY08-23, http://www.tceq.state.tx.us/assets/public/implementation/air/am/contracts/reports/oth/5820564593FY0823-20081230-tamu-New_Central_TX_LULC.pdf, Texas A & M University, College Station, Texas.

Railroad Commission of Texas, Barnett Shale Information, http://www.rrc.state.tx.us/oil-gas/major-oil-gas-formations/barnett-shale-information.

Smith, Jim and Estes, M., 2010. Dynamic Model Performance Evaluation Using Weekday-Weekend and Retrospective Analysis, Presented at the 9th CMAS Conference Oct. 11-13, 2010, Chapel, Hill, N.C.

Stauffer, D. R. and N. L. Seaman, 1990. Use of Four-Dimensional Data Assimilation in a Limited-Area Mesoscale Model. Part I: Experiments with Synoptic-Scale Data. Monthly Weather Review, 118: 1250-1277.

Stauffer, D.R. and N.L. Seaman, 1994. Multiscale four-dimensional data assimilation. Journal of Applied Meteorology, 33: 416-434.

Stauffer, D. R., N. L. Seaman, and F. S. Binkowski, 1991. Use of Four-Dimensional Data Assimilation in a Limited-Area Mesoscale Model. Part II: Effects of Data Assimilation Within the Planetary Boundary Layer. Monthly Weather Review, 119: 734-754.

TCEQ, 2007a. Revisions to the State Implementation Plan (SIP) for the Control of Ozone Air Pollution, Dallas-Fort Worth Eight-Hour Ozone Nonattainment Area Attainment Demonstration, TCEQ, Austin, Texas.

TCEQ, 2010. Adopted HGB Attainment Demonstration SIP Revision for the 1997 Eight-Hour Ozone Standard (2009-017-SIP-NR), Texas Commission on Environmental Quality, March 2010, http://www.tceq.state.tx.us/implementation/air/sip/texas-sip/hgb/hgb-latest-ozone.

TCEQ, 2015, Texas Air Emissions Repository (TexAER) web site, http://www5.tceq.texas.gov/texaer/.

Wiedinmyer, C., A. Guenther, M. Estes, I.W. Strange, G. Yarwood, and D. Allen, 2001. A Land Use Database and Examples of Biogenic Isoprene Emission Estimates for the State of Texas, USA. Atmospheric Environment, 35: 6465-6477.

CHAPTER 4: CONTROL STRATEGIES AND REQUIRED ELEMENTS

4.1 INTRODUCTION

The Dallas-Fort Worth (DFW) nonattainment area for the 2008 eight-hour ozone National Ambient Air Quality Standard (NAAQS), which consists of Collin, Dallas, Denton, Tarrant, Ellis, Johnson, Kaufman, Parker, Rockwall, and Wise Counties, includes a wide variety of major and minor industrial, commercial, and institutional entities. The Texas Commission on Environmental Quality (TCEQ) has implemented stringent and innovative regulations that address emissions of nitrogen oxides (NO_X) and volatile organic compounds (VOC) from these sources. This chapter describes existing ozone control measures for the DFW nonattainment area, as well as how Texas meets the following moderate ozone nonattainment area state implementation plan (SIP) requirements for the 2008 eight-hour ozone NAAQS: reasonably available control technology (RACT), reasonably available control measures (RACM), motor vehicle emissions budget (MVEB), and contingency measures.

4.2 EXISTING CONTROL MEASURES

Since the early 1990s, a broad range of control measures have been implemented for each emission source category for ozone planning in the DFW nonattainment area, formerly consisting of nine counties, Collin, Dallas, Denton, Tarrant, Ellis, Johnson, Kaufman, Parker, and Rockwall. Wise County was added to the nonattainment area for the 2008 eight-hour ozone NAAQS. Table 4-1: *Existing Ozone Control and Voluntary Measures Applicable to the DFW 10-County Nonattainment Area* lists the existing ozone control strategies that have been implemented for the one-hour and the 1997 and 2008 eight-hour ozone standards for all 10 counties comprising the DFW nonattainment area.

Table 4-1: Existing Ozone Control and Voluntary Measures Applicable to the DFW 10-County Nonattainment Area

Measure	Description	Start Date(s)
Industrial, Commercial, and Institutional (ICI) Major Source Rule 30 Texas Administrative Code (TAC) Chapter 117, Subchapter B, Division 4	Applies to all major sources (50 tons per year (tpy) of NO_X or more) with affected units in Collin, Dallas, Denton, Ellis, Johnson, Kaufman, Parker, Rockwall, and Tarrant Counties Applies to major sources (100 tpy of NO_X or more) with affected units in Wise County Affected source categories included in rule: boilers; process heaters; stationary gas turbines, and duct burners used in turbine exhaust ducts; lime kilns; heat treat and reheat metallurgical furnaces; stationary internal combustion engines; incinerators; glass, fiberglass, and mineral wool melting furnaces; fiberglass and mineral wool curing ovens; natural gas-fired ovens and heaters; brick and ceramic kilns; lead smelting reverberatory and blast furnaces; and natural gas-fired dryers used in organic solvent, printing ink, clay, brick, ceramic tile, calcining, and vitrifying processes	March 1, 2009 or March 1, 2010, depending on source category Note: these NO_X control requirements are in addition to the NO_X control strategies previously implemented for ICI major sources in Collin, Dallas, Denton, and Tarrant Counties in March 2002 for the one-hour ozone NAAQS January 1, 2017 for Wise County and for wood-fired boilers in all 10 counties of the DFW area

Measure	Description	Start Date(s)
ICI Minor Source Rule 30 TAC Chapter 117, Subchapter D, Division 2	Applies to all minor sources (less than 50 tpy of NO_X) with stationary internal combustion engines in Collin, Dallas, Denton, Ellis, Johnson, Kaufman, Parker, Rockwall, and Tarrant Counties	March 1, 2009 for rich-burn gas-fired engines, diesel-fired engines, and dual-fuel engines March 1, 2010 for lean-burn gas-fired engines
Stationary Diesel Engines 30 TAC Chapter 117, Subchapter B, Division 4 and Subchapter D, Division 2	Prohibition on operating stationary diesel and dual-fuel engines for testing and maintenance purposes between 6:00 a.m. and noon in Collin, Dallas, Denton, Ellis, Johnson, Kaufman, Parker, Rockwall, and Tarrant Counties	March 1, 2009
Major Utility Electric Generation Source Rule 30 TAC Chapter 117, Subchapter C, Division 4	NO_X control requirements for major source (50 tpy of NO_X or more) utility electric generating facilities in Collin, Dallas, Denton, Ellis, Johnson, Kaufman, Parker, Rockwall, and Tarrant Counties NO_X control requirements for major source (100 tpy of NO_X or more) utility electric generating facilities in Wise County Applies to utility boilers, auxiliary steam boilers, stationary gas turbines, and duct burners used in turbine exhaust ducts used in electric power generating systems Note: these NO_X control requirements are in addition to the NO_X control strategies implemented for utilities in Collin, Dallas, Denton, and Tarrant Counties in 2001 through 2005 for the one-hour ozone NAAQS	March 1, 2009 for Collin, Dallas, Denton, Ellis, Johnson, Kaufman, Parker, Rockwall, and Tarrant Counties January 1, 2017 for Wise County
Utility Electric Generation in East and Central Texas 30 TAC Chapter 117, Subchapter E, Division 1	NO_X control requirements on utility boilers and stationary gas turbines (including duct burners used in turbine exhaust ducts) at utility electric generation sites in East and Central Texas, including Parker County	May 1, 2003 through May 1, 2005
Cement Kiln Rule 30 TAC Chapter 117, Subchapter E, Division 2	NO_X control requirements for all Portland cement kilns located in Ellis County	March 1, 2009

Measure	Description	Start Date(s)
Nitric Acid Manufacturing Rule – General 30 TAC Chapter 117, Subchapter F, Division 3	NO_X emission standards for nitric acid manufacturing facilities (state-wide rule – no nitric acid facilities in DFW)	November 15, 1999
East Texas Combustion Sources Rule 30 TAC Chapter 117, Subchapter E, Division 4	NO_X control requirements for stationary rich-burn, gas-fired internal combustion engines (240 horsepower (hp) and greater) Measure implemented to reduce ozone in the DFW nonattainment area although controls not applicable in the DFW nonattainment area	March 1, 2010
Natural Gas-Fired Small Boilers, Process Heaters, and Water Heaters Rule 30 TAC Chapter 117, Subchapter E, Division 3	NO_X emission limits on small-scale residential and industrial boilers, process heaters, and water heaters equal to or less than 2.0 million British thermal units per hour in Collin, Dallas, Denton, Ellis, Johnson, Kaufman, Parker, Rockwall, and Tarrant Counties	May 11, 2000
VOC Control Measures 30 TAC Chapter 115	Control technology requirements for VOC sources for RACT and other SIP planning purposes including: storage, general vent gas, industrial wastewater, loading and unloading operations, general VOC leak detection and repair, solvent using processes, etc.	December 31, 2002 and earlier for Collin, Dallas, Denton, and Tarrant Counties June 15, 2007 or March 1, 2009 for Ellis, Johnson, Kaufman, Parker, and Rockwall Counties January 1, 2017 for Wise County
Degassing of Storage Tanks, Transport Vessels, and Marine Vessels Rule 30 TAC, Chapter 115, Subchapter F, Division 3	VOC control requirements for degassing during, or in preparation of, cleaning any storage tanks and transport vessels	May 21, 2011 for Collin, Dallas, Denton, and Tarrant Counties

Measure	Description	Start Date(s)
Storage Tanks Rule 30 TAC Chapter 115, Subchapter B, Division 1	Applies to major source storage tanks (50 tpy of VOC or more) in Collin, Dallas, Denton, Ellis, Johnson, Kaufman, Parker, Rockwall, and Tarrant Counties Applies to major source storage tanks (100 tpy of VOC or more) in Wise County Requires controls for slotted guidepoles and more stringent controls for other fittings on floating roof tanks, and control requirements or operational limitations on landing floating roof tanks Eliminates exemption for storage tanks for crude oil or natural gas condensate and regulates flash emissions from these tanks	March 1, 2013 January 1, 2017 for major source storage tanks in Wise County and for new inspection requirements to control flashed gases from storage tanks and corresponding recordkeeping requirements for fixed roof storage tanks in all 10 counties of the DFW area
Solvent-Using Processes Rules 30 TAC Chapter 115, Subchapter E	Implements control, testing, monitoring and recordkeeping requirements for eight emission source categories in the DFW nonattainment area for degreasing, surface coating, solvent cleaning, printing, and adhesive application processes. Certain rules were updated based on the control techniques guidelines issued by the United States Environmental Protection Agency (EPA) between 2006 and 2008 (see Dallas-Fort Worth Attainment Demonstration SIP Revision for the 1997 Eight-Hour Ozone Standard Nonattainment Area (2010-022-SIP-NR))	March 1, 2013 for Collin, Dallas, Denton, Ellis, Johnson, Kaufman, Parker, Rockwall, and Tarrant Counties January 1, 2017 for Wise County March 1, 2011 for major source offset lithographic printing lines and March 1, 2012 for minor source offset lithographic printing lines in Collin, Dallas, Denton, Ellis, Johnson, Kaufman, Parker, Rockwall, and Tarrant Counties

Measure	Description	Start Date(s)
Refueling – Stage I Rule 30 TAC, Chapter 115, Subchapter C, Division 2	Captures gasoline vapors that are released when gasoline is delivered to a storage tank Vapors returned to tank truck as storage tank is filled with fuel, rather than released into ambient air	1990 for Collin, Dallas, Denton, Ellis, Johnson, Kaufman, Parker, Rockwall, and Tarrant Counties January 1, 2017 for Wise County A SIP revision related to Stage I regulations was approved by the EPA, effective June 29, 2015
Refueling – Stage II Rule 30 TAC, Chapter 115, Subchapter C, Division 4	Captures gasoline vapors when vehicle is fueled at pump Vapors returned through pump hose to petroleum storage tank, rather than released into ambient air	1992 (Collin, Dallas, Denton, and Tarrant Counties) A SIP revision authorizing the decommissioning of Stage II vapor control equipment was approved by the EPA on March 17, 2014. Facilities may continue operating Stage II until August 31, 2018.
Texas Low Reid Vapor Pressure (RVP) Gasoline 30 TAC Chapter 114, Subchapter H, Division 1	Requires all gasoline for both on-road and non-road use to have RVP of 7.8 pounds per square inch or less from May 1 through October 1 each year	April 2000 in Ellis, Johnson, Kaufman, Parker, Rockwall, and Wise Counties
Texas Low Emission Diesel (TxLED) 30 TAC Chapter 114, Subchapter H, Division 2	Requires all diesel fuel for both on-road and non-road use to have a lower aromatic content and a higher cetane number	Phased in from October 31, 2005 through January 31, 2006
Federal Area/Non-Road Measures	Series of emissions limits implemented by the EPA for area and non-road sources Examples: diesel and gasoline engine standards for locomotives and leaf-blowers	Phase in through 2018

Measure	Description	Start Date(s)
Texas Emissions Reduction Plan (TERP) 30 TAC Chapter 114, Subchapter K	Provides grant funds for on-road and non-road heavy-duty diesel engine replacement/retrofit. The first emissions reduction incentive grant projects funded under TERP were for fiscal years (FY) 2002-2003 (September 1, 2001, through August 31, 2003). To focus the emissions reduction benefits for the areas that needed them the most, applications were accepted only for projects in the Houston-Galveston-Brazoria (HGB) and DFW nonattainment areas for FY 2002-2003. An application period limited to DFW, HGB, and Beaumont-Port Arthur was done in 2006 and 2007. The allocation approach established by the commission for TERP included several grant programs for reducing emissions from mobile sources and encouraging the use of cleaner alternative fuels for transportation, including the Diesel Emissions Reduction Incentive Program providing grants to replace or upgrade heavy-duty on-road vehicles, non-road equipment, locomotives, marine vessels, and some stationary engines.	January 2002

Measure	Description	Start Date(s)
Vehicle Inspection and Maintenance (I/M) Rule 30 TAC Chapter 114, Subchapter C	Yearly treadmill-type testing for pre-1996 vehicles and computer checks for 1996 and newer vehicles	May 1, 2002 in Collin, Dallas, Denton, and Tarrant Counties May 1, 2003 in Ellis, Johnson, Kaufman, Parker, and Rockwall Counties The DFW area meets the Federal Clean Air Act (FCAA), §182(b)(4) requirements to implement an I/M program, and according to 40 Code of Federal Regulations (CFR) §51.350(b)(2), an I/M program is required to cover the entire urbanized area based on the 1990 census. The current I/M program in the DFW ozone nonattainment area sufficiently covers a population equal to the DFW urbanized area, thus expansion of the I/M program to include Wise County is not required.
California Gasoline Engines	California standards for non-road gasoline engines 25 hp and larger	May 1, 2004
Voluntary Mobile Emissions Reduction Program	Various pedestrian, bicycle, traffic, and mass transit voluntary measures administered by the North Central Texas Council of Governments (NCTCOG) (see Appendix H for more details)	2007
Voluntary Energy Efficiency/Renewable Energy (EE/RE)	EE/RE projects encouraged by the Texas Legislature are outlined in section 5.4.1.1	See section 5.4.1.1

Measure	Description	Start Date(s)
Federal On-Road Measures	Series of emissions limits implemented by the EPA for on-road vehicles Included in measures: Tier 1, Tier 2, and Tier 3 light-duty and medium-duty passenger vehicle standards, heavy-duty vehicle standards, low sulfur diesel standards, National Low Emission Vehicle standards, and reformulated gasoline	Phase in through 2010 Tier 3 phase in from 2017 through 2025
Transportation Control Measures	Various transportation-related, local measures implemented under the previous one-hour and 1997 eight-hour ozone NAAQS NCTCOG has implemented all transportation control measure (TCM) commitments and provides an accounting of TCMs as part of the transportation conformity process. TCMs are not required to be considered for a moderate nonattainment area.	May 2007 for TCM commitments under 1997 eight-hour ozone standard August 1986 for TCM commitments under one-hour ozone standard

4.3 UPDATES TO EXISTING CONTROL MEASURES (NO CHANGE)

4.3.1 Updates to NO_X Control Measures (No change)

4.3.2 Updates to VOC Control Measures (No change)

4.3.3 Minor Source Stationary Diesel Engine Exemption (No change)

4.3.4 Decommissioning of Stage II Vapor Recovery (No change)

4.3.5 Updates to Stage I Vapor Recovery (No change)

4.4 NEW CONTROL MEASURES (NO CHANGE)

4.4.1 Stationary Sources (No change)

4.4.1.1 NO_X RACT Control Measures for Wise County (No change)

4.5 RACT ANALYSIS

4.5.1 General Discussion

Nonattainment areas classified as moderate and above are required to meet the mandates of the FCAA under §172(c)(1) and §182(b)(2) and (f). According to the EPA's 2008 eight-hour ozone SIP requirements rule (80 *Federal Register* [FR] 12264), states containing areas classified as moderate nonattainment or higher must submit a SIP revision to fulfill the RACT requirements for all control techniques guidelines (CTG) emission source categories and all non-CTG major sources of NO_X and VOC. This SIP revision must also contain adopted RACT regulations, certifications where appropriate that existing provisions are RACT, and/or negative declarations that there are no sources in the nonattainment area covered by a specific CTG source category. The major source threshold for moderate nonattainment areas is a potential to emit 100 tpy or more of either NO_X or VOC. The 100 tpy major source threshold applies in the newly designated Wise County. A 50 tpy major source threshold is retained for the remaining nine counties, which are currently classified as a serious nonattainment area under the 1997 eight-hour ozone NAAQS.

RACT is defined as the lowest emissions limitation that a particular source is capable of meeting by the application of control technology that is reasonably available considering technological and economic feasibility (44 FR 53762, September 17, 1979). RACT requirements for moderate and higher classification nonattainment areas are included in the FCAA to assure that significant source categories at major sources of ozone precursor emissions are controlled to a reasonable extent, but not necessarily to best available control technology (BACT) levels expected of new sources or to maximum achievable control technology (MACT) levels required for major sources of hazardous air pollutants.

While RACT and RACM have similar consideration factors like technological and economic feasibility, there is a significant distinction between RACT and RACM. A control measure must advance attainment of the area towards meeting the NAAQS for that measure to be considered RACM. Advancing attainment of the area is not a factor of consideration when evaluating RACT because the benefit of implementing RACT is presumed under the FCAA.

In 2008, the EPA approved the DFW NO_X rules in 30 TAC Chapter 117 (73 FR 73562). In 2009, the EPA approved the DFW VOC rules in 30 TAC Chapter 115 and NO_X rules for cement kilns in 30 TAC Chapter 117 as meeting the FCAA RACT requirements (74 FR 1903 and 74 FR 1927). In 2014, the EPA approved the 30 TAC Chapter 115 rules for VOC storage tanks as meeting the FCAA RACT requirements (79 FR 53299). State regulations in Chapter 115 that implement the controls recommended in CTG or alternative control techniques (ACT) documents or that implement equivalent or superior emission control strategies were determined to fulfill RACT requirements for any CTG or ACT documents issued prior to 2006 for the nine-county DFW 1997 eight-hour ozone nonattainment area.

The EPA issued 11 CTG documents between 2006 and 2008 with recommendations for VOC controls on a variety of consumer and commercial products. The RACT analysis included in the DFW Attainment Demonstration SIP revision for the 1997 Eight-Hour Ozone Standard adopted on March 10, 2010 addressed the following three CTG documents:

- Flat Wood Paneling Coatings, Group II issued in 2006;
- Offset Lithographic and Letterpress Printing, Group II issued in 2006; and
- Fiberglass Boat Manufacturing Materials, Group IV issued in 2008.

The RACT analysis included in the DFW Attainment Demonstration SIP Revision for the 1997 Eight-Hour Ozone Standard adopted on December 7, 2011 addressed the remaining eight CTG documents:

- Flexible Packaging Printing Materials, Group II issued in 2006;
- Industrial Cleaning Solvents, Group II issued in 2006;
- Large Appliance Coatings, Group III issued in 2007;
- Metal Furniture Coatings, Group III issued in 2007;
- Paper, Film, and Foil Coatings, Group III issued in 2007;
- Miscellaneous Industrial Adhesives, Group IV issued in 2008;
- Miscellaneous Metal and Plastic Parts Coatings, Group IV issued in 2008; and
- Auto and Light-Duty Truck Assembly Coatings, Group IV issued in 2008.

In 2014, the EPA approved the 30 TAC Chapter 115 rules for offset lithographic printing as meeting the FCAA RACT requirements (79 FR 45105). In 2015, the EPA approved the DFW VOC rules in 30 TAC Chapter 115 addressing the remaining CTGs issued between 2006 and 2008, in addition to approving the DFW RACT analysis as meeting the FCAA RACT requirements for all affected VOC and NO_X sources under the 1997 eight-hour ozone NAAQS (80 FR 16291).

TCEQ rules that are consistent with or more stringent than controls implemented in other nonattainment areas were also determined to fulfill RACT requirements. Federally approved state rules and rule approval dates can be found in 40 CFR §52.2270(c), EPA Approved Regulations in the Texas SIP. Emission sources subject to the more stringent BACT or MACT requirements were determined to also fulfill RACT requirements.

The TCEQ fulfilled FCAA RACT requirements for the 2008 eight-hour ozone NAAQS as part of the 2018 DFW Attainment Demonstration (AD) SIP revision for the 2008 eight-hour ozone NAAQS submitted to the EPA on July 10, 2015. However, as part of this 2017 DFW AD SIP revision, the TCEQ reviewed the 2013 point source emissions inventory to verify that all CTG or ACT emission source categories and non-CTG or non-ACT major emission sources in the DFW nonattainment area were subject to requirements that meet or exceed the applicable RACT requirements, or that further emission controls on the sources were either not economically feasible or not technologically feasible. The TCEQ concluded that RACT is in place for all emission sources in the DFW area and that no additional rulemaking is necessary as part of this 2017 DFW AD SIP Revision.

4.5.2 NO_X RACT Determination (No change)

4.5.3 VOC RACT Determination (No change)

4.6 RACM ANALYSIS

4.6.1 General Discussion

FCAA, §172(c)(1) requires states to provide for implementation of all RACM as expeditiously as practicable and to include RACM analyses in the SIP. In the general preamble for implementation of the FCAA Amendments published in the April 16, 1992 issue of the *Federal Register* (57 FR 13498), the EPA explains that it interprets FCAA, §172(c)(1) as a requirement that states incorporate into their SIP all RACM that would advance a region's attainment date; however, states are obligated to adopt only those measures that are reasonably available for implementation in light of local circumstances.

The TCEQ used a two-step process to develop the list of potential control strategies evaluated during the RACM analysis for the 2018 DFW AD SIP for the 2008 eight-hour ozone NAAQS submitted to the EPA on July 10, 2015. The same list was used for this 2017 DFW AD SIP revision. First, the TCEQ compiled a list of potential control strategy concepts based on an initial evaluation of the existing control strategies in the DFW nonattainment area and existing sources of VOC and NO_X in the DFW nonattainment area. The EPA allows states the option to consider control measures outside the ozone nonattainment area that can be shown to advance attainment; however, consideration of these sources is not a requirement of the FCAA. A draft list of potential control strategy concepts was developed from this initial evaluation. The TCEQ also invited stakeholders to suggest any additional strategies that might help advance attainment of the DFW nonattainment area. The final list of potential control strategy concepts for RACM analysis includes the strategies on the initial draft list and the strategies suggested by stakeholders during the informal stakeholder comment process.

Each control measure identified through the control strategy development process was evaluated to determine if the measure would meet established criteria to be considered reasonably available. The TCEQ used the general criteria specified by the EPA in the proposed approval of the New Jersey RACM analysis published in the January 16, 2009 issue of the *Federal Register* (74 FR 2945):

> *RACM is defined by the EPA as any potential control measure for application to point, area, on-road and non-road emission source categories that meets the following criteria:*
>
> - *The control measure is technologically feasible;*
> - *The control measure is economically feasible;*
> - *The control measure does not cause "substantial widespread and long-term adverse impacts;"*
> - *The control measure is not "absurd, unenforceable, or impracticable;"*
> - *The control measure can advance the attainment date by at least one year.*

The EPA did not provide guidance in the *Federal Register* notice on how to interpret the criteria "advance the attainment date by at least one year." Considering the July 20, 2018 attainment date for this 2017 DFW AD SIP revision, the TCEQ evaluated this aspect of RACM based on advancing the deadline for implementing control measures by one year, to July 20, 2017. As a result of the December 23, 2014 court decision that vacated the previous December 31, 2018 attainment date, the commission reevaluated RACM as part of this 2017 DFW AD SIP revision based on the new attainment date of July 20, 2018, since the new attainment year is now 2017.

In order for a control measure to "advance attainment," it would need to be implemented prior to the beginning of ozone season in the attainment year, so suggested control measures that could not be implemented by March 1, 2017 could not be considered RACM because the measures would not advance attainment. To "advance the attainment date by at least one year" to July 20, 2017, suggested control measures would have to be fully implemented by March 1, 2016. In order to provide a reasonable amount of time to fully implement a control measure, the following must be considered: availability and acquisition of materials; the permitting process; installation time; and the time and resources necessary for implementation of testing and monitoring to demonstrate compliance.

The TCEQ also considered whether the control measure was similar or identical to control measures already in place in the DFW nonattainment area. If the suggested control measure would not provide substantive and quantifiable benefit over the existing control measure, then the suggested control measure was not considered RACM because reasonable controls were already in place. Tables G-1: *DFW Area Stationary Source RACM Analysis* and G-2: *DFW Area On-Road and Non-Road Mobile Source RACM Analysis* of Appendix G: *RACM Analysis* presents the final list of potential control measures as well as the RACM determination for each measure.

4.6.2 Results of the RACM Analysis

Based on the RACM analysis, the TCEQ determined that no potential control measures met the criteria to be considered RACM. All potential control measures evaluated for stationary sources were determined to not be RACM due to technological or economic feasibility, enforceability, adverse impacts, or ability of the measure to advance attainment of the NAAQS. In general, the inability to advance attainment is the primary determining factor in the RACM analyses. As discussed in Chapter 3: *Photochemical Modeling* and Chapter 5: *Weight of Evidence* of this 2017 DFW AD SIP revision, the current modeling results in conjunction with the weight of evidence analysis indicate that the DFW area will demonstrate attainment. Modeling results based on the April 2007 EPA modeling guidance project the future ozone design value to be 77 parts per billion (ppb). Use of the newer EPA draft guidance projects this 2018 future ozone design value to be 76 ppb. These 2018 design values and the weight of evidence analysis included in Chapter 5 of this 2017 DFW AD SIP revision demonstrate attainment of the 2008 eight-hour ozone NAAQS. Based on a July 20, 2018 attainment deadline, a control measure would have to be in place by March 1, 2017 (prior to the beginning of ozone season in the attainment year) to be considered RACM. Furthermore, a control measure would have to be in place by March 1, 2016 in order for the measure to advance the attainment date by one year; to July 20, 2017; and it is not possible for the TCEQ to reasonably implement any control measures that would provide for earlier attainment of the NAAQS. Specifically, there is not adequate time to adopt additional rule requirements and have these rules go into effect or for sources to acquire, install, permit, and/or begin operation prior to this date. Negative RACM determinations for potential control measures that were based on technological or economic feasibility, enforceability, or adverse impacts remain relevant, regardless of attainment year.

4.7 MVEB

The MVEB refers to the maximum allowable emissions from on-road mobile sources for each applicable criteria pollutant or precursor as defined in the SIP. The budget must be used in transportation conformity analyses. Areas must demonstrate that the estimated emissions from transportation plans, programs, and projects do not exceed the MVEB. The attainment budget represents the summer weekday on-road mobile source emissions that have been modeled for the AD, and includes all of the on-road control measures reflected in Chapter 4: *Control Strategies and Required Elements* of the demonstration. The on-road emission inventory establishing this MVEB was developed with the 2014 version of the Motor Vehicle Emission Simulator (MOVES2014) model, and is shown in Table 4-2: *2017 Attainment Demonstration MVEB for the 10-County DFW Area*. For additional detail, refer to Chapter 3 of Appendix B*: Emissions Modeling for the DFW Attainment Demonstration SIP Revision for the 2008 Eight-Hour Ozone Standard.*

Table 4-2: 2017 Attainment Demonstration MVEB for the 10-County DFW Area

10-County DFW Area On-Road Emissions Inventory Description	NO_X tons per day (tpd)	VOC (tpd)
2017 On-Road MVEB Based on MOVES2014	130.77	64.91

4.8 MONITORING NETWORK

The TCEQ operates a variety of monitors in support of assessing ambient air quality throughout the state of Texas. These monitors meet the requirements for several federally required networks including the State or Local Air Monitoring Stations network (SLAMS), Photochemical Assessment Monitoring Stations network, Chemical Speciation Network, National Air Toxics Trends Stations network, and National Core Multipollutant Monitoring Stations network.

The Texas annual monitoring network plan provides information on ambient air monitors established to meet federal ambient monitoring requirements including comparison to the NAAQS. Under 40 CFR §58.10, all states are required to submit an annual monitoring network plan to the EPA by July 1 of each year. The annual monitoring network plan is made available for public inspection for at least 30 days prior to submission to the EPA. The plan and any comments received during the 30 day inspection period are forwarded to the EPA for final review and approval. The TCEQ's 2015 plan presented the current Texas network, as well as proposed changes to the network from July 1, 2015, through December 31, 2016. The plan was posted for public comment from May 15, 2015, through June 14, 2015, and was submitted to the EPA on July 1, 2015.

The current DFW area monitoring network in 2015 includes 20 regulatory ozone monitors. There are 17 ozone monitors located in Collin, Dallas, Denton, Ellis, Johnson, Kaufman, Parker, Rockwall, and Tarrant Counties and an additional three ozone monitors in Navarro, Hood, and Hunt Counties. The TCEQ ensures compliance with monitoring siting criteria and data quality requirements for these and all other federally required monitors in accordance with 40 CFR Part 58. The TCEQ utilizes this data to support determinations regarding air quality in the DFW nonattainment area.

4.9 CONTINGENCY PLAN (NO CHANGE)

4.10 REFERENCES

EPA, 1993. NO_X Substitution Guidance (https://www3.epa.gov/ttn/oarpg/t1/memoranda/noxsubst.pdf)

EPA, 2005. Clean-Fuel Vehicle Standards, no. CCD-05-1

CHAPTER 5: WEIGHT OF EVIDENCE

5.1 INTRODUCTION

The corroborative analyses presented in this chapter demonstrate the progress that the Dallas-Fort Worth (DFW) nonattainment area is making towards attainment of the 2008 eight-hour ozone National Ambient Air Quality Standard (NAAQS) of 75 parts per billion (ppb). This corroborative information supplements the photochemical modeling analysis presented in Chapter 3: *Photochemical Modeling* to support a conclusion that the DFW nonattainment area will reach attainment of the 2008 eight-hour ozone standard by July 20, 2018. The United States Environmental Protection Agency's (EPA) *Guidance on the Use of Models and Other Analyses for Demonstrating Attainment of Air Quality Goals for Ozone, $PM_{2.5}$, and Regional Haze* (EPA, 2007) states that all modeled attainment demonstrations (AD) should include supplemental evidence that the conclusions derived from the basic attainment modeling are supported by other independent sources of information. This chapter details the supplemental evidence, i.e., the corroborative analyses, for this AD.

This chapter describes analyses that corroborate the conclusions of Chapter 3. First, information regarding trends in ambient concentrations of ozone, ozone precursors, and reported emissions in the DFW nonattainment area is presented. Analyses of ambient data and reported emissions trends corroborate the modeling analyses and independently support the AD. An overview is provided of background ozone levels transported into the DFW nonattainment area. More detail on these ozone and emission trends is provided in Appendix D: *Conceptual Model for the DFW Attainment Demonstration SIP Revision for the 2008 Eight-Hour Ozone Standard*. Second, this chapter also discusses the results of additional air quality studies and their relevance to the DFW AD. Third, this chapter describes air quality control measures that are not quantified but are nonetheless expected to yield tangible air quality benefits, even though they were not included in the AD modeling discussed in Chapter 3. Finally, information is provided to inform the public regarding on-going initiatives that are expected to improve the scientific understanding of ozone formation in the DFW nonattainment area.

5.2 ANALYSIS OF AMBIENT TRENDS AND EMISSION TRENDS

When development work on this 2017 DFW AD state implementation plan (SIP) revision commenced in 2012, the EPA's April 2007 *Guidance on the Use of Models and Other Analyses for Demonstrating Attainment of Air Quality Goals for Ozone, $PM_{2.5}$, and Regional Haze* (http://www3.epa.gov/ttn/scram/guidance/guide/final-03-pm-rh-guidance.pdf) (EPA, 2007) was the latest modeling guidance available. The EPA released an update to this guidance in December 2014 entitled *Draft Modeling Guidance for Demonstrating Attainment of Air Quality Goals for Ozone, $PM_{2.5}$, and Regional Haze* (http://www3.epa.gov/ttn/scram/guidance/guide/Draft_O3-PM-RH_Modeling_Guidance-2014.pdf) (EPA, 2014). The April 2007 document will be referred to as either the "2007 guidance" or "2007 modeling guidance," and the December 2014 one will be referred to as the "draft guidance" or "draft modeling guidance." Section 7.0: *How Can Additional Analyses Be Used to Support the Attainment Demonstration?* of the 2007 guidance states that a simple way to qualitatively assess progress toward attainment is to examine recently observed air quality and emissions trends. Downward trends in observed air quality and in emissions (past and projected) are consistent with progress toward attainment. The strength of evidence produced by emissions and air quality trends is increased if an extensive monitoring network exists, which is the case in an area like DFW that currently has 20 operational monitors for ozone, 15 for nitrogen oxides (NO_X), and 15 automated gas chromatographs (Auto-GC) for volatile organic compounds (VOC). More detail on these specific locations and pollutants measured per monitor can be found on the Texas Commission on Environmental Quality (TCEQ) Air Monitoring Sites

Web page. (https://www.tceq.texas.gov/airquality/monops/sites/mon_sites.html). This section examines the emissions and ambient trends from the extensive ozone and ozone precursor monitoring network in the DFW area. Despite a continuous increase in the population of the 10-county DFW nonattainment area, a strong economic development pattern, and growth in vehicle miles traveled (VMT), the observed emission trends are downward for ozone and its precursors of NO_X and VOC. More details regarding ambient and emissions trends are included in Appendix D.

Appendix D provides an extensive set of graphics that detail ozone trends in the region from 1991 through 2014. The graphics and analyses also illustrate the wealth of monitoring data examined including regulatory ozone monitors and a network of Auto-GCs. The one-hour and the eight-hour ozone design values both have overall sustained decreasing trends over the past 18 years. The DFW area has monitored attainment of the revoked one-hour ozone standard since 2006. At the end of the 2014 ozone season, the eight-hour design value was 81 ppb, which is in attainment of the 1997 eight-hour ozone standard of 84 ppb. No monitor in the region had measured a fourth high in 2014 above the 1997 standard of 84 ppb, and only two had fourth highs in 2014 above the 2008 ozone standard of 75 ppb. These 2014 fourth high values of 77 ppb and 79 ppb were measured at the Denton Airport South and Fort Worth Northwest monitors, respectively. As of 2015, the Denton Airport South monitor has a design value of 83 ppb.

An analysis conducted by the TCEQ (https://www.tceq.texas.gov/assets/public/implementation/air/am/committees/pmt_dfw/20131105/20131105-DFW-Ozone-75ppb-Kite.pdf) and presented at a DFW area air quality technical meeting in November 2013 graphically shows changes in design value by monitor over the period 2003 through 2013 with the largest reduction of design values at the northwestern area monitors that historically have recorded the highest ozone levels. For example, the Keller monitor design value dropped 15 ppb in that period and Grapevine Fairway dropped 14 ppb. Additional analyses tracked the historic fourth highest eight-hour ozone levels at five northwest DFW monitors from 2001 to 2013. When 2012 and 2013 are examined, there is a strong suggestion that the 2011 fourth highest levels monitored may be outliers in the downward trend. These 2011 fourth-high values are included in the DFW nonattainment area design value calculations from 2011 through 2013, but are not part of the 2014 and 2015 design value determinations. The ozone measurements through 2015 combined with the overall historic ozone trends at all DFW area monitors suggest that the region will reach attainment of the 2008 standard by July 20, 2018.

As documented in Chapter 2: *Anthropogenic Emissions Inventory Description* of this 2017 DFW AD SIP revision, emissions trends examined through reported and developed inventories support the downward trends in ozone and ozone precursors observed through the measurements of pollutant concentrations at monitors. While NO_X emissions are more significant in the formation of ozone in the DFW nonattainment area, VOC trends are examined as well. On-road mobile sources are the single largest contributors to NO_X emissions in the DFW nonattainment area. According to the TCEQ emissions inventory (EI) estimates for 2011, on-road mobile represents 54% of the total NO_X for the DFW nonattainment area, non-road and off-road mobile accounts for 26.3%, area sources account for 10.3%, and point sources account for 9.1%. The downward trend in total NO_X emissions is in large part due to the downward trends in NO_X emissions from on-road mobile sources. Even though human population and VMT in the DFW nonattainment area have both increased roughly 38% from 1999 to 2014, NO_X emission trends from on-road mobile sources as well as total NO_X emissions have decreased since 1999, due largely due to targeted emissions reductions strategies implemented by state rules, federal measures, and local initiatives. Mobile strategies are listed with all existing DFW emission reduction strategies in Table 4-1: *Existing Ozone Control and Voluntary Measures Applicable to the DFW Nine-County Nonattainment Area* of this 2017 DFW AD SIP revision. NO_X emissions from point sources, over which the TCEQ does have more direct regulatory control compared with mobile sources, have shown decreases of 62% over the past 16 years. Ambient NO_X monitoring data corroborate these trends in reported emissions, with decreases in ambient NO_X monitoring concentrations observed in the DFW nonattainment area over the past 17 years.

Since the mid-1990s, the TCEQ has collected 40-minute measurements on an hourly basis of up to 58 VOC compounds using Auto-GC instruments. These instruments automatically measure and report chemical compounds resident in ambient air. The TCEQ has also employed two types of ambient monitoring canisters in the DFW nonattainment area, one that samples ambient air over a 24-hour period and another that samples ambient air for a single hour at a time, usually at four different times of day. Since 1999, peak VOC concentrations above the 90th percentile have generally trended downward. During the same time period, mean VOC concentrations trended downward until roughly 2005 and have been relatively constant since 2006. On-road VOC emission trends discussed later in this chapter show a more distinct downward trend for 1999-2005 than for 2006-and-later years. Ozone formation in DFW is much more sensitive to anthropogenic NO_X than to anthropogenic VOC. This is due to the primarily NO_X-limited character of ozone formation in DFW, coupled with an abundance of naturally occurring reactive VOC from biogenic sources, such as isoprene emitted by oak trees. Much of the anthropogenic VOC emitted in the DFW nonattainment area is in the form of compounds with relatively low reactivity such as ethane and propane. Appendix D provides more detail on these VOC trend analyses and their impacts on ozone formation in DFW.

The Anthropogenic Precursor Culpability Assessment and Ozone Source Apportionment Technology (OSAT) analyses detailed in Chapter 3 and Appendix C: *Photochemical Modeling for the DFW Attainment Demonstration SIP Revision for the 2008 Eight-Hour Ozone Standard* indicate that emission sources outside of the 10-county DFW nonattainment area also contribute to the eight-hour ozone concentrations within the 10-county DFW nonattainment area. On average, the ozone produced outside of the DFW nonattainment area, in addition to the natural background ozone, accounts for a large portion of the maximum ozone concentrations within the DFW nonattainment area. Analyses (Berlin et al., 2013; Cooper et al., 2012) suggest that background ozone is trending downward across the United States (U.S.), which can reduce peak ozone in the DFW nonattainment area. The EPA Air Quality Trends Web page (http://www.epa.gov/airtrends/aqtrends.html) highlights the significant percent changes in NO_X reductions between 2000 and 2013. Some of these NO_X reductions can be attributed to strategies implemented in Texas. For example, electric generating units (EGU) in the counties east of the DFW nonattainment area, which is the area that is predominately upwind on high ozone days, have reduced emissions of NO_X by about 58% over the past 16 years.

As part of the examination of emissions trends, it is also important to examine the variability of NO_X concentrations by the day of the week. As discussed in Chapter 3, NO_X concentrations are lower on Saturdays and Sundays compared to weekdays. The lower concentrations of ozone precursors on weekends are likely due to the absence of morning commuter traffic during that time. This finding further supports the conclusion that lowering NO_X reduces ozone since NO_X is the primary precursor in ozone formation when naturally occurring reactive VOC from biogenic sources is abundant.

The VOC or NO_X limitation of an air mass is an important way to evaluate how immediate reductions in VOC and NO_X concentrations affect ozone concentrations. A detailed analysis of the DFW nonattainment area's NO_X or VOC limitation is included in Appendix D. Ozone responds best to VOC reductions in VOC-limited areas and to NO_X reductions in NO_X-limited areas. In transitional areas, both VOC and NO_X reductions should be effective. Analysis of VOC to NO_X ratios indicates that the urban core of the DFW nonattainment area is transitional and trending towards NO_X-limitation, while the more rural parts of the DFW nonattainment area are NO_X-limited and are trending towards more strongly NO_X-limited. Because the DFW nonattainment area overall is trending towards NO_X-limited and the northwest locations of the design value setting monitors are NO_X-limited, this result also supports reducing NO_X as a method to control ozone overall in the DFW nonattainment area.

It is more difficult to control ozone in the urban core because the emissions in that area, which is transitional and not strongly NO_X-limited, are primarily from on-road mobile sources, for which the TCEQ has limited authority to regulate. However, both state and federal regulation have resulted in estimated downward trends in NO_X emission and VOC emissions since 1999 from on-road and non-road mobile emission inventories. These reductions have contributed to the downward trend in ozone levels monitored within the urban core during the same 15 year period. More detail regarding emissions trends can be found in Chapter 3 as well as in Section 5.2.2.1: *NO_X Emission Trends* of this chapter. The ambient ozone and emissions trends briefly discussed above lead to the following conclusions:

- Emissions of NO_X, VOC, and their monitored ambient concentrations have been decreasing across the DFW nonattainment area, despite a rapidly expanding population and strong continued economic development over a sustained period as documented by the Federal Reserve Bank of Dallas Economic Indicators (http://www.dallasfed.org/research/update/dfw/index.cfm).
- Observed NO_X concentrations and reported NO_X emissions are both trending downward, which suggests lower ozone concentrations should follow in an area that is primarily NO_X-limited.
- The decrease in NO_X emissions is largely due to reductions of on-road and non-road mobile sources, which are the largest source of NO_X in the DFW nonattainment area. The reductions can be attributed to an increasingly modern and cleaner motor vehicle fleet, as well as implementation of on-road control programs such as inspection and maintenance, Texas Emission Reduction Plan (TERP), and Texas Low Emission Diesel. In addition, controls on point sources both in the DFW nonattainment area and statewide continue to contribute to these NO_X reductions.
- Modeled emissions from on-road and non-road mobile sources as well as trend analyses indicate that NO_X concentrations will continue trending downward out to the modeled attainment year of 2017 and beyond.
- The one-hour ozone design value has decreased from 140 ppb when the 1990 Clean Air Act Amendments were signed to 102 ppb in 2015. The eight-hour ozone design value decreased from 100 ppb in 2003 to 83 ppb in 2015.
- Given the currently implemented control programs, total DFW nonattainment area NO_X in 2017 is expected to be reduced by roughly 49% from 2006 levels, with projected NO_X reductions of 54% for both on-road sources and non-road sources. More detail is contained in Chapter 3 on these expected reductions from 2006 through 2017.

Accordingly, the strong and lasting historic downward trends in observed air quality and in emissions (past and projected) are consistent with progress toward attainment and are positive evidence supporting the results of the photochemical modeling documented in Chapter 3, indicating that the DFW nonattainment area will attain the 2008 ozone NAAQS by July 20, 2018.

5.2.1 Ozone Design Value and Background Ozone Trends

As noted above, eight-hour ozone design values have decreased over the past 18 years, as shown in Figure 5-1: *One-Hour and Eight-Hour Ozone Design Values in the DFW Area from 1997 through 2014*. The 2015 one-hour ozone design value is 102 ppb, which demonstrates continued attainment of the revoked one-hour ozone NAAQS, at levels substantially below the one-hour ozone standard. The 2015 eight-hour ozone design value for the DFW nonattainment area is 83 ppb at Denton Airport South, which is in attainment of the former 84 ppb standard and demonstrates progress toward the current 75 ppb standard. This monitor is located to the north-northwest of the DFW nonattainment area, which is downwind of the urban core considering prevailing winds.

The trend line for the one-hour ozone design value shows a decrease of about 2.1 ppb per year, but the trend line for the eight-hour ozone design value only shows a decrease of about 1.1 ppb per year. The one-hour ozone design values decreased about 27% from 1991 through 2015 and the eight-hour ozone design values decreased about 21% over that same time. The slower change in the eight-hour ozone design values compared to the one-hour ozone design values could relate to the background ozone, which appears to affect the eight-hour ozone much more than the one-hour ozone.

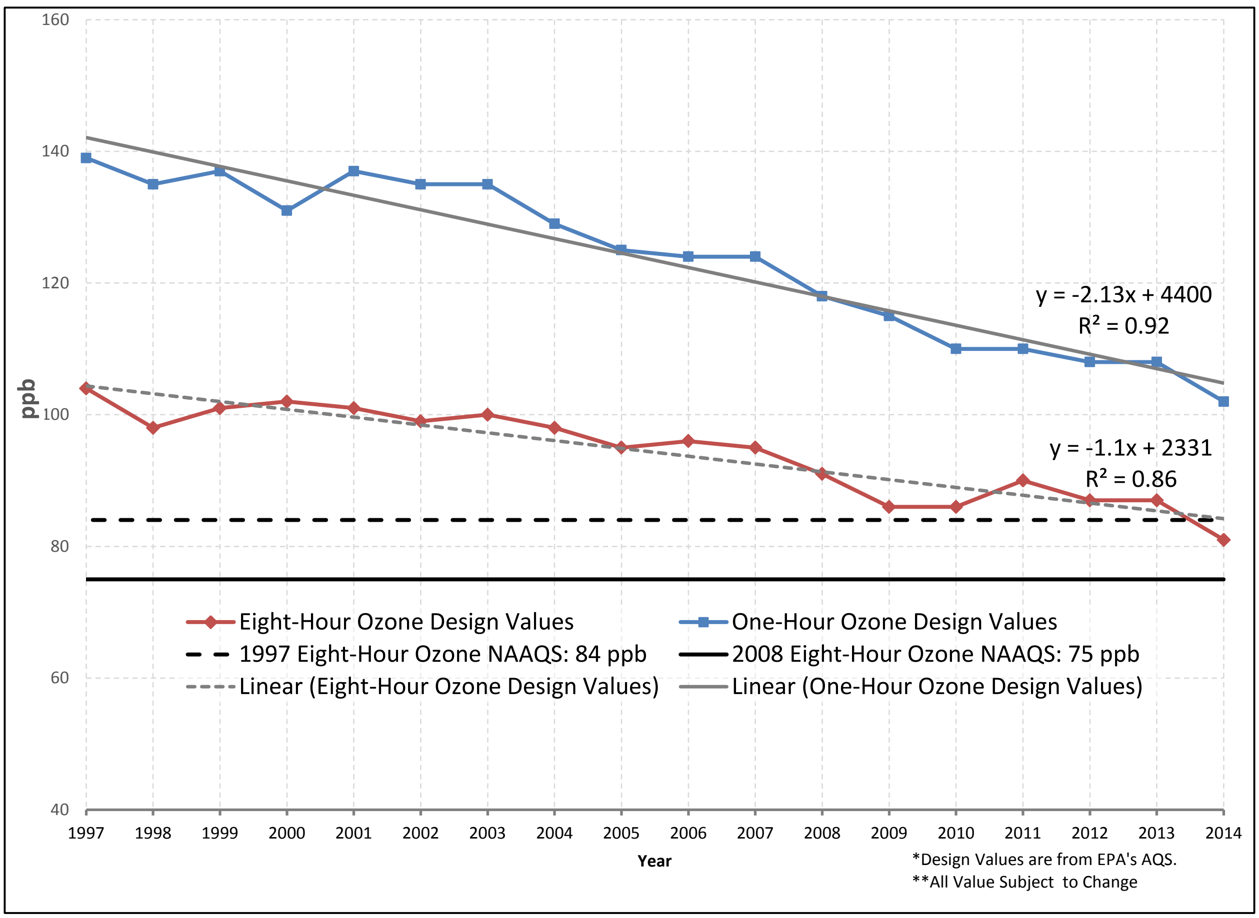


Figure 5-1: One-Hour and Eight-Hour Ozone Design Values in the DFW Area from 1997 through 2014

A background ozone trend analysis was conducted to define background ozone and the ozone concentration carried into the DFW nonattainment area. Background ozone reflects the ozone produced from all sources outside of the 10-county DFW nonattainment area. Continental and natural background ozone concentrations are generally assumed to be about 40 ppb. Ozone levels in the DFW nonattainment area are the sum of the background ozone entering the area and the locally produced ozone. The local ozone contribution is found by subtracting the background ozone concentration from the maximum ozone concentration.

To obtain the background ozone concentrations, monitors outside of the urban core were identified. Out of this subset of background ozone monitors, the minimum ozone concentration was identified during the time that the maximum ozone concentration was measured. This minimum eight-hour ozone concentration is considered the background ozone for the DFW nonattainment area. Figure 5-2: *Eight-Hour Ozone in the DFW area from 1997 through 2014* shows that in the DFW nonattainment area, the average background ozone contribution is a larger part of the maximum eight-hour ozone than the local ozone contribution. The inter-seasonal variability in the peak ozone concentrations seems to come from the seasonal variability in the background ozone concentrations as opposed to the local ozone contributions. Because background ozone contributes a large portion of the total eight-hour ozone in the DFW nonattainment area, it would be difficult to see large decreases in the eight-hour ozone concentration if the background ozone does not also decrease.

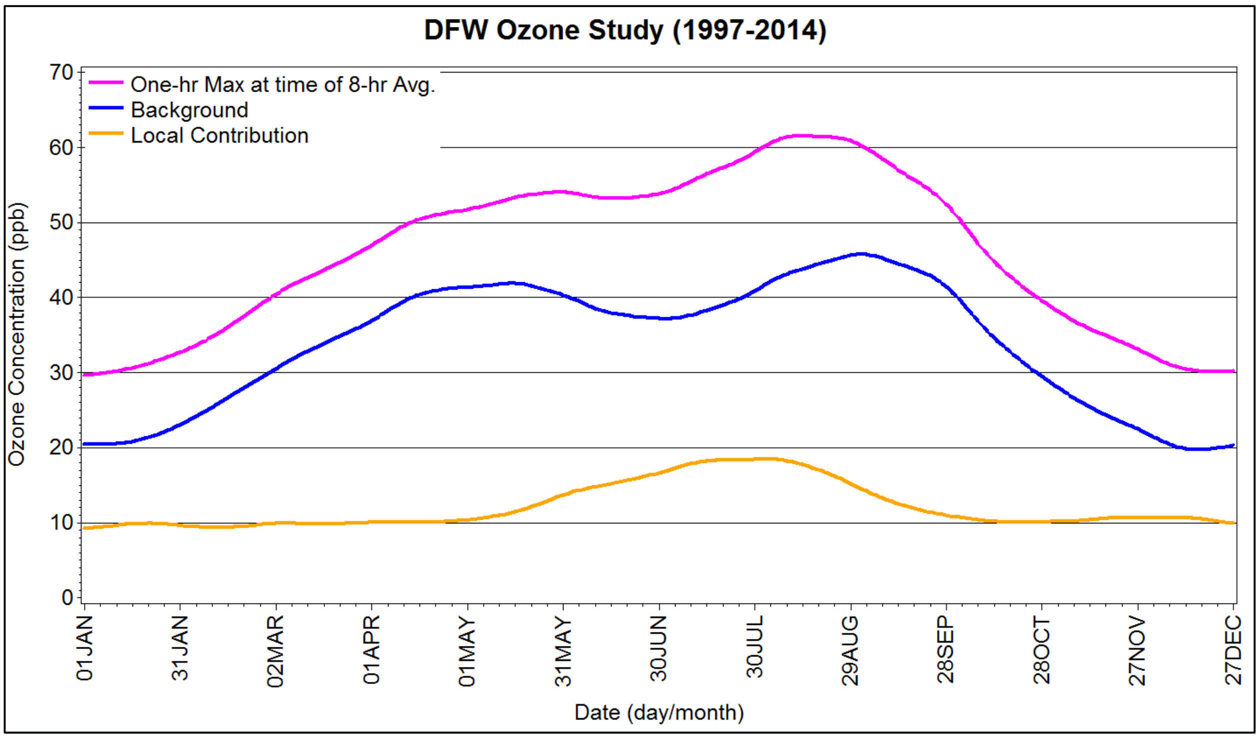


Figure 5-2: Eight-Hour Ozone in the DFW Area from 1997 through 2014

Using a similar method, the TCEQ conducted an analysis to determine the background trend in eight-hour ozone for the period from 1997 through 2014. Results from this analysis are shown in Figure 5-3: *DFW Background Ozone for 1997 through 2014*. The findings show that there is a slight downward trend in the background ozone. The percent change in average background ozone from the 1997 to 2014 ozone seasons is 4.51%, and the percent change in the 95th percentile average ozone concentrations is 5.67% over that same time. The current estimated average background ozone in the DFW nonattainment area is 52 ppb, but can vary greatly depending on the day of interest. Evidence of background eight-hour ozone in the DFW nonattainment area is another positive factor indicating support for the photochemical modeling results documented in Chapter 3.

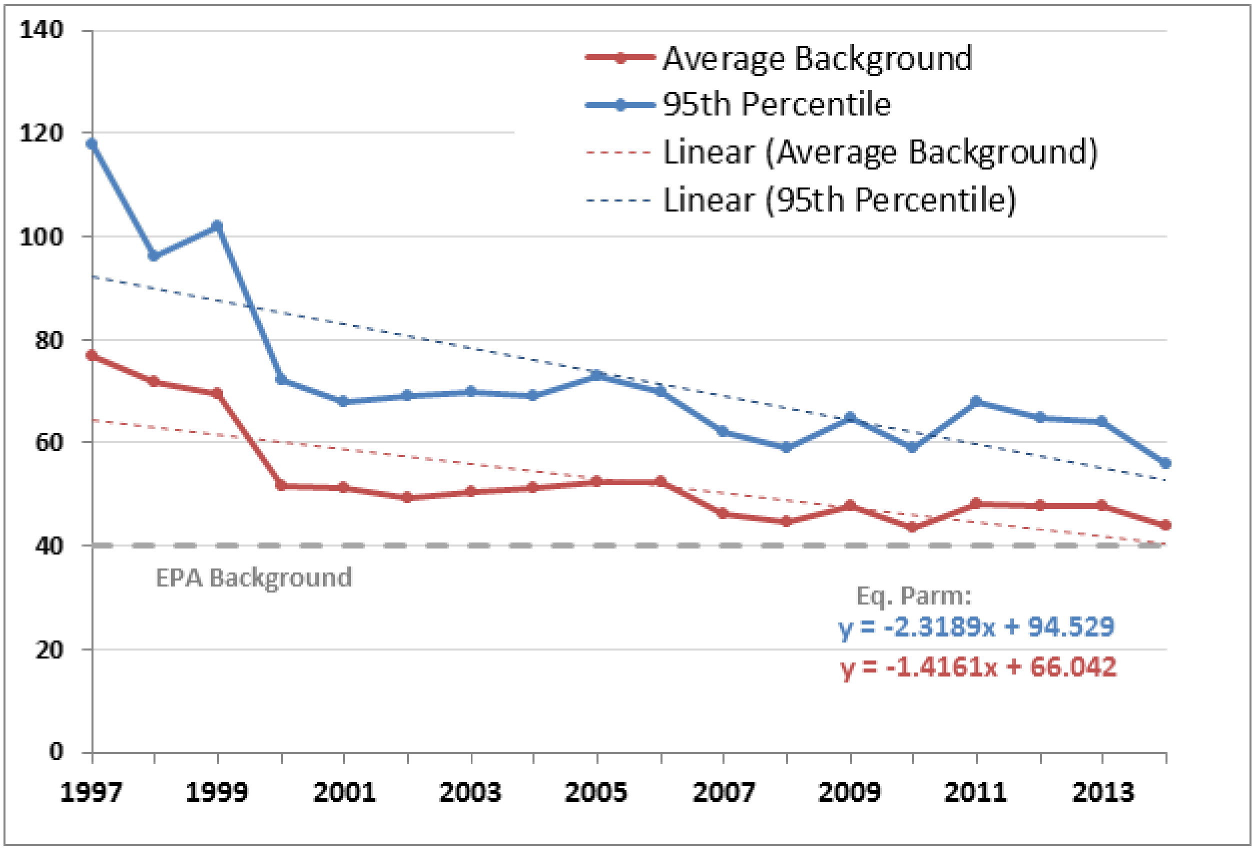


Figure 5-3: DFW Background Ozone for 1997 through 2014

5.2.2 NO_X Trends

NO_X, a precursor to ozone formation, is a mixture of nitrogen oxide and nitrogen dioxide (NO_2). NO_X is primarily emitted by fossil fuel combustion, lightning, biomass burning, and soil (Martin, et al., 2006). Examples of common NO_X emission sources in urban areas are automobiles, diesel engines, other small engines, residential water heaters, industrial heaters, flares, and industrial and commercial boilers. Mobile, residential, and commercial NO_X sources are usually numerous smaller sources distributed over a large geographic area, while industrial sources are usually large point sources, or numerous small sources, clustered in a small geographic area. Because of the large number of NO_X sources, elevated ambient NO_X concentrations can occur throughout the DFW nonattainment area. This section will discuss trends in both NO_X emissions and ambient NO_X concentrations. The overall downward trends in both NO_X emissions and ambient NO_X concentrations in the DFW nonattainment area are another positive factor indicating support for the photochemical modeling results documented in Chapter 3.

5.2.2.1 NO_X Emission Trends

DFW nonattainment area anthropogenic emissions are from the following four aggregate categories: point sources, on-road mobile sources, non-road mobile sources, and area sources. Specific industry types can be categorized under one or more of these aggregate groups. The data used in this trend analysis come from several sources. Companies in the DFW nonattainment area report annual point source EI data. The Texas Transportation Institute

(TTI) prepared the on-road mobile source emission inventories for the TCEQ. The TCEQ prepared the area and the non-road mobile source data for 2006 and 2017 using EPA-approved models and techniques.

The annually reported point source NO_X emissions from 1997 through 2012 are shown in Figure 5-4: *Reported Point Source NO_X Emissions for the 10-County DFW Area*. The emissions are reported in tons per year (tpy) and are aggregated by year. The aggregation is of all NO_X sources located within the 10 counties of the DFW nonattainment area. The graph shows an overall downward trend in NO_X emissions and the pattern closely matches that of the observed NO_X concentrations at the DFW nonattainment area monitors, which will be shown later in this document.

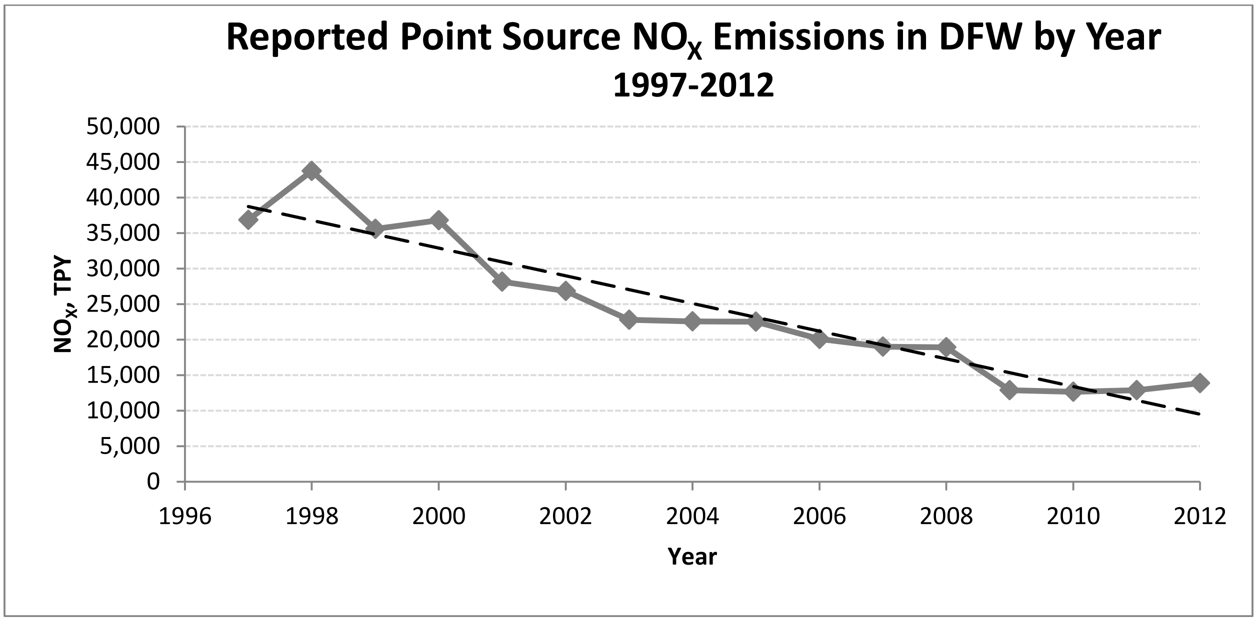


Figure 5-4: Reported Point Source NO_X Emissions for the 10-County DFW Area

Historically, much of the point source NO_X emission reductions have come from cement kilns located within Ellis County. In 2007, a source cap for cement kilns in Ellis County was adopted (30 Texas Administrative Code §117.3123). In 2008, 2010, and 2011, further reductions were achieved with changes in cement kiln operations and shutdown of certain processes and kilns. In large part, the downward trends in reported emissions are attributable to the reductions and facility shutdowns in Ellis County.

The decrease in point source NO_X emissions from 1997 through 2012 is seen more clearly in Figure 5-5: *Reported Point Source NO_X Emissions by DFW County*. Ellis County reports the greatest amounts of point source NO_X emissions as well as the greatest reductions in point source NO_X emissions. A large portion of these reductions took place from 2006 to 2009. Other large reductions in point source NO_X emissions can be seen in Dallas and Tarrant Counties due to the implementation of many of the point source rules summarized in Table 4-1. The remaining counties consistently report substantially lower point source NO_X emissions, with no appreciable trend over the 2006 to 2009 period. Since Wise County was designated nonattainment in 2012, some facilities have only recently started to report as point sources because they exceed the 25 NO_X tpy and/or 10 VOC tpy thresholds applicable to nonattainment counties. Newly reported NO_X sources in Wise County are reflected by a small increase in the point source NO_X emission totals for the 2011 and 2012 periods.

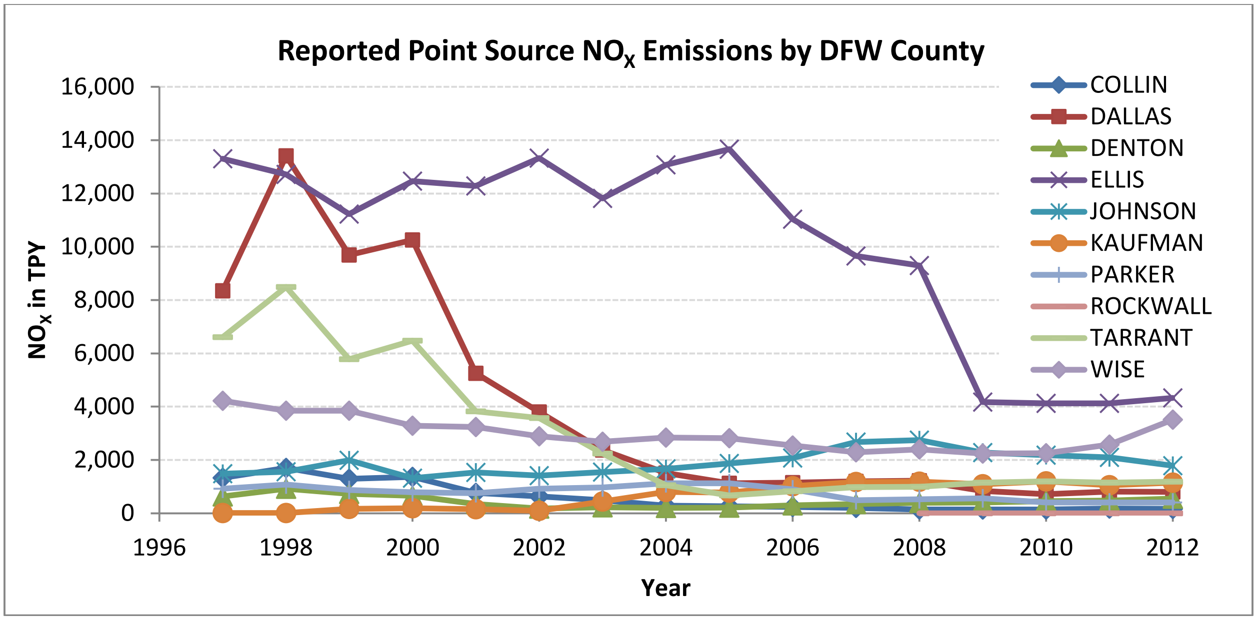


Figure 5-5: Reported Point Source NO_X Emissions by DFW County

Other point sources of NO_X are EGUs located within and outside of the DFW nonattainment area. NO_X emissions from EGUs are displayed in Figure 5-6: *Trends in EGU NO_X Emissions in the DFW 10-County Area* and show a downward trend due to the implementation of EGU rules described in Table 4-1. NO_X emissions from EGUs in the 10-county DFW nonattainment area have decreased by 88.9% from 1997 through 2012.

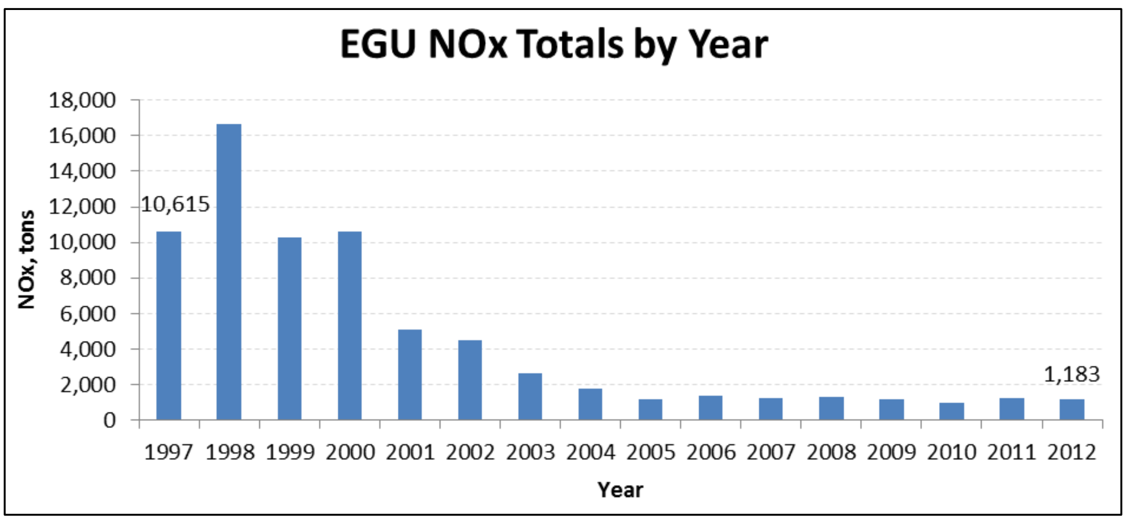


Figure 5-6: Trends in EGU NO_X Emissions in the DFW 10-County Area

On-road mobile sources are the biggest contributor to NO_X emissions in the DFW nonattainment area. With on-road mobile NO_X sources accounting for over half of the total NO_X emissions in the DFW nonattainment area, it is important to discuss the trends in NO_X emissions for this source category. TTI has estimated the emissions of NO_X, VOC, carbon monoxide, and VMT from 1999 through 2050 using the 2014 version of the EPA's Motor Vehicle Emission Simulator (MOVES2014) model. Figure 5-7: *MOVES2014 10-County DFW Area On-Road Emission Trends for 1999 through 2050* shows the results of this work from TTI. The estimates show that NO_X emissions have and will continue to decrease through to year 2037, though at different rates over time. These emission decreases occur even though VMT is projected to increase out to 2050 because cleaner newer vehicles will continuously replace higher-emitting older ones. The downward trend in NO_X emissions from on-road sources mirrors the trends in ambient NO_X concentrations observed at urban monitors, which will be discussed in the following section. If the downward trend in on-road NO_X emissions continues as projected, observed NO_X concentrations would be expected to decrease as well, thus reducing ozone-producing precursors in the DFW airshed.

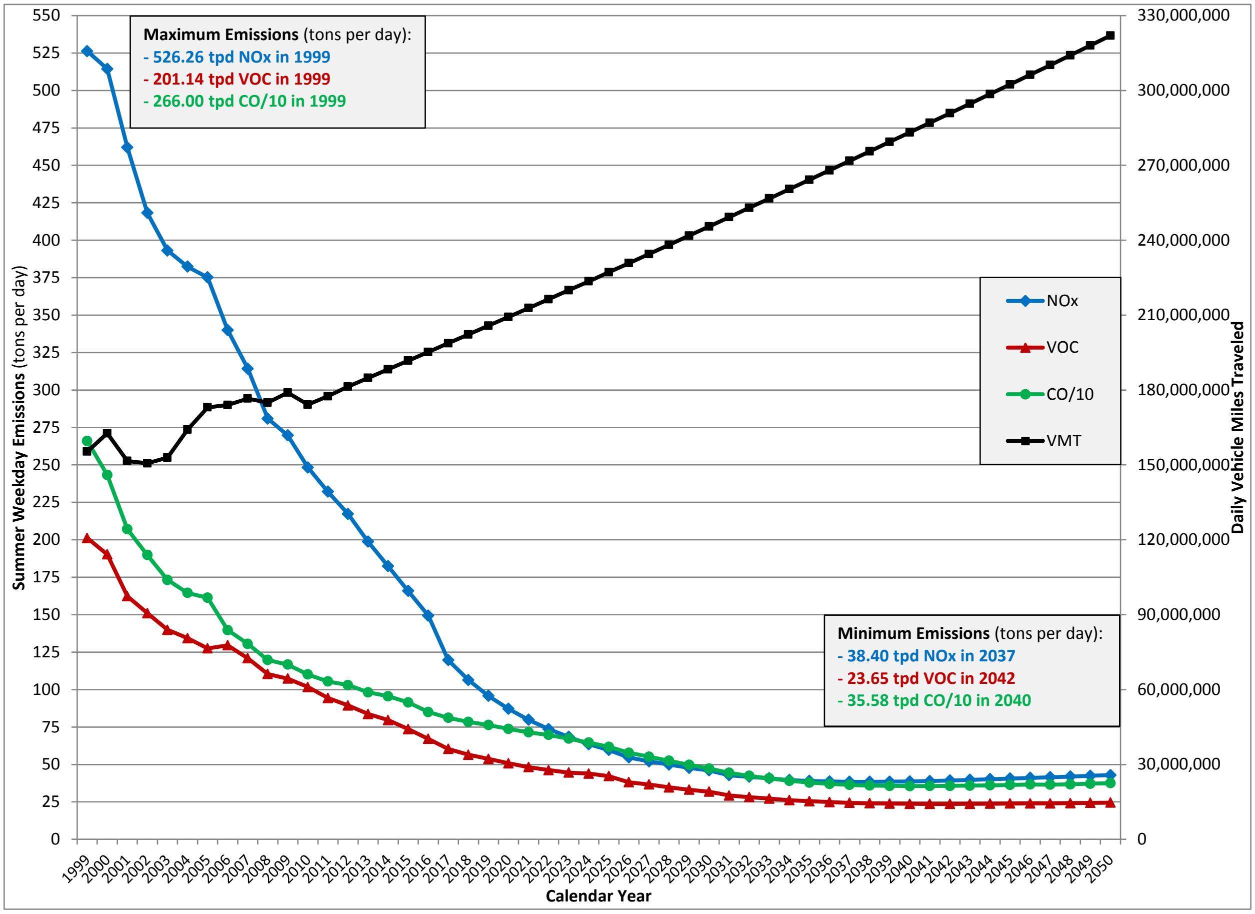


Figure 5-7: MOVES2014 10-County DFW Area On-Road Emission Trends for 1999 through 2050

Similar to on-road, the non-road source category contributes a significant amount to total NO_X emissions in the DFW nonattainment area. Emission projections of non-road NO_X emissions were estimated using the Texas NONROAD (TexN) model, and are shown in Figure 5-8: *TexN DFW Area Non-Road Emission Trends for 2000 through 2050*. The results show that NO_X emissions from non-road sources will decrease through year 2031, though at different rates over time. Since on-road and non-road NO_X sources account for the vast majority of NO_X emissions in the DFW nonattainment area, and since these two source categories are projected to have continuously lower emissions over the next several years, and because ozone production is dependent on NO_X emissions, it is expected that future ozone concentrations will also be reduced.

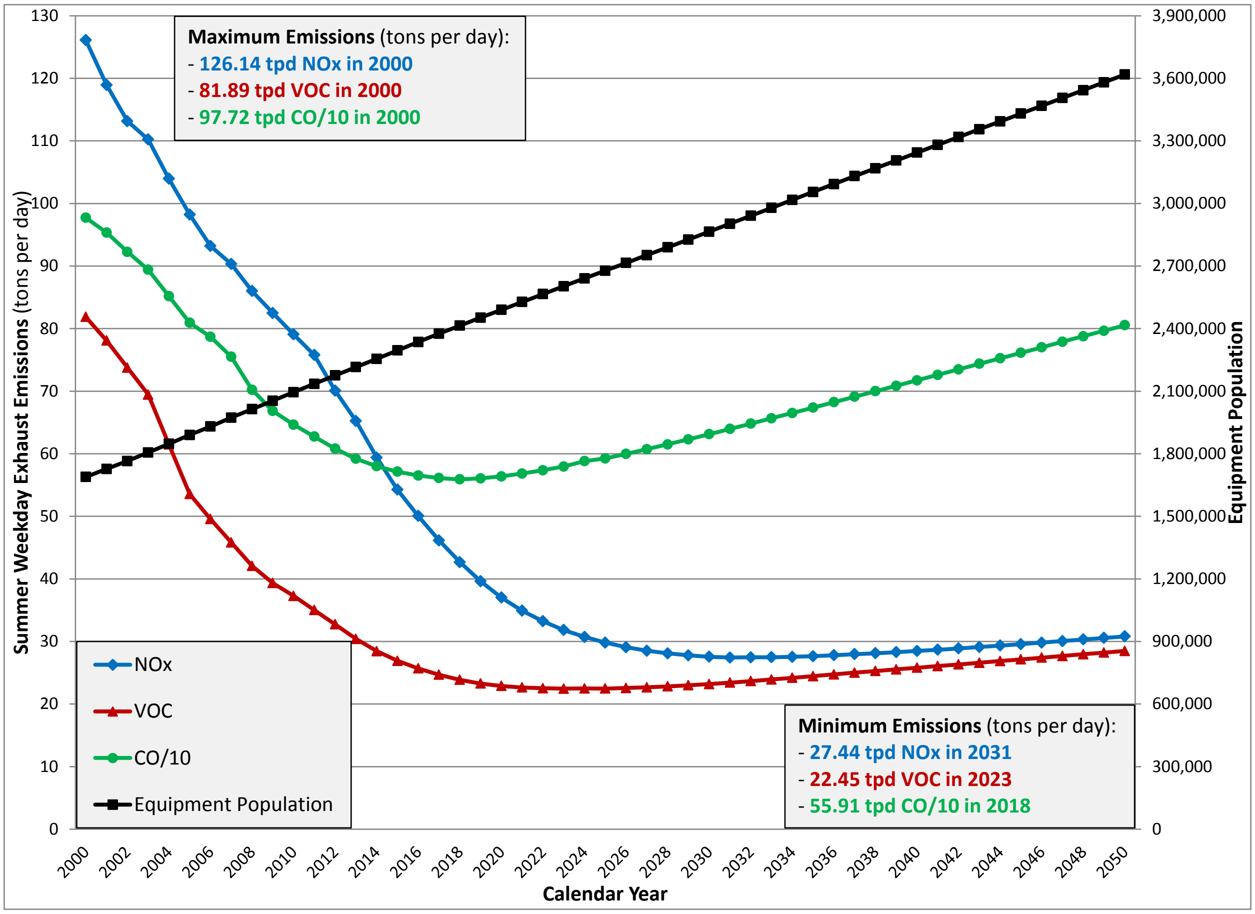


Figure 5-8: TexN DFW Area Non-Road Emission Trends for 2000 through 2050

5.2.2.2 Ambient NO_X Trends

Trends for ambient NO_X concentrations are presented in Figure 5-9: *Ozone Season (March through October) Daily Peak NO_X Trends in the DFW Area*. Trends are for the ozone season (March through October) and represent the 90th percentile, the 50th percentile, and the 10th percentile of daily peak NO_X concentrations in the DFW nonattainment area. The largest NO_X concentrations and the median NO_X concentrations in the DFW nonattainment area appear to be decreasing over time, while the 10th percentile concentrations have remained flat. A dotted line is provided to highlight the trend in ambient NO_X concentrations.

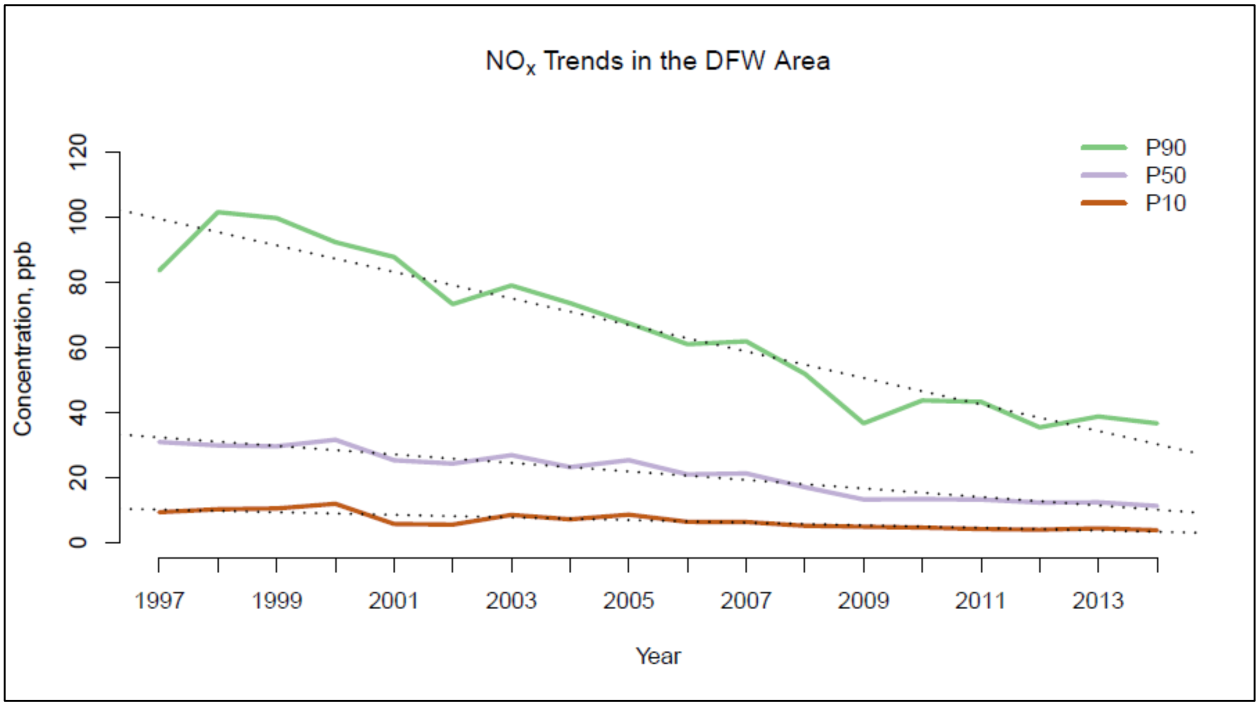


Figure 5-9: Ozone Season (March through October) Daily Peak NO_X Trends in the DFW Area

The NO_X trends in the DFW nonattainment area are more pronounced at urban monitors as seen in Figure 5-10: *90th Percentile Daily Peak NO_X Concentrations in the DFW Area*. The downward trends in ambient NO_X concentrations are observed at all monitors except at the Parker County monitor, for which the trend is flat. The Parker County monitor measures the lowest NO_X concentrations because it is located in a rural area 34 miles west of the Fort Worth area with very little on-road activity or nearby NO_X sources. All other monitors, however, demonstrate downward NO_X trends. The monitors with smaller downward trends do not record high NO_X concentrations, mostly because they are rural monitors with little on-road activity. The typical ozone design value setting monitors (Denton Airport South, Keller, and Grapevine Fairway) show downward trends in ambient NO_X concentrations. Because of the prevailing winds during ozone season, these monitors also observe transported NO_X from the DFW urban areas and benefit from lower transported NO_X emissions.

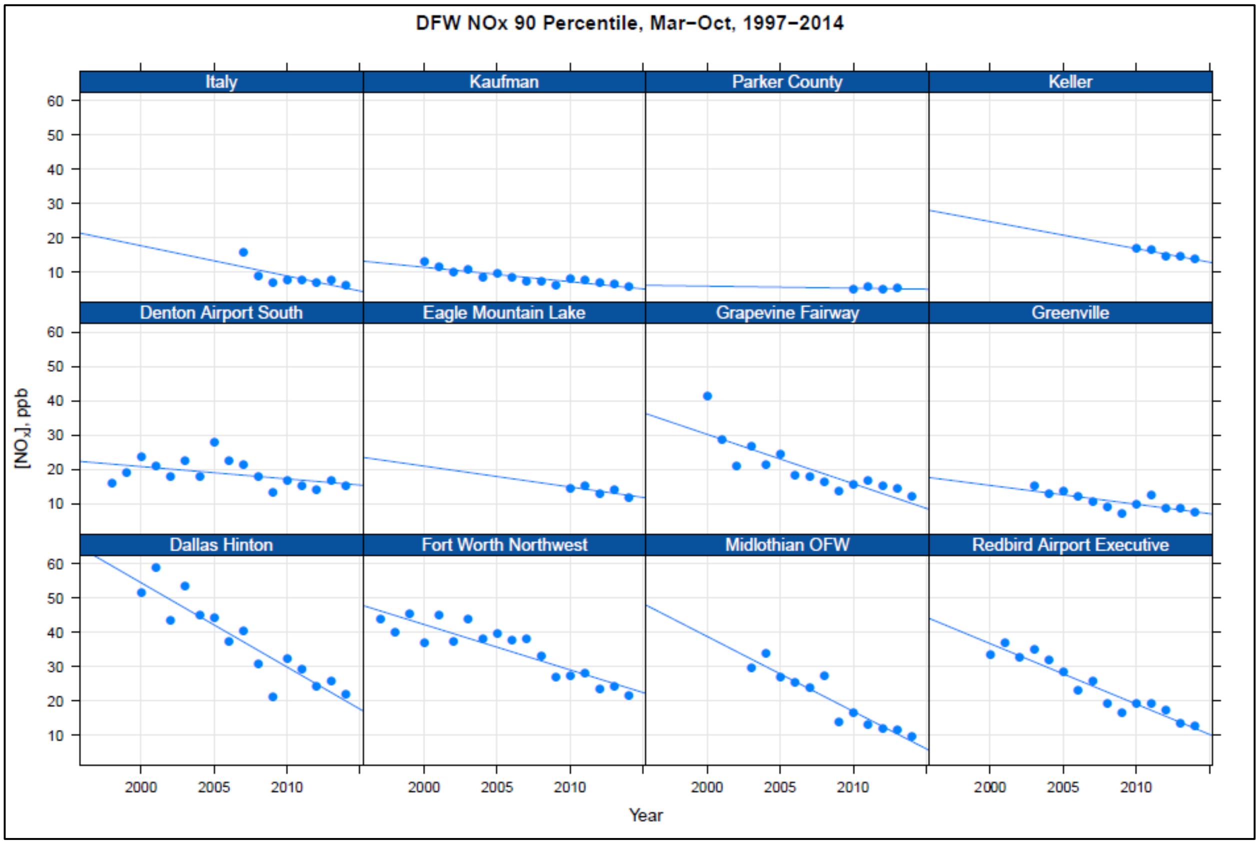


Figure 5-10: 90th Percentile Daily Peak NO_X Concentrations in the DFW Area

Ambient NO_X concentrations in the overall DFW nonattainment area are trending downward, especially in the DFW urban areas. This downward trend results from the state controls placed on point sources, along with the federal standards implemented for on-road vehicles and non-road equipment.

5.2.3 VOC and NO_X Limitations

The VOC and NO_X limitation of an air mass can help determine how immediate reductions in VOC and NO_X concentrations might affect ozone concentrations. A NO_X-limited region occurs where the radicals from VOC oxidation are abundant, and therefore the ozone formation is more sensitive to the amount of NO_X present in the atmosphere. In these regions, controlling NO_X would be more effective in reducing the ozone concentrations. In VOC-limited regions, NO_X is abundant, and therefore the ozone formation is more sensitive to the amount of radicals from VOC oxidation present in the atmosphere. In VOC-limited regions, controlling VOC emissions would be more effective in reducing the ozone concentrations. Areas where ozone formation is not strongly limited by either VOC or NO_X are considered transitional, and controlling either VOC or NO_X emissions would reduce ozone concentrations in these regions.

The annual median VOC to NO_X ratios at the Dallas Hinton Street, Eagle Mountain Lake, and Fort Worth Northwest Auto-GC monitors are shown in Figure 5-11: *Trend in VOC to NO_X ratios using AutoGC Data*. VOC to NO_X ratios at the three AutoGC monitors show that the DFW nonattainment area is becoming more NO_X-limited over time. The Dallas Hinton Street and Fort Worth Northwest monitors were VOC-limited, but have begun to trend towards NO_X-limited, and are currently showing transitional conditions. This result can be attributed to the lower ambient NO_X concentrations due to NO_X reductions taking place in the urban DFW nonattainment area.

The more rural Eagle Mountain Lake monitor is NO_X-limited and shows a trend towards even more NO_X-limited conditions. This monitor not only observes biogenic emissions and oil and gas emissions, but also observes emissions from the urban DFW nonattainment area because it is located downwind of the urban core. Because total VOC emissions at this monitor are not increasing, the increase in the VOC to NO_X ratio can be attributed to decreasing NO_X emissions from the urban DFW nonattainment area.

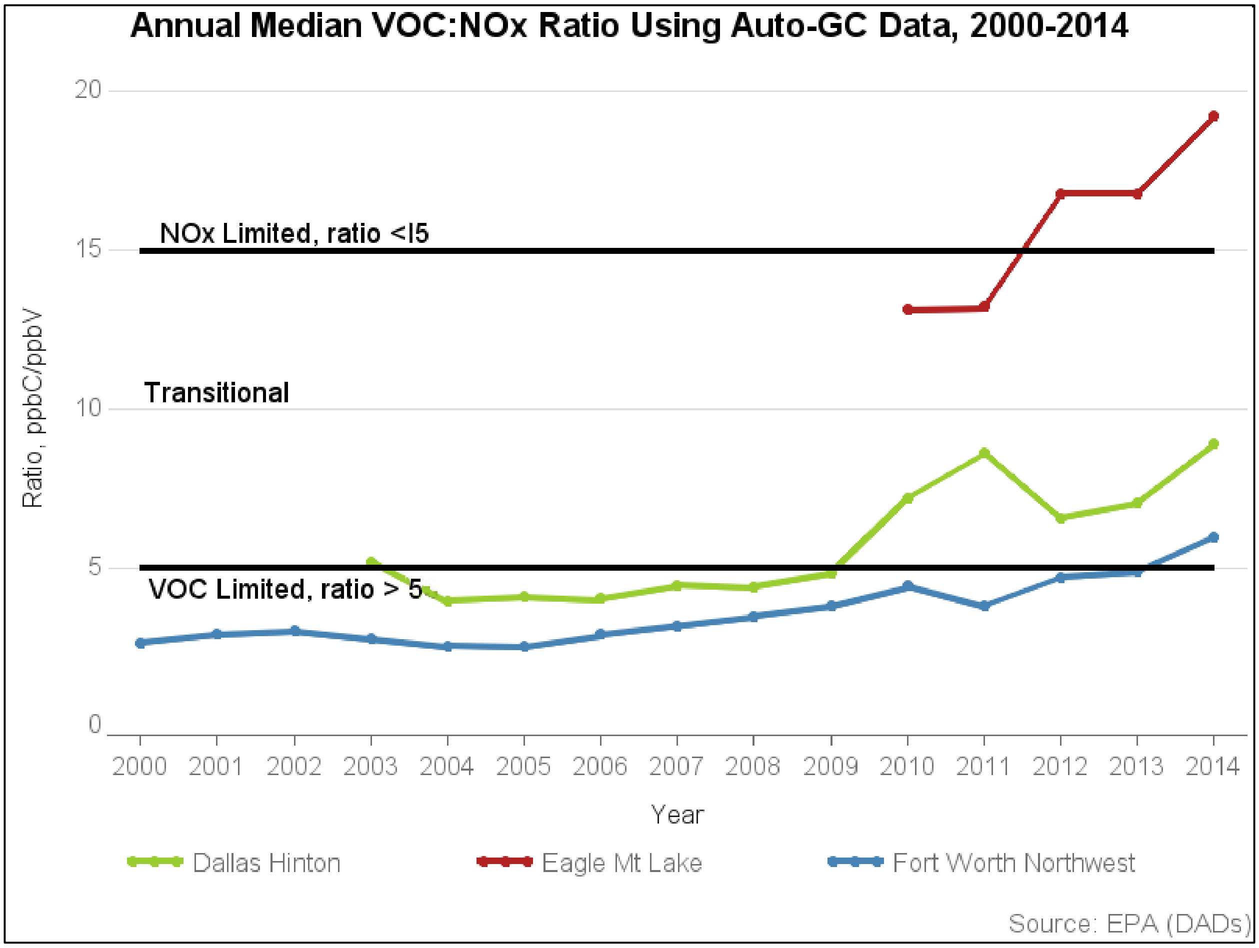


Figure 5-11: Trend in VOC to NO_X Ratios Using AutoGC Data

This evidence of continued NO_X-limitation in the DFW nonattainment area is another positive factor indicating support for the photochemical modeling results which also indicate the NO_X-limited nature of the DFW nonattainment area, as documented in Chapter 3.

5.2.4 Weekday/Weekend Effect

The trends in NO_X concentrations by day of the week show how local control strategies might affect the ozone concentrations. Examining the way ozone behaves on days with lower NO_X concentrations will help demonstrate how ozone might behave if there were overall reductions in NO_X. To investigate if there is a day of the week effect in the DFW nonattainment area, NO_X concentrations were calculated by the day of the week from 1997 through 2014. The NO_X data at Fort Worth Northwest are from 2003 and 2004 only.

Results displayed in Figure 5-12: *Day of Week NO_X Concentrations* show that at urban monitors, weekends observe lower NO_X than most weekdays. This implies that there is less NO_X generated on weekends, most likely due to less on-road activity as discussed in Chapter 3 and Appendix C. Since NO_X is a precursor to ozone formation, controlling NO_X should in turn reduce ozone concentrations.

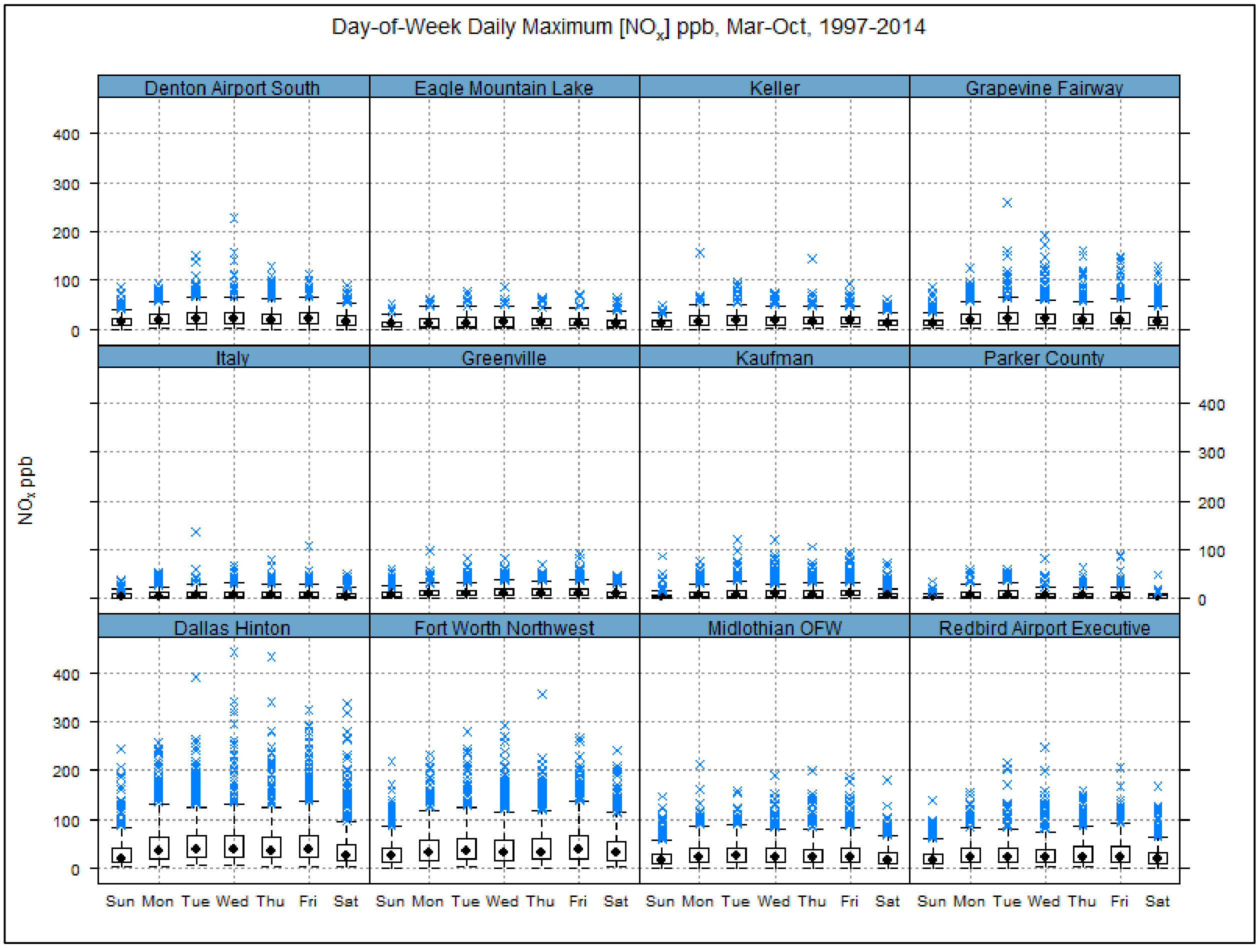


Figure 5-12: Day of Week NO_X Concentrations

Given that there is less NO_X generated on weekends, there accordingly should be fewer high ozone days on weekends. To determine the number of days with high eight-hour ozone on weekends, days with eight-hour ozone over 75 ppb were counted using all DFW area monitors.

Figure 5-13: *Weekday/Weekend Effect for Ozone in the DFW Area* shows that the total number of days with eight-hour ozone concentrations greater than 75 ppb is greater on weekdays compared to weekends. Fewer high eight-hour ozone days occur on Sundays (85 days) compared to other days of the week. Sunday had 18 fewer high eight-hour ozone days than Mondays, which had the second lowest amount of high eight-hour ozone days (103 days). High eight-hour ozone days occur most often on Fridays, with 137 days. It appears that high ozone occurs less frequently on Sunday, when there are also lower amounts of NO_X from on-road sources. By the end of the week, the DFW nonattainment area begins to experience higher ozone as well as higher NO_X emissions. This result corroborates the hypothesis that local NO_X reductions will lead to lower ozone concentrations, and this weekday/weekend analysis using monitoring data corroborates the weekday/weekend modeling analysis summarized in Chapter 3.

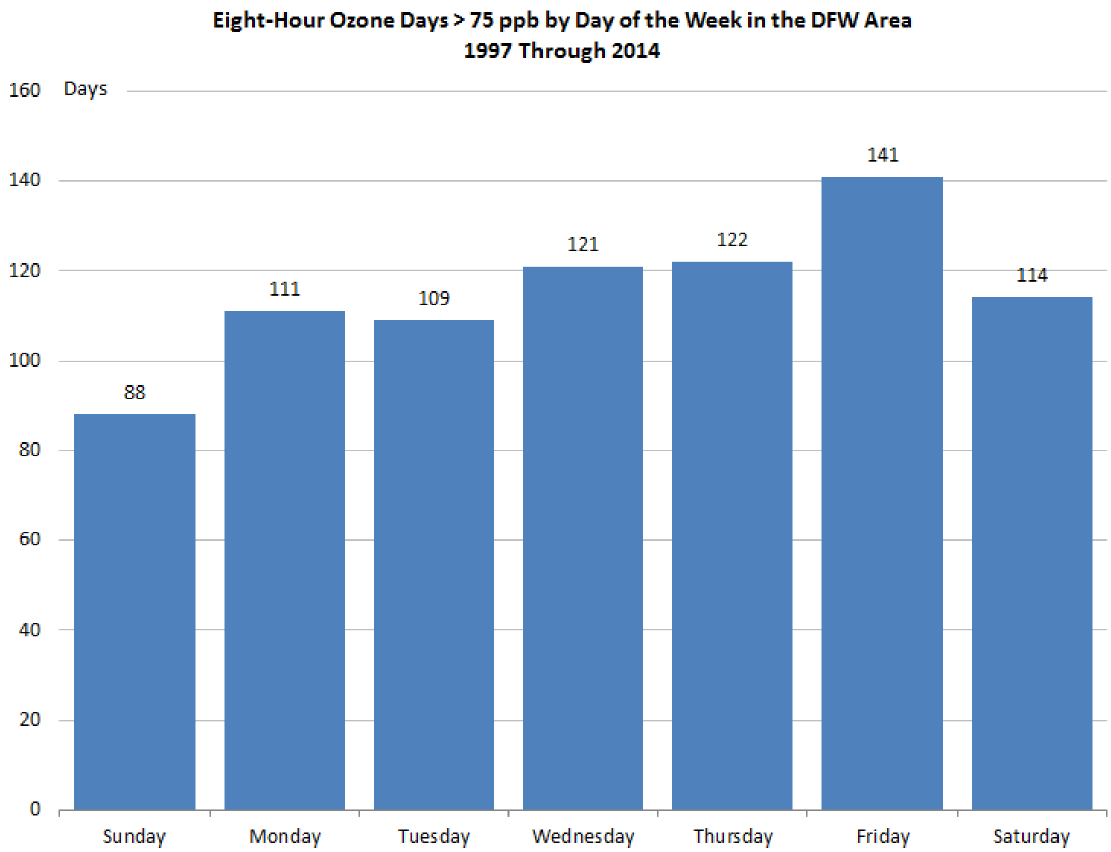


Figure 5-13: Weekday/Weekend Effect for Ozone in the DFW Area

5.2.5 VOC Trends

Total non-methane organic carbon (TNMOC), which is used to represent VOC concentrations, can enhance ozone production in combination with NO_X and sunlight. TNMOC is an important precursor to ozone formation. However, because the DFW air shed is more NO_X-limited, controlling TNMOC is not as effective as controlling NO_X to reduce ozone concentrations. Nevertheless, these precursors to ozone formation are discussed below.

Two types of monitors record TNMOC data in the DFW nonattainment area: AutoGCs, which record hourly data, and canisters, which collect 24-hour data. Because the canisters have more long-term data than the AutoGCs, they can provide more long-term trend information. The annual geometric mean TNMOC concentrations collected using the seven canisters in the DFW nonattainment area are presented in Figure 5-14: *Annual Geometric Mean TNMOC Concentrations*. The chart shows that annual geometric mean TNMOC concentrations in the DFW nonattainment area are declining, although there appear to be fewer decreases occurring after 2006. Due to the NO_X-limited nature of the DFW nonattainment area, controlling TNMOC is not as effective at controlling NO_X to reduce ozone concentrations. Since the rate of decline in TNMOC concentrations since 2006 is much less pronounced than that for NO_X, we would expect TNMOC controls to have a much smaller effect for reducing ozone. This information also supports the photochemical modeling results documented in Chapter 3.

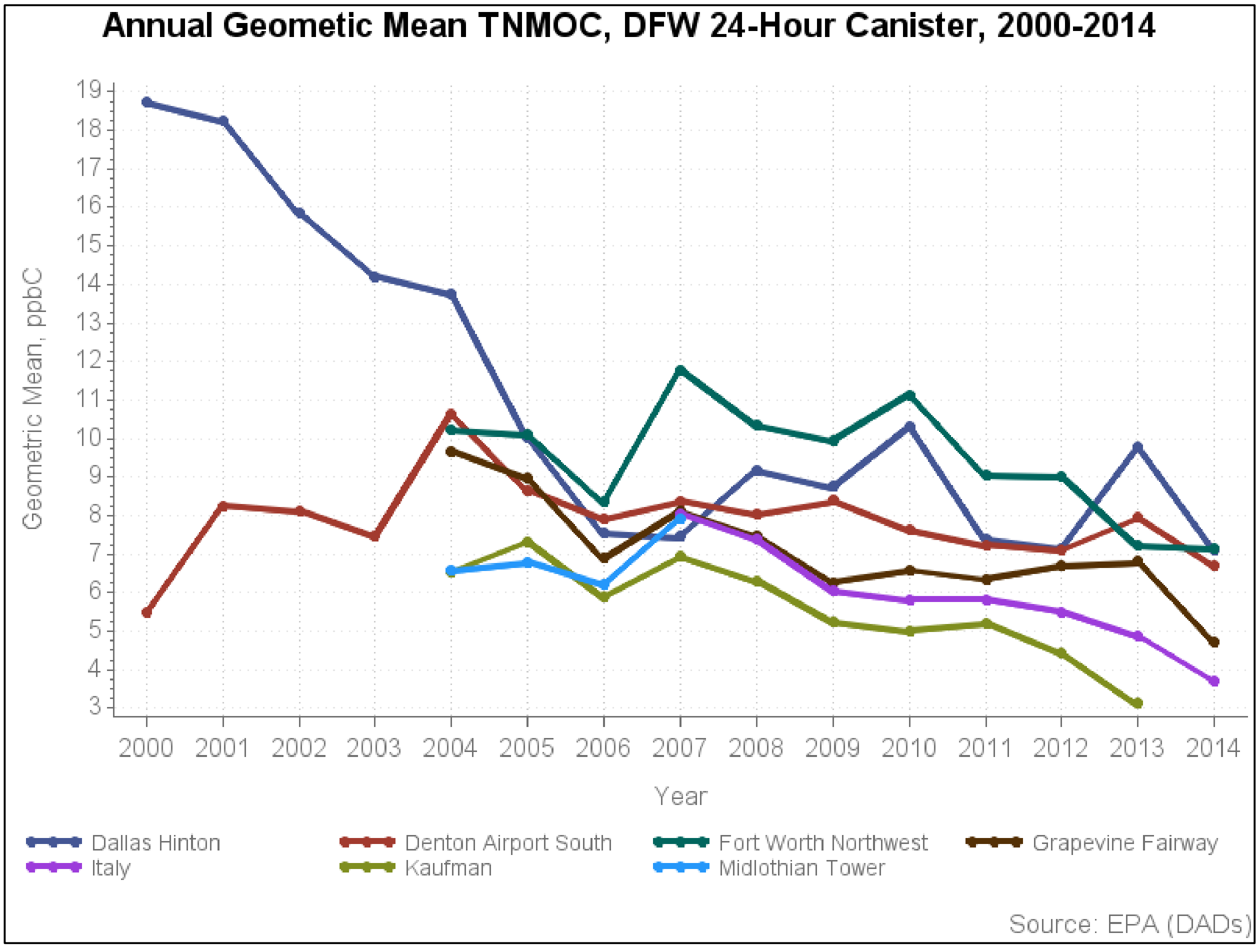


Figure 5-14: Annual Geometric Mean TNMOC Concentrations

5.3 STUDIES OF OZONE FORMATION, ACCUMULATION, AND TRANSPORT RELATED TO DFW

A number of peer-reviewed studies have been performed that relate to air quality in the DFW nonattainment area and ozone ADs in general. These studies are an important component of the Weight of Evidence (WoE) analyses in that in several cases they corroborate the conclusion that there are downward trends in ozone, NO_X, and VOC. Additional research also provides support of the improvements in the use of photochemical modeling as a predictive tool. Several of the studies summarized below relate to the effects of precipitation on biogenic emissions, VOC profiles for oil and gas production, and the effects of oil and gas operations on ozone formation. Each study is fully referenced in the bibliography.

One study by Sather and Cavender (2012) examined trends in ozone and its precursors at several cities in the south central U.S., including DFW. Several parameters associated with meteorology conducive to high ozone were also examined, including days with temperatures ≥90 degrees Fahrenheit, days with resultant wind speeds ≤4 miles per hour, and the number of days with precipitation. They evaluated five five-year periods from 1986 through 1990 and continuing from 2006 through 2010. They found that ozone-conducive days were lowest from 2001 through 2005, and highest during 1991 through 1995 and 2006 through 2010. In spite of the increase in ozone-conducive days during 2006 through 2010, the number of hours above 75 ppb at four DFW monitoring sites decreased by more than 70 hours per site compared to 2001 through 2005. The downward trends observed by Sather and Cavender for NO_X and VOC matched those calculated by the TCEQ.

Another study by Tang et al. (2013) relating to emissions inventories used two advanced numerical techniques to estimate a top-down NO_X EI based upon the NO_2 column density measurements from the Ozone Monitoring Instrument (OMI) satellite. These two techniques, the discrete Kalman filter and the decoupled direct method, allowed the Comprehensive Air Quality Model with Extensions (CAMx) to adjust the original bottom-up TCEQ inventory for 2006 ozone episodes iteratively until it matched the satellite-derived NO_2 column observations. A second top-down adjustment was calculated based upon ground-based NO_X measurements. The two methods gave widely diverging results, with the OMI measurement pushing the inventory slightly higher, and the ground monitoring pushing the inventory much lower. The original TCEQ 2006 inventory included emissions of NO_X from lightning and other sources often not included in standard emissions inventories, but the two top-down inventories were still different.

Each of the top-down inventories was substituted into the CAMx modeling to see if ozone model performance was improved. Neither alternative inventory showed substantial improvements over the original inventory. The tendency of the Tang et al. modeling to overestimate ground NO_2 concentrations and underestimate column densities could not be corrected by the techniques used in this study. Other model weaknesses aside from potential emission inventory error could explain this discrepancy, particularly the simulation of planetary boundary layer dynamics. Another explanation is that different data retrieval techniques used for OMI data have shown large variations, even though they are supposed to match each other. Revisions to the retrieval algorithms are being implemented to try to correct the problem. The results of this study did not compel any changes in the SIP modeling for DFW.

A third emissions/modeling related study evaluated by TCEQ staff was by Lamsal et al. (2008), which attempted to infer the ground-based NO_2 concentrations based upon the OMI satellite data. Since the ground-based NO_2 monitors have a known high bias, due to their inability to distinguish between NO_2 and other oxidized nitrogen compounds, the authors developed a correction for the ground-based NO_2 data. They found that OMI NO_2 column analysis was able to predict ground NO_2 concentrations reasonably well, which may allow these data to fill gaps in the NO_2 measurement network across the country. Tarrant County was an area that they specifically examined to see how well OMI NO_2 column analysis could predict ground NO_2. However, the OMI NO_2 results for Tarrant County did not include sufficient resolution that could be used to alter the NO_X emission estimates by source category for the 2006 and 2017 SIP modeling performed for DFW.

A fourth study related to emissions evaluated by the TCEQ was by Huang et al. (2014), which examined drought effects on biogenic emissions during two drought years (2006 and 2011) and one "wet" year (2007) to elucidate the relationship between leaf area index (LAI) and emissions. Drought severity was evaluated using the Standard Precipitation Index and the Palmer Drought Severity Index. Monthly average LAI was estimated from the Moderate Resolution Imaging Spectroradiometer (MODIS) satellite data for four different regions in eastern Texas; DFW was included in the "North Central" region. The study found large differences in LAI between the wet year and the drought years, with up to 50% decreases during the drought years relative to 2007. Isoprene and monoterpene emissions estimated with the Model of Emissions of Gases and Aerosols from Nature (MEGAN) and Texas-specific land cover categories were lower during drought years by 25-30%. The authors also looked at which month showed the largest inter-annual variations, and determined which factor was most important (i.e., inter-annual meteorological variations or LAI). September showed the greatest emission variation due to LAI variations. April showed the largest emission variation due to meteorological conditions, and to the combination of meteorology and LAI. These results may ultimately help improve biogenic emissions modeling by taking into account drought conditions when modeling the emissions from vegetation.

A fifth modeling support study evaluated by the TCEQ was Lefohn et al. (2014), which modeled background ozone using the Goddard Earth Observing System with Chemistry (GEOS-Chem) global model and CAMx for 2006. The source apportionment tools in CAMx were invoked to track the sources of background ozone simulated throughout the country. Many sites were examined in detail, including the Dallas Executive Airport monitoring site, which was used to assess the impact of background ozone on DFW. Twelve kilometer (km) CAMx modeling yielded decent mean fractional bias of hourly ozone in DFW during April, May, September, and October, but biased by about +20% during June and July, and by about -20% for the other months. For April, May, and October, the estimated global average background was about 58-63% of the total ozone for the Dallas Executive Airport site. During June through September, the global average background was only about 43-48% of the total ozone. Overall, the percentage of total ozone attributed to background tended to decrease at higher concentrations of total ozone. Using their estimation method, they found indications of stratospheric contributions to background in March and June 2006, though the contributions were not quantified or focused upon specific days. Because the contributions were not quantified, there is no quantification of the uncertainty of this assessment. The results presented in this paper are consistent with DFW regional background ozone assessments developed by the TCEQ using an upwind-downwind method.

A sixth study evaluated by the TCEQ was Pacsi et al. (2013), which carried out CAMx modeling for eastern Texas at 12 km after making adjustments to the 2012 future case inventory used by the TCEQ for the June 2006 ozone episode that was included with the DFW AD SIP adopted in December 2011. The study estimated how regional NO_X emissions and consequent ozone formation would vary based on four natural gas price scenarios of $1.89, $2.88, $3.87, and $7.74 per Million British Thermal Units (MMBTU). Using the $2.88 scenario as a baseline, the $1.89 scenario resulted in lower NO_X at EGUs since more natural gas was being used instead of coal. However, NO_X emissions from natural gas production were increased to account for the increase in demand from EGUs. The regional ozone decrease was 0.2-0.5 ppb for this $1.89 scenario, but some localized ozone increases were seen downwind of natural gas production areas. Conversely, the $3.87 and $7.74 scenarios resulted in regional ozone increases of 0.2-0.7 ppb because the use of higher NO_X emitting coal for EGUs was favored over natural gas.

Overall, the studies evaluated by the TCEQ are supportive of the use of photochemical modeling as a predictive tool in determining attainment.

5.4 QUALITATIVE CORROBORATIVE ANALYSIS

This section outlines additional measures, not included in the photochemical modeling, that are expected to further reduce ozone levels in the DFW nonattainment area. Various federal, state, and local control measures exist that are anticipated to provide real emissions reductions; however, these measures are not included in the photochemical model because they may not meet all of the EPA's criteria for modeled reductions. While the modeling analysis described in Chapter 3 shows an estimated future ozone design value of 76 or 77 ppb, emissions reductions from these measures, in addition to those from the measures included in the photochemical model, support the conclusion that the DFW area will attain the 2008 ozone NAAQS by the end of 2017.

5.4.1 Additional Measures

5.4.1.1 Energy Efficiency and Renewable Energy (EE/RE) Measures

Energy efficiency (EE) measures are typically programs that reduce the amount of electricity and natural gas consumed by residential, commercial, industrial, and municipal energy consumers. Examples of EE measures include increasing insulation in homes, installing compact fluorescent light bulbs, and replacing motors and pumps with high efficiency units. Renewable energy (RE) measures include programs that generate energy from resources that are replenished or are otherwise not consumed as with traditional fuel-based energy production. Examples of renewable energy include wind energy and solar energy projects.

Local government programs frequently implement EE/RE measures. An example of a locally initiated RE measure is the Solar Ready II (SRII) project launched by the North Central Texas Council of Governments (NCTCOG). The purpose of the SRII project was to identify and implement best management practices to support the growth of solar installations in the region. The SRII project ended in March 2016. However, while not a commitment, the NCTCOG has indicated to the TCEQ that NCTCOG staff will continue to promote the best management practices of the SRII project through ongoing efforts.

Additionally, Texas leads the nation in RE generation from wind. As of December 2014, Texas has 14,098 megawatts (MW) of installed wind generation capacity[3]; more than double that of California, the state with the next highest amount of installed wind generation capacity. Texas' total net electrical generation from renewable wind generators for 2014 is estimated to be approximately 39 million megawatt-hours (MWh)[4], approximately 22% of the total wind net electrical generation for the U.S. As of December 31, 2015, Texas' installed wind generation capacity increased to 17,713 MW, approximately a 25% increase in just one year.

While EE/RE measures are beneficial and do result in lower overall emissions from fossil fuel-fired power plants in Texas, emission reductions resulting from these programs are not explicitly included in photochemical modeling for SIP purposes because local efficiency efforts may not result in local emissions reductions or may be offset by increased demand in electricity. The complex nature of the electrical grid makes accurately quantifying emission reductions from EE/RE measures difficult. At any given time, it is impossible to determine exactly where a specific user's electricity was produced. The electricity for users in a nonattainment area may not necessarily be generated solely within that nonattainment area. For example, some of the electricity used within a nonattainment area in East Texas could be generated by a power plant in a nearby attainment county or even in West Texas. If electrical demand is reduced in a nonattainment area due to local efficiency measures, the resulting emission reductions from power generation facilities may occur in any number of locations around the state. Similarly, increased RE generation may not necessarily replace electrical generation from local fossil fuel-fired power plants within a particular nonattainment area.

While specific emission reductions from EE/RE measures are not provided in the SIP, persons interested in estimates of energy savings and emission reductions from EE/RE measures can access additional information and reports from the Energy Systems Laboratory, Texas A&M

[3] U.S. Department of Energy, National Renewable Energy Laboratory, http://apps2.eere.energy.gov/wind/windexchange/wind_installed_capacity.asp

[4] U.S. Department of Energy, Energy Information Administration, Form EIA-923 data, http://www.eia.gov/electricity/data/eia923/

Engineering Experiment Station, at http://esl.tamu.edu/. The reports submitted to the TCEQ regarding EE/RE measures are available under TERP Letters and Reports.

Finally, the Texas Legislature has enacted a number of EE/RE measures and programs. The following is a summary of Texas EE/RE legislation since 1999.

76th Texas Legislature, 1999

- Senate Bill (SB) 7
- House Bill (HB) 2492
- HB 2960

77th Texas Legislature, 2001

- SB 5
- HB 2277
- HB 2278
- HB 2845

78th Texas Legislature, 2003

- HB 1365 (Regular Session)

79th Texas Legislature, 2005

- SB 20 (First Called Session)
- HB 2129 (Regular Session)
- HB 2481 (Regular Session)

80th Texas Legislature, 2007

- HB 66
- HB 3070
- HB 3693
- SB 12

81st Texas Legislature, 2009

- None

82nd Texas Legislature, 2011

- SB 898 (Regular Session)
- SB 924 (Regular Session)
- SB 981 (Regular Session)
- SB 1125 (Regular Session)
- SB 1150 (Regular Session)
- HB 51 (Regular Session)

83rd Texas Legislature, 2013

- None

84th Texas Legislature, 2015

- SB 1626
- HB 1736

Renewable Energy

SB 5, 77th Texas Legislature, 2001, set goals for political subdivisions in affected counties to implement measures to reduce energy consumption from existing facilities by 5% each year for five years from January 1, 2002 through January 1, 2006. In 2007, the 80th Texas Legislature passed SB 12, which extended the timeline set in SB 5 through 2007 and made the annual 5% reduction a goal instead of a requirement. The State Energy Conservation Office (SECO) is charged with tracking the implementation of SB 5 and SB 12. Also during the 77th Texas Legislature, the Energy Systems Laboratory (ESL), part of the Texas Engineering Experiment Station, Texas A&M University System, was mandated to provide an annual report on EE/RE efforts in the state as part of the TERP under Texas Health and Safety Code (THSC), §388.003(e).

The 79th Texas Legislature, 2005, Regular and First Called Sessions, amended SB 5 through SB 20, HB 2129, and HB 2481 to add, among other initiatives, renewable energy initiatives that require: 5,880 MW of generating capacity from renewable energy by 2015; the TCEQ to develop a methodology for calculating emission reductions from renewable energy initiatives and associated credits; the ESL to assist the TCEQ in quantifying emissions reductions from EE/RE programs; and the Public Utility Commission of Texas (PUCT) to establish a target of 10,000 MW of installed renewable technologies by 2025. Wind power producers in Texas exceeded the renewable energy generation target by installing over 10,000 MW of wind electric generating capacity by 2010.

HB 2129, 79th Texas Legislature, 2005, Regular Session, directed the ESL to collaborate with the TCEQ to develop a methodology for computing emission reductions attributable to use of renewable energy and for the ESL to annually quantify such emission reductions. HB 2129 directed the Texas Environmental Research Consortium to use the Texas Engineering Experiment Station to develop this methodology. With the TCEQ's guidance, the ESL produces an annual report, Statewide Air Emissions Calculations from Energy Efficiency, Wind and Renewables, detailing these efforts.

In addition to the programs discussed and analyzed in the ESL report, local governments may have enacted measures beyond what has been reported to SECO and the PUCT. The TCEQ encourages local political subdivisions to promote EE/RE measures in their respective communities and to ensure these measures are fully reported to SECO and the PUCT.

SB 981, 82nd Texas Legislature, 2011, Regular Session, allows a retail electric customer to contract with a third party to finance, install, or maintain a distributed renewable generation system on the customer's side of the electric meter, regardless of whether the customer owns the installed system. SB 981 also prohibits the PUCT from requiring registration of the system as an electric utility if the system is not projected to send power to the grid.

HB 362, 82nd Texas Legislature, 2011, Regular Session, helps property owners install solar energy devices such as electric generating solar panels by establishing requirements for property owners associations' approval of installation of solar energy devices. HB 362 specifies the conditions that property owners associations may and may not deny approval of installing solar energy devices.

SB 1626, 84th Texas Legislature, 2015, modifies the provisions established by HB 362 from the 82nd Texas Legislature, 2011, Regular Session, regarding property owners associations' authority to approve and deny installations of solar energy devices such as electric generating solar panels. HB 362 included an exception that allowed developers to prohibit installation of solar energy devices during the development period. SB 1626 limits the exception during the development period to developments with 50 or fewer units.

Residential and Commercial Building Codes and Programs

THSC, Chapter 388, Texas Building Energy Performance Standards, as adopted in SB 5 of the 77th Texas Legislature, 2001, states in §388.003(a) that single-family residential construction must meet the energy efficiency performance standards established in the energy efficiency chapter of the International Residential Code. The Furnace Pilot Light Program includes energy savings accomplished by retrofitting existing furnaces. Also included is a January 2006 federal mandate raising the minimum Seasonal Energy Efficiency Ratio SEER for air conditioners in single-family and multi-family buildings from 10 to 13.

THSC, Chapter 388, as adopted in SB 5 of the 77th Texas Legislature, 2001, states in §388.003(b) that non-single-family residential, commercial, and industrial construction must meet the energy efficiency performance standards established in the energy efficiency chapter of the International Energy Conservation Code.

HB 51, 82nd Legislature, 2011, Regular Session, requires municipalities to report implementation of residential and commercial building codes to SECO.

HB 1736, 84th Texas Legislature, 2015, update THSC §388.003 to adopt, effective September 1, 2016, the energy efficiency chapter of the International Residential Code as it existed on May 1, 2015. HB 1736 also established a schedule by which SECO could adopt updated editions of the International Residential Code in the future, not more often than once every six years.

Federal Facility EE/RE Projects

Federal facilities are required to reduce energy use by Presidential Executive Order 13123 and the Energy Policy Act of 2005 (Public Law 109-58 EPACT20065). The Energy Systems Laboratory compiled energy reductions data for the federal EE/RE projects in Texas.

Political Subdivisions Projects

SECO funds loans for energy efficiency projects for state agencies, institutions of higher education, school districts, county hospitals, and local governments. Political subdivisions in nonattainment and affected counties are required by SB 5, 77th Texas Legislature, 2001, to report EE/RE projects to SECO. These projects are typically building systems retrofits, non-building lighting projects, and other mechanical and electrical systems retrofits such as municipal water and waste water treatment systems.

Electric Utility Sponsored Programs

Utilities are required by SB 7, 76th Texas Legislature, 1999, and SB 5, 77th Texas Legislature, 2001, to report demand-reducing energy efficiency projects to the PUCT (see THSC, §386.205 and Texas Utilities Code (TUC), §39.905). These projects are typically air conditioner replacements, ventilation duct tightening, and commercial and industrial equipment replacement.

SB 1125, 82nd Texas Legislature, 2011, Regular Session, amended the TUC, §39.905 to require energy efficiency goals to be at least 30% of annual growth beginning in 2013. The metric for the energy efficiency goal remains at 0.4% of peak summer demand when a utility program accrues that amount of energy efficiency. SB 1150, 82nd Texas Legislature, 2011, Regular Session, extended the energy efficiency goal requirements to utilities outside the Electric Reliability Council of Texas area.

State Energy Efficiency Programs

HB 3693, 80th Texas Legislature, 2007, amended the Texas Education Code, Texas Government Code, THSC, and TUC. The bill:

- requires state agencies, universities and local governments to adopt energy efficiency programs;
- provides additional incentives for electric utilities to expand energy conservation and efficiency programs;
- includes municipal-owned utilities and cooperatives in efficiency programs;
- increases incentives and provides consumer education to improve efficiency programs; and
- supports other programs such as revision of building codes and research into alternative technology and renewable energy.

HB 51, 82nd Texas Legislature, 2011, Regular Session, requires new state buildings and major renovations to be constructed to achieve certification under an approved high-performance design evaluation system.

HB 51 also requires, if practical, that certain new and renovated state-funded university buildings comply with approved high-performance building standards.

SB 898, 82nd Texas Legislature, 2011, Regular Session, extended the existing requirement for state agencies, state-funded universities, local governments, and school districts to adopt energy efficiency programs with a goal of reducing energy consumption by at least 5% per state fiscal year (FY) for 10 state FYs from September 1, 2011 through August 31, 2021.

SB 924, 82nd Texas Legislature, 2011, Regular Session, requires all municipally owned utilities and electric cooperatives that had retail sales of more than 500,000 MWh in 2005 to report each year to SECO information regarding the combined effects of the energy efficiency activities of the utility from the previous calendar year, including the utility's annual goals, programs enacted to achieve those goals, and any achieved energy demand or savings goals.

5.4.1.2 Cement Kiln Consent Decree (No change)

5.4.1.3 Clean Air Interstate Rule (CAIR) and Cross-State Air Pollution Rule (CSAPR)

In March 2005, the EPA issued CAIR to address EGU emissions that transport from one state to another. The rule incorporated the use of three cap and trade programs to reduce sulfur dioxide (SO_2) and NO_X: the ozone-season NO_X trading program, the annual NO_X trading program, and the annual SO_2 trading program.

Texas was not included in the ozone season NO_X program but was included for the annual NO_X and SO_2 programs. As such, Texas was required to make necessary reductions in annual SO_2 and NO_X emissions from new and existing EGUs to demonstrate that emissions from Texas do not contribute to nonattainment or interfere with maintenance of the 1997 particulate matter with an aerodynamic diameter less than or equal to a nominal 2.5 micrometers ($PM_{2.5}$) NAAQS in another state. CAIR consisted of two phases for implementing necessary NO_X and SO_2

reductions. Phase I addressed required reductions from 2009 through 2014. Phase II was intended to address reductions in 2015 and thereafter.

In July 2006, the commission adopted a SIP revision to address how the state would meet emissions allowance allocation budgets for NO_X and SO_2 established by the EPA to meet the federal obligations under CAIR. The commission adopted a second CAIR-related SIP revision in February 2010. This revision incorporated various federal rule revisions that the EPA had promulgated since the TCEQ's initial submittal. It also incorporated revisions to 30 Texas Administrative Code Chapter 101 resulting from legislation during the 80th Texas Legislature, 2007.

A December 2008 court decision found flaws in CAIR but kept CAIR requirements in place temporarily while directing the EPA to issue a replacement rule. In July 2011, the EPA finalized CSAPR to meet Federal Clean Air Act (FCAA) requirements and respond to the court's order to issue a replacement program. Texas was included in CSAPR for ozone season NO_X, annual NO_X, and annual SO_2 due to the EPA's determination that Texas significantly contributes to nonattainment or interferes with maintenance of the 1997 eight-hour ozone NAAQS and the 1997 $PM_{2.5}$ NAAQS in other states. As a result of numerous EGU emission reduction strategies already in place in Texas, the annual and ozone season NO_X reduction requirements from CSAPR were relatively small but still significant. CSAPR required an approximate 7% reduction in annual NO_X emissions and less than 5% reduction in ozone season NO_X emissions.

On August 21, 2012, the U.S. Court of Appeals for the District of Columbia (D.C.) Circuit vacated CSAPR. Under the D.C. Circuit Court's ruling, CAIR remained in place until the EPA developed a valid replacement.

The EPA and various environmental groups petitioned the Supreme Court of the United States to review the D.C. Circuit Court's decision on CSAPR. On April 29, 2014, a decision by the Supreme Court reversed the D.C. Circuit and remanded the case. On October 23, 2014, the D.C. Circuit lifted the CSAPR stay and on November 21, 2014, the EPA issued rulemaking, which shifted the effective dates of the CSAPR requirements to account for the time that had passed after the rule was stayed in 2011. Phase 1 of CSAPR took effect January 1, 2015 and Phase 2 is scheduled to begin January 1, 2017. On July 28, 2015, the D.C. Circuit Court ruled that the 2014 annual SO_2 budgets and the 2014 ozone season NO_X budgets for Texas were invalid because they required over control of Texas emissions, and remanded these budgets back to the EPA without vacatur.

On January 22, 2015, the EPA issued a memorandum to provide information on how it intends to implement FCAA interstate transport requirements for the 2008 ozone NAAQS. The EPA provided preliminary modeling results for 2018, which show contribution to nonattainment of the 2008 ozone NAAQS in the DFW area from sources outside of Texas. On July 23, 2015, the EPA issued a notice of data availability regarding updated ozone transport modeling results for a 2017 attainment year.

On December 3, 2015, the EPA published a proposed update to the CSAPR ozone season program by issuing the CSAPR Update Rule for the 2008 eight-hour ozone standard (80 *Federal Register* 75706). As part of this rule, the EPA is also proposing to promulgate FIPs for nine states, including Texas, that incorporate revised emissions budgets to replace the ozone season NO_X budgets remanded by the D.C. Circuit on July 28, 2015. These proposed budgets would be effective for the 2017 ozone season, the same period in which the phase 2 budgets that were invalidated by the court are to become effective. Therefore, this proposed action, if finalized, would replace the remanded budgets promulgated in CSAPR to address the 1997 ozone NAAQS with budgets developed to address the more stringent 2008 ozone NAAQS. Remanded SO_2 budgets are still to be resolved. Therefore, while the current CSAPR budgets for Texas are still in effect, the budgets may be subject to change in the future after the EPA's reconsideration, finalization of the CSAPR Update Rule, or changes resulting from further appeals.

As discussed in Section 3.5.4, *2017 Future Case Emissions*, the TCEQ used CSAPR as the basis for allocating EGU emission caps in the 2017 future year. Section 3.7.4.1, *CAIR Phase II Sensitivity*, presents the results of a sensitivity analysis where the CSAPR caps were replaced with those that would apply under Phase II of the CAIR program.

5.4.1.4 TERP

The TERP program was created in 2001 by the 77th Texas Legislature to provide grants to offset the incremental costs associated with reducing NO_X emissions from high-emitting heavy-duty internal combustion engines on heavy-duty vehicles, non-road equipment, marine vessels, locomotives, and some stationary equipment.

The primary emissions reduction incentives are awarded under the Diesel Emissions Reduction Incentive Program (DERI). The DERI incentives are awarded to projects to replace, repower, or retrofit eligible vehicles and equipment to achieve NO_X emission reductions in Texas ozone nonattainment areas and other counties identified as affected counties under the TERP where ground-level ozone is a concern.

From 2001 through August 2015, $968 million in DERI grants were awarded for projects projected to help reduce 168,289 tons of NO_X. Over $327 million in DERI grants were awarded to projects in the DFW area, with a projected 58,062 tons of NO_X reduced. These projects are estimated to reduce up to 18.7 tons per day of NO_X in the DFW area in 2015. The emissions reduction estimates will change yearly as older projects reach the end of the project life and new projects begin achieving emissions reductions.

Also, of the $327 million awarded in the DFW area, $22 million were awarded to North Central Texas Council of Governments (NCTCOG) through third-party grants to administer subgrants in the DFW area.

Three other incentive programs under the TERP will result in the reduction in NO_X emissions in the DFW area, as discussed below.

The Drayage Truck Incentive Program was established in 2013 to provide grants for the replacement of drayage trucks operating in and from seaports and rail yards located in the nonattainment areas. Nine projects to replace 36 vehicles were awarded grants in FY 2015 totaling $3.95 million. One of these projects was in the DFW area and totaled $501,524. The project will result in a reduction of approximately 25 tons of NO_X, representing 0.02 tons per day of NO_X reduced starting in 2017.

The Texas Clean Fleet Program (TCFP) was established in 2009 to provide grants for the replacement of light-duty and heavy-duty diesel vehicles with vehicles powered by alternative fuels, including: natural gas, liquefied petroleum gas, hydrogen, methanol (85% by volume), or electricity. This program is for larger fleets, with a requirement that an applicant apply for replacement of at least 20 vehicles at a time. From 2009 through August 2015, over $31.4 million in TCFP grants were awarded for projects to help reduce over 400 tons of NO_X. Over $9.1 million in TCFP grants were awarded to projects in the DFW area, with a projected 181.6

tons of NO_X reduced. The projects are projected to reduce up to 0.07 tons per day of NO_X in the DFW area starting in 2015.

The Texas Natural Gas Vehicle Grant Program (TNGVGP) was established in 2011 to provide grants for the replacement of medium-duty and heavy-duty diesel vehicles with vehicles powered by natural gas. This program may include grants for individual vehicles or multiple vehicles. The majority of the vehicle's operation must occur in the Texas nonattainment areas, other counties designated as affected counties under the TERP, and the counties in and between the triangular area between Houston, San Antonio, Dallas, and Fort Worth. From 2011 through August 2015 over $46.3 million in TNGVGP grants were awarded for projects to help reduce a projected 1,646 tons of NO_X. Over $18.5 million in TNGVGP grants were awarded to projects in the DFW area, with a projected 769 tons of NO_X reduced. These projects are estimated to reduce up to 0.4 tons per day of NO_X in the DFW area starting in 2015.

HB 1, General Appropriations Bill, 84th Texas Legislature, 2015, appropriated $118.1 million per year for implementation of the TERP in FYs 2016 and 2017. This represents an increase of $40.5 million per year over the appropriation amount in FYs 2014 and 2015. The additional funding will result in more grant projects that result in NO_X reductions in the eligible TERP areas, including the DFW area.

5.4.1.5 Low-Income Vehicle Repair Assistance, Retrofit, and Accelerated Vehicle Retirement Program (LIRAP)

The TCEQ established a financial assistance program for qualified owners of vehicles that fail the emissions test. The purpose of this voluntary program is to repair or remove older, higher emitting vehicles from use in certain counties with high ozone. The LIRAP provisions of House Bill (HB) 2134, 77th Texas Legislature 2001, created the program. In 2005, HB 1611, 79th Texas Legislature, modified the program to apply only to counties that implement a vehicle inspection and maintenance program and have elected to implement LIRAP fee provisions. The counties currently participating in the LIRAP are Brazoria, Fort Bend, Galveston, Harris, Montgomery, Collin, Dallas, Denton, Ellis, Johnson, Kaufman, Parker, Rockwall, Tarrant, Travis, and Williamson Counties.

SB 12, 80th Texas Legislature 2007, expanded the LIRAP participation criteria by increasing the income eligibility to 300% of the federal poverty rate and increasing the amount of assistance toward the replacement of a retired vehicle. HB 3272, 82nd Texas Legislature 2011, Regular Session, expanded the class of vehicles eligible for a $3,500 voucher to include hybrid, electric, natural gas, and federal Tier 2, Bin 3 or cleaner Bin certification vehicles. The program provides $3,500 for a replacement hybrid, electric, natural gas, and federal Tier 2, Bin 3 or cleaner Bin certification vehicle of the current model year or the previous three model years; $3,000 for cars of the current or three model years; and $3,000 for trucks of the current or previous two model years. The retired vehicle must be 10 years old or older or must have failed an emissions test. From December 12, 2007 through February 29, 2016, the program has retired and replaced 55, 807 vehicles at a cost of $167,629,312.80. During the same period, an additional 39,379 vehicles have had emissions-related repairs at a cost of $20,894,123.66. The total retirement/replacement and repair expenditure from December 12, 2007 through February 29, 2016 is $188,523,436.46.

In the DFW nonattainment area, the LIRAP is currently available to vehicle owners in nine counties: Collin, Dallas, Denton, Ellis, Johnson, Kaufman, Parker, Rockwall and Tarrant. Between December 12, 2007 and February 29, 2016, the program has repaired 17,433 vehicles and retired and replaced 29,344 vehicles at a cost of $96,873,835.61. HB 1, General

Appropriations Bill, 84th Texas Legislature 2015, appropriated $43.5 million per year for FY 2016 and FY 2017 to continue this clean air strategy in the 16 participating counties. Participating DFW area counties were allocated approximately $21.6 million per year for the LIRAP for FYs 2016 and 2017. This is an increase of approximately $18.8 million per year over the previous biennium.

5.4.1.6 Local Initiative Projects (LIP)

Funds are provided to counties participating in the LIRAP for implementation of air quality improvement strategies through local projects and initiatives. In the DFW area, LIP funding is available to the nine counties currently participating in the LIRAP: Collin, Dallas, Denton, Ellis, Johnson, Kaufman, Parker, Rockwall, and Tarrant. HB 1, General Appropriations Bill, 84th Texas Legislature 2015, appropriated $4.8 million per year for FY 2016 and FY 2017 to continue this clean air strategy. The nine DFW area counties were allocated approximately $2.4 million per year for FYs 2016 and 2017. This is an increase of approximately $2.1 million per year over the previous biennium.

Dallas County used LIP funds in 2008 to establish the Dallas County Clean Air Emissions Task Force. For its first seven years, the task force targeted high-emitting vehicles, smoking vehicles, and suspicious vehicles to verify that the state safety and emissions inspection windshield certificates on these vehicles were legitimate and in compliance with air quality standards. The task force's objective is to reduce the number of fraudulent, fictitious, or improperly issued safety and emissions inspection windshield certificates.

Following the success of Dallas County's emissions enforcement project, Denton (2008-2016), Ellis (2008-2014), Johnson (2010-2014), Kaufman (2012-2016), and Tarrant (2010-2016) Counties established similar task forces. Beginning in March 2015, the emission enforcement task forces adjusted their objectives to concentrate on the identification of vehicles with counterfeit registration insignia and the reduction of fraudulent vehicle inspection reports. These programs have partnered with local and state agencies to enforce state laws, codes, rules, and regulations regarding air quality and mobile emissions in the DFW area. The citizens of the entire north Texas region benefit from these programs as a result of the reduction in NO_X emissions from each vehicle brought into emissions compliance.

The City of Plano, through Interlocal Agreements with Collin County, used LIP funding in 2012 and 2014 for Local Initiative Projects. In 2012, LIP funding was used by the City of Plano to install auxiliary power units in Police Department vehicles to reduce vehicle emissions during the daily activities of traffic enforcement. This idle reduction technology powers equipment such as lights, radio, and computers so that law enforcement officers can shut-off their vehicles to perform traffic control, traffic accident investigations, lunch breaks, and other activities where the enforcement officer is outside their vehicle. In 2014, the City of Plano used LIP funding to install wireless communications technology at 20 intersections and additional pan/tilt cameras at 19 of those intersections. The project allows signal management from a traffic management center to reduce traffic congestion and idling in an effort to reduce emissions. The project reduces idling by improving traffic flow and decreasing the number of times vehicles must stop at traffic lights. The "Exhaust Phase" of an engine emits the most emissions during starting, idling, and breaking stationary inertia. The project increases the emissions reduction benefits by allowing real-time traffic management instead of a stagnate model to better manage peak-hour congestion, while minimizing cross-traffic congestion, and reducing emissions.

5.4.1.7 Local Initiatives

The NCTCOG submitted an assortment of locally implemented strategies in the DFW nonattainment area including pilot programs, new programs, or programs with pending methodologies. These programs are expected to be implemented in the ten-county nonattainment area by 2017. Due to the continued progress of these measures, additional air quality benefits will be gained and will further reduce precursors to ground level ozone formation. A summary of each strategy is included in Appendix H: *Local Initiatives Submitted by the North Central Texas Council of Governments.*

5.4.1.8 Voluntary Measures

While the oil and natural gas industry is required to install controls either due to state or federal requirements, the oil and natural gas industry has in some instances voluntarily implemented additional controls and practices to reduce VOC emissions from oil and natural gas operations in the DFW nonattainment area as well as other areas of the state. Examples of these voluntary efforts include: installing vapor recovery units on condensate storage tanks; using low-bleed natural gas actuated pneumatic devices; installing plunger lift systems in gas wells to reduce gas well blowdown emissions; and implementing practices to reduce VOC emissions during well completions (i.e., "Green Completions"). The EPA's Natural Gas STAR Program provides details on these and other practices recommended by the EPA as voluntary measures to reduce emissions from oil and natural gas operations and improve efficiency. Additional information on the EPA Natural Gas STAR Program may be found on the EPA's Natural Gas STAR Program Web page (http://www.epa.gov/gasstar/).

The TCEQ continues to attempt to quantify the extent and impacts of these voluntary measures through area source emissions inventory improvement projects, such as the projects detailed in Chapter 6: *Ongoing Initiatives.*

5.5 CONCLUSIONS

The TCEQ has used several sophisticated technical tools to evaluate the past and present causes of high ozone in the DFW nonattainment area in an effort to predict the area's future air quality. Photochemical grid modeling performance has been rigorously evaluated, and 2006 ozone episodes from both June and August-September have been used to match the times of year when the highest ozone levels have historically been measured in the DFW nonattainment area. Historical trends in ozone and ozone precursor concentrations and their causes have been investigated extensively. The following conclusions can be reached from these evaluations.

First, as documented in Chapter 3 and Appendix C, the photochemical grid modeling performs relatively well, with one weakness being an overproduction of ozone primarily during night-time hours and days when lower ozone concentrations are measured. Problems observed with the base case ozone modeling are those that are known to exist in all photochemical modeling exercises, particularly when multiple consecutive weeks are modeled rather than short time periods of just one or two weeks. The model can be used with confidence to project future ozone design values because the EPA's 2007 and draft guidance documents both recommend applying the relative response in modeled ozone to monitored design values. Under the all days attainment test from the EPA's 2007 guidance, the photochemical grid modeling predicts that the 2017 future year ozone design value at four monitors located in the northwest portion of the DFW area will be above the 75 ppb standard: 77 ppb for Denton Airport South, Eagle Mountain Lake, and Grapevine Fairway monitors, and 76 ppb for the Keller monitor. The remaining 15 ozone monitors that were operational in 2006 have 2017 future design values ranging from 62-75 ppb. Use of the all days test results in the 2017 future design values for all DFW area monitors either below or within the 73-78 ppb WoE range inferred for the 75 ppb standard from the 82-87 ppb WoE range that is specified in the 2007 modeling guidance for the 84 ppb standard.

Application of the top 10 days attainment test recommended by the draft EPA modeling guidance from December 2014 projects a 76 ppb future design value at the Denton Airport South and Eagle Mountain Lake monitors, with the remaining 17 monitors ranging from 62-75 ppb. The draft guidance recommends the newer top 10 days test over the older all days test because “model response to decreasing emissions is generally most stable when the base ozone predictions are highest. The greater model response at higher concentrations is likely due to more ‘controllable’ ozone at higher concentrations.” The TCEQ concurs with this assessment, and feels that the top 10 days test is a superior predictor of future ozone design values for this AD. The draft guidance no longer specifies a WoE range for future year design values, and instead requires “a fully-evaluated, high-quality modeling analysis that projects future values that are close to the NAAQS.” With inclusion of the superior top 10 days test, this 2017 DFW AD SIP revision and all of its appendices document a fully-evaluated high-quality modeling analysis with future year design values that are close to or below the 75 ppb eight-hour ozone standard for all DFW area ozone monitors.

The prospective and weekday-weekend evaluations presented in Chapter 3 show that the model response to emission decreases is similar to the response observed in the atmosphere, suggesting that the NO_X and VOC emission levels projected for 2017 will lead to lower ozone concentrations recorded at the DFW area monitors. The prospective analysis presented in Chapter 3 and Appendix C showed that applying 2012 emission estimates to the 2006 base case meteorology did a satisfactory job of estimating the 2012 eight-hour ozone design values at various DFW area monitors. This is particularly significant because this 2012 modeling performed significantly better than that submitted in the 2011 AD SIP revision. As summarized in Table 3-37: *Summary of Ozone Modeling Platform Changes*, the current modeling platform relies on improved tools and methodologies that were not available when the 2011 AD SIP revision work was performed: updated version of the photochemical model; improved meteorological model; improved chemical mechanism for VOC speciation; superior biogenic emissions model; updated anthropogenic emission inventories; and larger fine and coarse grid modeling domains.

For the cement kiln and electric utility sources within DFW, the required emission caps are modeled in the future year even if historical operational levels have only been roughly 50% of these caps. For example, the cement kilns operated at an average ozone season day level of 9.03 NO_X tons per day (tpd) in 2012, but the 2017 future year is still modeled at the 17.64 NO_X tpd cap. In a similar fashion, the EGUs emitted an average of 8.25 NO_X tpd in 2012, but the 2017 future year is modeled at the CSAPR caps of 13.98 NO_X tpd. This conservative approach of modeling the maximum allowable emission levels ensures that future estimates are not underestimated for these large NO_X sources on high ozone days.

Second, trend analyses show that ozone has decreased significantly since 2000 when the eight-hour ozone design value at the Denton Airport South monitor was 102 ppb. As of 2015, the Denton Airport South monitor has an eight-hour ozone design value of 83 ppb. NO_X and VOC precursor trends also show significant decreases, which has led to this reduced ozone formation. These reductions in precursors in the DFW nonattainment area are due to a combination of federal, state, and local emission controls. As shown in this chapter, Chapter 3, and Appendix B, the on-road and non-road mobile source categories are the primary sources of NO_X emissions in the DFW nonattainment area, and are expected to continue their downward decline due to fleet turnover where older high-emitting sources are replaced with newer low-emitting ones. The current TERP program managed by the TCEQ continues to accelerate the mobile source fleet turnover effect by providing financial incentives for purchases of lower-emitting vehicles and equipment. Ozone formation is expected to decline through the 2017 modeled attainment year as lower amounts of NO_X are emitted from these sources. Based on the photochemical grid modeling results and these corroborative analyses, the WoE indicates that the DFW nonattainment area will attain the 2008 eight-hour ozone standard by July 20, 2018.

5.6 REFERENCES

Berlin, S.R., A.O. Langford, M. Estes, M. Dong, D.D. Parrish (2013), Magnitude, decadal changes, and impact of regional background ozone transported into the greater Houston, Texas area, Environ. Sci. Technol., 47(24): 13985-13992, doi: 10.1021/es4037644.

Cooper, O. R., R.-S. Gao, D. Tarasick, T. Leblanc, and C. Sweeney (2012), Long-term ozone trends at rural ozone monitoring sites across the United States, 1990–2010, J. Geophys. Res., 117, D22307, doi:10.1029/2012JD018261.

Huang, L., McDonald-Buller, E.C., McGaughey, G., Kimura, Y., Allen, D.T. (2014), Annual Variability in Leaf Area Index and Isoprene and Monoterpene Emissions during Drought Years in Texas, Atmospheric Environment (2014), doi: 10.1016/j.atmosenv.2014.04.016.

Kite, Chris, Preliminary Results of Ozone Modeling for the Dallas-Fort Worth (DFW) Area, DFW State Implementation Plan (SIP) Technical Information Meeting, November 5, 2013, http://www.tceq.texas.gov/assets/public/implementation/air/am/committees/pmt_dfw/20131105/20131105-DFW-Ozone-75ppb-Kite.pdf.

Lamsal, L. N., R. V. Martin, A. van Donkelaar, M. Steinbacher, E. A. Celarier, E. Bucsela, E. J. Dunlea, and J. P. Pinto (2008), Ground-level nitrogen dioxide concentrations inferred from the satellite-borne Ozone Monitoring Instrument, J. Geophys. Res., 113, D16308, doi:10.1029/2007JD009235.

Lefohn, A.S., C. Emery, D. Shadwick, H. Wernli, J. Jung, and S. Oltmans (2014), Estimates of background surface ozone concentrations in the United States based on model-derived source apportionment, Atmos. Environ., 84: 275-288, http://dx.doi.org/10.1016/j.atmosenv.2013.11.033.

Martin, R.V, C. E. Sioris, K. Chance, T. B. Ryerson, T. H. Bertram, P. J. Woodridge, R. C. Cohen, J. A. Neuman, A. Swanson, F. M. Flocke. 2006. Evaluation of space-based constraints on global nitrogen oxide emissions with regional aircraft measurements over and downwind of eastern North America, J. Geophys. Res., 111, D15308, doi:10.1029/2005JD006680.

Nielsen-Gammon, John W., James Tobin, and Andrew McNeel. “A Conceptual Model for Eight-Hour Ozone Exceedances in Houston, Texas. Part I: Background Ozone Levels in Eastern Texas.” Center for Atmospheric Chemistry and the Environment, Texas A&M University, 2004, p. 16-17.

Pacsi, A.P., N.S. Alhajeri, D. Zavela-Araiza, M.D. Webster, D.T. Allen, (2013), Regional air quality impacts of increased natural gas production and use in Texas, Environ. Sci. Technol., 47(7): 3521-3527, dx.doi.org/10.1021/es3044714.

Pegues et al. (2012), Efficacy of recent state implementation plans for 8-hour ozone, Journal of the Air & Waste Management Association, 62(2):252–261, DOI: 10.1080/10473289.2011.646049.

Sather, M.E., and K. Cavender (2012), Update of long-term trends analysis of ambient 8-hour ozone and precursor monitoring data in the South Central U.S.; encouraging news, J. Environ. Monit. 14: 666-676, doi: 10.1039/C2EM10862C.

Tang, W., D. Cohan, L. Lamsal, X. Xiao, and W. Zhou (2013), Inverse modeling of Texas NO_X emissions using space-based and ground-based NO_2 observations, Atmos. Chem. Phys., 13, 11005–11018, http://www.atmos-chem-phys.net/13/11005/2013/.

U.S. Environmental Protection Agency, Air Quality Trends, http://www.epa.gov/airtrends/aqtrends.html.

Texas Administrative Code. Title 30. Chapter 117. 2007.

CHAPTER 6: ONGOING INITIATIVES

6.1 INTRODUCTION (NO CHANGE)

6.2 ONGOING WORK

6.2.1 Oil and Gas Well Drilling Activities

There have been significant variations in drilling activity in certain regions of Texas over the past ten years, in particular for unconventional horizontal wells in shale formations such as the Barnett Shale, which overlaps the western portion of the 2008 Dallas-Fort Worth (DFW) ozone nonattainment area.

The Texas Commission on Environmental Quality (TCEQ) has contracted with Eastern Research Group, Inc. (ERG) to complete a study to develop 2014 periodic emissions inventory estimates as well as improve forecasted emissions for drilling rigs using Texas-specific data. The TCEQ has expedited finalizing this data and portions of it have been included in the area source oil and gas emissions inventory used in this 2017 DFW Attainment Demonstration (AD) state implementation plan (SIP) revision; see Chapter 3: *Photochemical Modeling,* Section 3.5.4.4: *Area Sources* for details. The TCEQ will evaluate using these data in other future attainment AD and reasonable further progress (RFP) SIP revisions as appropriate, as well as evaluate potential opportunities for follow-up research. The final report can be accessed on the TCEQ's Air Quality Research and Contract Reports: Emissions Inventory Web page (http://www.tceq.state.tx.us/airquality/airmod/project/pj_report_ei.html)

6.2.2 Upstream Oil and Condensate Storage Tanks and Loading Activities

The TCEQ has contracted with ERG to complete a study to evaluate the extent and types of controls on upstream oil and condensate storage tanks as well as loading activities. This study focused on shale formations producing hydrocarbon liquids in Texas, including the Barnett Shale. The results of this project will be used to improve upstream area source oil and gas volatile organic compounds (VOC) emissions estimates.

The TCEQ has expedited finalizing this data so that portions of it have been included in the area source oil and gas emissions inventory used in this SIP revision; see Chapter 3, Section 3.5.4.4 for details. The TCEQ will evaluate using these data in other future AD and RFP SIP revisions as appropriate, as well as evaluate potential opportunities for follow-up research.

6.2.3 Biogenic Emissions Projects

There are four ongoing Air Quality Research Program (AQRP) projects dedicated to improving the estimates of biogenic emissions throughout Texas.

- AQRP 14-008: Investigation of input parameters for biogenic emissions modeling in Texas during drought years (University of Texas).
- AQRP 14-016: Improved land cover and emission factor inputs for estimating biogenic isoprene and monoterpene emissions for Texas air quality simulations (Environ, National Oceanic and Atmospheric Administration, and Pacific Northwest National Laboratory).
- AQRP 14-017: Incorporating space-borne observations to improve biogenic emission estimates in Texas (University of Alabama-Huntsville, Rice University).
- AQRP 14-030: Improving modeled biogenic isoprene emissions under drought conditions and evaluating their impact on ozone formation (Texas A&M University).

These four projects will investigate biogenic emissions using modeling, aircraft-measured concentration data, satellite-estimated solar radiation and temperature data, and field study data from a forest research site, respectively. The wide-ranging efforts of these projects will benefit SIP modeling for the DFW nonattainment area by expanding our understanding of biogenic emissions and the factors that drive them.

Appendices available upon request.

Kathy Singleton
SIP Project Manager
kathy.singleton@tceq.texas.gov
512.239.0703

RESPONSE TO COMMENTS RECEIVED CONCERNING THE DALLAS-FORT WORTH (DFW) 2008 EIGHT-HOUR OZONE STANDARD NONATTAINMENT AREA ATTAINMENT DEMONSTRATION (AD) STATE IMPLEMENTATION PLAN (SIP) REVISION FOR THE 2017 ATTAINMENT YEAR

PROPOSED DECEMBER 9, 2015

The commission conducted public hearings in Arlington on January 21, 2016, at 6:30 p.m., and in Austin on January 26, 2016, at 10:00 a.m. During the comment period, which closed on January 29, 2016, the commission received comments from Amanda Crowe for United States Congresswoman Eddie Bernice Johnson (Congresswoman Johnson), the DFW Chapter of System Change Not Climate Change, Dallas City Councilmember Sandy Greyson (Councilmember Greyson), the Dallas County Medical Society, the Denton Drilling Awareness Group, Downwinders at Risk (Downwinders), Empowering Oak Cliff, Erin Moore for Dallas County Commissioner Dr. Theresa Daniel (Commissioner Daniel), the Fort Worth League of Neighborhood Associations, Frack Free Denton, Keep America Moving, the League of Women Voters of Dallas, the League of Women Voters of Irving, Liveable Arlington, the Lone Star Chapter of the Sierra Club, the North Texas Renewable Energy Group, Public Citizen, the Regional Transportation Council (RTC), the Sierra Club, the Sierra Club of Dallas, the Texas Campaign for the Environment, the Texas Medical Association, the United States Environmental Protection Agency (EPA), and 51 individuals.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

GENERAL COMMENTS

General Support

Congresswoman Johnson acknowledged the effort of the Texas Commission on Environmental Quality (TCEQ or agency) staff in developing the proposal and expressed support of the collaboration between federal and state agencies to develop a successful strategy for preserving the environment and improving the health of the DFW region. The RTC commended the TCEQ for quickly turning around this 2017 DFW AD SIP revision for the 2017 attainment year. The EPA expressed appreciation for the TCEQ's consideration of the numerous measures to reduce emissions of ozone precursors, and noted that the TCEQ analysis indicates that a number of the measures would require local action to implement. The EPA encouraged the TCEQ to support local, voluntary implementation of the most cost effective measures, to the extent possible.

The TCEQ appreciates the support and is committed to working with local entities and interested parties to keep them updated on SIP developments and informed about technical issues related to air quality. No changes were made in response to these comments.

Public Participation

The Sierra Club and Downwinders appreciated the opportunity to submit comments on the TCEQ's Attainment Demonstration SIP for the 2008 eight-hour ozone National Ambient Air Quality Standard (NAAQS). The RTC expressed appreciation for the staff who held a public hearing in the DFW region. An individual expressed concern that the TCEQ does not act in the interest of citizens and that the TCEQ's rules are not designed to provide easy points of information access for citizens. An individual commented that public hearings are a total exercise in futility and are ineffective.

The League of Women Voters of Dallas noted appreciation for the TCEQ's public hearing to allow the democratic process of citizens' participation in critical decisions affecting the air that all North Texans breathe and submitted the following:

> The League of Women Voters of Dallas support the preservation of the physical, chemical, and biological integrity of the ecosystem and maximum protection of public health and the environment. We support regulation of pollution sources by control and penalties, inspection and monitoring, full disclosure of pollution data, incentives to accelerate pollution control. We support vigorous enforcement mechanisms including sanctions for states and localities that do not comply with federal standards and substantial fines for noncompliance. We support measures to reduce vehicular pollution, including inspection and maintenance of emission controls, changes in engine design, fuel types, and the development of more energy-efficient transportation systems. We support regulation and reduction of pollution from stationary sources, regulation and reduction of ambient toxic air pollutants, and measures to reduce transboundary air pollutants such as ozone and those that cause acid deposition.

The TCEQ encourages public participation in the SIP development process and appreciates the efforts of those who took the time to evaluate the proposed DFW AD SIP revision and provide oral and written comments. The TCEQ takes its duties very seriously and has reviewed and analyzed all testimony related to this 2017 DFW AD SIP revision, provided responses to comments, and made changes as

appropriate. All public comments received have been included in this 2017 DFW AD SIP revision package for submission to the EPA.

The TCEQ also strives to provide information on agency activities to the public. To get e-mail or text updates on your choice of topics from the TCEQ, go to https://service.govdelivery.com/accounts/TXTCEQ/subscriber/new. No changes were made in response to these comments.

Incorporation of Previous Comments

The Sierra Club and Downwinders requested that the comments they submitted to the TCEQ in February 2015 on the 2018 Proposed *DFW 2008 Eight-Hour Ozone Nonattainment Area Attainment Demonstration SIP Revision* be incorporated by reference, except to the extent those comments explicitly address issues unique to attainment in 2018 rather than to the current attainment year of 2017.

The 2018 DFW 2008 Eight-Hour Ozone Standard Nonattainment Area AD SIP Revision and the Response to Comments adopted by the commission on June 3, 2015 (2018 DFW AD SIP revision), Non-rule Project 2013-015-SIP-NR) that address the comments submitted by the Sierra Club and Downwinders are incorporated by reference and can be found on the TCEQ's Web page at: https://www.tceq.texas.gov/assets/public/implementation/air/sip/dfw/dfw_ad_sip_2015/AD/Adoption/DFWAD_13015SIP_ado_all.pdf. No changes were made in response to these comments.

General Air Quality Concerns

Congresswoman Johnson expressed sensitivity to the problems arising from poor air quality and the damaging impact it can have on the health of Texans, and indicated more must be done to protect sensitive populations from the negative health effects of ozone. The DFW Chapter of System Change Not Climate Change expressed concern that many more thousands will die and more should be done to save children and the planet.

Liveable Arlington was concerned about the intense drilling in Arlington and its neighboring cities; as residents, they spend time always surrounded by drilling emissions and the children are constantly exposed to emissions. The Denton Drilling Awareness Group and Frack Free Denton were concerned about the contributions of oil and gas development to the degradation of the air quality in North Texas and endorsed many of the comments made at the public hearing regarding the SIP and modeling.

Keep America Moving stated that they have seen the air turn black in Fort Worth. Empowering Oak Cliff commented that the poor air quality limits time outside and was concerned that after it rains, a brown haze rolls into Dallas. An individual commented that the pollution is actually visible, a purplish-gray shroud that hangs over the area.

An individual expressed concern that the most recent evidence shows the smog pollution increasing from 81 parts per billion (ppb) in 2014 to 83 ppb in 2015 and that the TCEQ has failed to take sufficient steps to mitigate this problem. An individual was concerned that others will not move to Dallas because of the poor air quality. An individual urged the TCEQ to take care of the air, the children, this country, and environment. An individual expressed concern that the TCEQ does not responsibly monitor or require that businesses not pollute the air and water. An individual was concerned that the urban smog feeds upon itself as people create a dome of trapped pollution. An individual was concerned about bad air quality and commented that key decision makers should make changes.

An individual was concerned about the haze coming into downtown Dallas and having to stay inside on an ozone day due to respiratory problems. An individual was concerned about the adverse health effects experienced during ozone alert days and noted that a family member can feel when there's an ozone alert day and takes medications to deal with it. An individual commented that it's time to stop having red alert days, bad air days, and stay-inside days. An individual commented that citizens have been attending meetings for years and describing to various officials how the air around the DFW area has negatively affected their health.

The TCEQ takes its responsibilities very seriously and endeavors to protect the public interest in every action it takes, including those intended to reduce air pollution. The TCEQ strives to protect Texas' human and natural resources, including those in the DFW area, consistent with sustainable economic development, as required by state and federal laws. Information regarding air quality and health effects is provided in the Health Benefits section in this response to comments. No changes were made in response to these comments.

TCEQ Failure to Meet Clean Air Standards

Councilmember Greyson commented that after 20 years of plans that have not met clean air standards, the TCEQ needs to put a better plan in place than the one currently proposed. The Sierra Club and Downwinders commented that although the measures required to ensure compliance with ozone standards in the DFW area raise difficult political issues, the TCEQ has failed to fulfill its obligation to protect the public from the deleterious human health and economic impacts of ozone pollution for more than 45 years. Empowering Oak Cliff commented that it is no longer standing idle but demanding action. Public Citizen commented that for over 20 years it has been working with the TCEQ to come up with a clean air plan to reduce air pollution in the DFW area, and the TCEQ and the State of Texas have failed to protect the people who live and breathe in the DFW area from the impacts of air pollution.

The Texas Campaign for the Environment commented that after 20 years there is still not a plan that meets the Federal Clean Air Act (FCAA) requirements. The DFW Chapter of System Change Not Climate Change commented that the TCEQ has failed repeatedly. The League of Women Voters of Dallas commented that the DFW area has been in continual violation of the Federal Clean Air Act for ozone pollution since 1991, and is currently classified as a nonattainment area for the current federal eight-hour ozone standard of 75 ppb, which is now considered to be inadequate and soon to be replaced by lower 70 ppb standard. The Lone Star Chapter of the Sierra Club commented that over the last 20 years the State of Texas has never succeeded in bringing the DFW area into compliance with the FCAA. Further commenting that North Texas has waited too long, and it's time for the TCEQ to address the regional air problems and devise a successful air plan.

Two individuals commented that the DFW area has been in nonattainment since 1991. An individual commented that for 20 years the region has waited for more than marginal kind of SIPs. An individual commented that if the area hasn't been in attainment since 1991, the whole organization is a failure. An individual is concerned that the TCEQ gives contentious responses to the EPA, doesn't answer its questions, and refuses to do what the EPA asks the TCEQ to do.

An individual commented that there's pressure from the polluters' side, and there is no way the TCEQ will move forward with implementing any of these strategies that are well-known and have been implemented all over the place to clean up the air.

An individual commented that state government has failed thousands of Texans for the last 20 years and that's not close enough, that's long enough. Two individuals commented that they are putting their energy toward pleading with the EPA and that 20 years of illegal air sounds criminal. An individual commented that based on a systemic statewide disregard for environmental concerns, the commenter has no confidence in this state's willingness or ability to adequately address air quality standards. An individual commented that previous SIPs have failed, decades have passed, and this SIP is the latest in a sad procession of SIPs supposedly researched and then designed to bring the North Texas region into compliance with federally mandated ozone levels. An individual commented that he attended the public hearing for one reason, to inspire long overdue action to reduce ozone in North Texas.

The TCEQ does not agree that it has failed in carrying out its duties. As discussed further elsewhere in this response to comments, air quality in the DFW area has improved dramatically as a result of state, local, and federal air pollution control measures. The TCEQ remains committed to working with area stakeholders to attain the 2008 eight-hour ozone standard as expeditiously as practicable in accordance with EPA rules and guidance and the FCAA. As discussed in this SIP revision, assessment and evaluation of ozone formation is complex, involving hundreds of chemical compounds and chemical reactions, since ozone is not emitted directly. The TCEQ follows EPA rules and guidance in the development of required attainment demonstrations to determine the appropriate mix of control strategies best targeted to address ozone formation in a particular airshed. As shown in Chapter 3, and Appendix B, of this AD SIP revision, the on-road and non-road mobile source categories are the primary sources of NO_X emissions in the DFW nonattainment area, and the FCAA generally preempts state authority to adopt or enforce emissions standards for mobile sources. No changes were made in response to these comments.

Reevaluate the SIP and Add Controls

Congresswoman Johnson expressed concern that the TCEQ's current SIP falls short of complying with federal standards and that additional steps may be needed to protect the health of the citizens. Commissioner Daniel commented that the EPA finds the TCEQ SIP to be inadequate. Further, leading medical experts have asked the EPA to reject the plan for health reasons; Dallas County citizens need the TCEQ to provide a plan that can meet or exceed the current standard of 75 ppb. Commissioner Daniel noted that only attainment should be considered close enough. Councilmember Greyson commented that an effective plan is needed with measures that will get the area to the clean air goal. Councilmember Greyson also referenced the EPA's comment that with the shorter attainment date, the EPA remains concerned that there are no new measures beyond federal measures and fleet turnover and that additional local and regional ozone precursor emission reductions will be necessary to reach attainment by 2017.

The Sierra Club and Downwinders commented that the TCEQ's proposed 2017 AD SIP revision is significantly flawed and cannot be approved by the EPA. Liveable Arlington commented that if the SIP revision that's been submitted by the TCEQ did a good job of reducing pollution, one would see significant drops in ozone in this area. These reductions in ozone would be sufficient to bring most parts of the metroplex into compliance with the current 75 ppb standard. The Texas Campaign for the Environment noted that close enough is not good enough and the TCEQ should not expect EPA approval.

The League of Women Voters of Dallas commented that the official EPA comments have stated that the TCEQ's newly proposed DFW clean air plan will not be effective without additional reductions in smog-forming pollution and warn that the state's refusal to comply with certain Clean Air Act requirements make the plan unacceptable. They urged the TCEQ to seriously reevaluate the SIP that it presented and develop a plan to clean the air and protect public health and the environment.

Public Citizen commented that the SIP once again fails to make any significant reduction in power plants, the kilns, or the emissions from the Barnett Shale. Liveable Arlington commented that a plan that cannot take the area to 75 ppb in a timely way and takes no steps to reduce smog-forming pollution from the oil and gas industry does not protect residents of the area. The Lone Star Chapter of the Sierra Club commented that there is a need for meaningful pollution standards on oil and gas equipment, coal plants, cement kilns, and other major pollution sources.

The Fort Worth League of Neighborhood Associations commented that at the 2015 convention in November, the Texas Medical Association passed a resolution to reject the TCEQ's 2015 SIP and advocate for development of a new SIP report that conforms to the scientific peer-reviewed modeling methods developed by the University of Texas (UT) Southwestern Medical School and the University of North Texas experts. The Texas Campaign for the Environment commented that this plan is supposed to provide clean, healthy, safe, and legal air and it does not. The Sierra Club of Dallas stated that it is absolutely horrified at the complete disregard for human health and safety by the State of Texas, which has never taken a single step to make the oil and gas industry the least bit safe to Texas residents.

An individual commented that the TCEQ should take this seriously and reevaluate the SIP that's been presented and come up with something that works for everybody. An individual commented that people are angry about all the ineffective air SIPs. An individual noted that the so-called clean air plans, including this update to the DFW eight-hour ozone SIP, have never brought the area into compliance with EPA standards. Three individuals expressed concern that the TCEQ holds hearings and appears to listen, but then another meaningless plan is thrown out to the public. An individual commented that the people of DFW have suffered for many years under inadequate clean air plans and the proposed SIP plan will not help to achieve cleaner air, but keeps the public imprisoned in polluted air by a state agency that does not consider the health and welfare of the public when formulating so-called SIP plans. An individual commented that the Texas air has been getting dirtier since the 1990s and the last five times Texas has done a SIP it has failed to implement a plan that makes meaningful cuts in the emissions to get the air clean, yet the TCEQ considers it close enough; the individual's granddaughter commented that this may not make a dent, but all kids need clean air to breathe. An individual disagrees with the proposed rulemaking because it is not aggressive enough to result in meeting the proposed ozone limits, much less the lower limits arguably required to prevent adverse health effects.

An individual commented that the State of Texas is the Flint, Michigan of air quality; they breathe in illegal air and smog. An individual asked that the TCEQ consider with all seriousness the significance of the resolution passed by the 40,000+ membership of the Texas Medical Association to reject the current version of the SIP. Further, the commenter was concerned that all of North Texas is at great risk for a host of ailments, including death, as a result of the toxicity in the air and for which the TCEQ bears the burden of responsibility.

Twenty individuals commented that they are opposed to the awful State air plan for DFW because it doesn't include any cuts in pollution from major sources and doesn't cut smog enough to comply with the current smog standard. An individual implored the EPA to hold to the regulations that are available to it to impose on industries. An individual commented that this new SIP, fully in the spirit of regulatory make-believe, advocates no new strategies for ozone reduction. An individual commented that it's disgusting and unacceptable that the TCEQ would propose a plan with no new cuts in emissions whatsoever.

An individual commented that it's maddening and extremely frustrating that this SIP doesn't deal with drilling emissions.

The purpose of this DFW AD SIP revision is to demonstrate attainment of the 2008 eight-hour ozone standard in accordance with the EPA's guidance and FCAA requirements. The DFW area has made considerable improvement in air quality, as evidenced by the information provided in this DFW AD SIP revision. For example, between 2000 and 2014 the eight-hour ozone design value has trended downward 21 ppb, as a result of both state and federal rules. The number of days with at least one DFW eight-hour ozone monitored value day over 75 ppb has also decreased from 63 to 12 over the same period. The DFW area design values by monitor ranged from 88-102 ppb in 2000, but ranged from 67-81 ppb as of 2014 with 45% of these monitors either at or below the 75 ppb standard. Progress toward attainment of the ozone standard from 2000 through 2014 has been significant, even in light of DFW area human population increasing by 32% during this period and vehicle miles traveled increasing by 16%, which largely influences mobile emissions. All emissions in the nonattainment area (on-road mobile, non-road mobile, stationary point sources, and area sources) were reviewed in this DFW AD SIP revision. For more information on power plants, cement kilns, or the emissions from the Barnett Shale, see the Control Strategy and Technical Analysis sections in this document.

The TCEQ has evaluated all relevant information documented in this SIP revision in addition to public comment in reaching its decision regarding the appropriate control strategies for the DFW nonattainment area.

No changes were made in response to these comments.

The DFW SIP Revision Should Be Replaced With a Federal Implementation Plan

Congresswoman Johnson was hopeful that the TCEQ is up to the challenge and would call on the EPA to ensure that the right of Texans to clean air is protected. Councilmember Greyson commented that the state needs to adopt the EPA's suggestions for this plan, or the EPA should formulate the plan.

Public Citizen announced it doesn't believe the TCEQ anymore, and is asking the federal government and the EPA to come in and do a federal implementation (FIP) plan to finally clean up the air in Texas. The League of Women Voters of Irving urged the TCEQ to revise the plan and meet the requirements, if not, the EPA needs to do the job that the TCEQ seems to lack the will to do. The Sierra Club of Dallas stated that clean air is a basic human right, not something that the State of Texas should be allowed to take away and give to the oil and gas companies to use as a sewer and further commented that it's time for this tragedy of justice to stop; the EPA needs to take over the SIP and bring some sanity and morality to the state. Liveable Arlington strongly urged the EPA to reject and implement a better plan that deals with the harmful effects of pollution from oil and gas drilling. The Lone Star Chapter of the Sierra Club commented that it's time for the EPA to take over the air planning process with a FIP plan and reject allowing the TCEQ to continue the planning process any further; the TCEQ has failed to clean up the air in the DFW region for more than two decades and action and results are needed.

The North Texas Renewable Energy Group commented that it is going to continue its war on coal and the TCEQ and further stated that the EPA needs to step in and declare this new SIP a failure. The Texas Campaign for the Environment commented that if the TCEQ doesn't take responsibility to clean up industry, the EPA needs to do a FIP. The Dallas County Medical Society and the Texas Medical Association commented that the physicians of the Dallas County Medical Society and the 45,000 physicians of Texas are dismayed by the TCEQ's rejection of their petition for rule change and failing an immediate revision, urges the EPA to respond to the problem with a FIP. The FW League of Neighborhoods urged the EPA to reject the proposed clean air plan of the TCEQ.

An individual asked the EPA to please take over the Texas SIP. An individual commented that people are beyond frustrated that they have been working on this issue for years, written the powers that be, gone to meetings and hearings, and their pleas are always met by deaf ears. Further, the individual urged the EPA to please get involved in this process and take over for the TCEQ in this matter. An individual commented that Texas needs a good smog plan for DFW and the EPA is the only hope to breathing cleaner air; the State of Texas does not have the citizen's best interest when it comes to air including frackquakes from the oil and gas industry. An individual commented that in the event the TCEQ can't do what it should, EPA, Region 6 is the only hope.

An individual noted that the Clean Air Act requires the EPA to implement a FIP if a SIP fails to include measurements that will assure attainment of the NAAQS. An individual requested an EPA intervention to ensure the air quality in DFW so the seven million people it affects get the attention they deserve. Two individuals commented that after 20 years, they are done asking the TCEQ to do much of anything, and hope that at this point the EPA steps in. An individual pleaded with the EPA to take the area into the 21st century with a FIP, not a SIP. An individual urged the staff to solve the issues or resign and requested that the EPA take over. An individual commented that the EPA is the last hope in this state, in this region, to get this done. Further commenting that enough is enough, and it's time that the EPA take this region over with a FIP. An individual commented that the only way that the citizens of the area will ever begin to enjoy reasonably healthy air is if the EPA institutes a plan capable of bringing the DFW area into compliance with a new 70 ppb standard. An individual urged the EPA to please take over the problem and that the TCEQ commissioners need to be fired. An individual commented that the state needs to do its job or the EPA is going to do it for the state. An individual commented that it is the duty of the people to nurture the world and protect it and pled with the EPA to take over the management of air quality from the TCEQ, establish severe, meaningful, and enforceable regulations on polluters to give citizens the clean and safe air they deserve to breathe.

The DFW area has seen considerable improvement in air quality since the time of the area's initial nonattainment designation under the one-hour ozone standard in 1991. In 2008, the EPA issued a determination that the DFW four-county one-hour ozone nonattainment area (Collin, Dallas, Denton, and Tarrant Counties) had attained the one-hour NAAQS based on certified 2004 through 2006 monitoring data and was further supported by 2007 through 2008 monitoring data. The DFW area continues to monitor attainment of the one-hour ozone standard. In addition, the eight-hour ozone design values in the DFW area have been trending downward since 2000, and the area is now monitoring attainment of the 1997 eight-hour ozone standard based on certified 2012 through 2014 monitoring data. On February 24, 2015, the TCEQ submitted early certification of 2014 ozone air monitoring data to the EPA, along with a request for a determination of attainment for the 1997 eight-hour ozone standard (85 ppb) for the DFW area. On September 1, 2015, the EPA finalized a clean data determination for the DFW 1997 eight-hour ozone nonattainment area (80 *Federal Register* [FR] 52630). The DFW area continues to monitor attainment of the 1997 eight-hour ozone standard with preliminary monitoring data for 2013 through 2015.

This SIP revision satisfies the FCAA, §182 requirements and EPA guidance for the DFW nonattainment area under the 2008 eight-hour ozone standard by demonstrating attainment of the 2008 eight-hour ozone NAAQS by July 20, 2018 based on a photochemical modeling analysis of reductions in nitrogen oxides (NO_X) and volatile organic compounds (VOC) emissions from existing control strategies and a WoE analysis. Once a SIP revision is adopted by the commission, the SIP package is submitted to the EPA. Once submitted, the EPA will review this SIP revision and either approve or disapprove it.

Since the modeling cannot provide an absolute prediction of future-year ozone design values, additional information from corroborative analyses are used in assessing whether the area will attain the ozone standard by July 20, 2018. The 2017 future-year design value (DV_F) calculations are provided using both the "all days" and "top 10 days" attainment tests discussed below. A WoE range of 73-78 ppb is inferred from the EPA official modeling guidance from April 2007 entitled *Guidance on the Use of Models and Other Analyses for Demonstrating Attainment of Air Quality Goals for Ozone, PM2.5, and Regional Haze* (https://www3.epa.gov/ttn/scram/guidance/guide/final-03-pm-rh-guidance.pdf). Use of the "all days" attainment test from this official modeling guidance results in a peak ozone design value of 77 ppb that falls within this 73-78 ppb range. The EPA released a draft update to this modeling guidance in December 2014 entitled *Draft Modeling Guidance for Demonstrating Attainment of Air Quality Goals for Ozone, $PM_{2.5}$, and Regional Haze* (https://www3.epa.gov/ttn/scram/guidance/guide/Draft_O3-PM-RH_Modeling_Guidance-2014.pdf) which does not specify a WoE range, and instead requires that the DV_F figures be "close to the NAAQS." The newer "top 10 days" attainment test results in a peak ozone design value of 76 ppb that meets this requirement. Differences in the application of these two tests are more thoroughly

described in Chapter 3: *Photochemical Modeling*, Section 3.7.2: *Future Baseline Modeling*.

The WoE includes supplemental evidence that the conclusions derived from the basic attainment modeling are supported by other independent sources of information including: emission trends, additional air quality studies, air quality control measures that are not quantified but are nonetheless expected to yield tangible air quality benefits, and on-going initiatives that are expected to improve the scientific understanding of ozone formation in the DFW nonattainment area. No changes were made in response to these comments.

Texas Campaign for the Environment stated that the EPA has said that the proposed plan is not adequate, that this plan does not follow the law, and that it is not an option to not follow the FCAA.

The commission disagrees with the commenter that it has not followed the law in preparing this SIP revision. At the time of the public hearing on the 2017 DFW AD SIP revision in Arlington, Texas on June 21, 2016, the EPA had not yet offered formal comments on this 2017 DFW AD SIP revision but had commented on a previous demonstration using a different attainment date. The commission has considered all comments, including the comments that the EPA has submitted on the current 2017 DFW AD SIP revision. The commission has followed all relevant EPA guidance on how to develop an AD SIP revision, and is submitting an DFW 2017 AD SIP revision with all required elements. The commission agrees that it is necessary to follow the FCAA, and this AD SIP revision contains all elements required by the FCAA and EPA guidance. No changes were made in response to this comment.

An individual commented that he is concerned about recent news stories about the Environmental Defense Fund petitioning the EPA to revoke the TCEQ's authority to develop clean air implementation plans because of recent Texas legislative actions. The individual is also concerned about lawsuits brought by Texas to prevent EPA enforcement of the Clean Air Act and is concerned about the TCEQ's implementation plan.

These comments are beyond the scope of this action. The TCEQ continues to meet its obligations under the FCAA, including the obligation to develop a plan to bring any ozone nonattainment areas, including the DFW area, into attainment as expeditiously as practicable. That is the purpose of the current 2017 DFW AD SIP revision. Any current lawsuits between the EPA and the TCEQ have no direct relation to the purpose of this AD SIP revision. No changes were made in response to these comments.

Environmental Justice

Congresswoman Johnson commented that working together, greater strides can be made for environmental justice and cleaner air for all. An individual stated that West Dallas is the poster child for environmental racism due to the poverty in the area, which has existed since he was a child.

The TCEQ has made a strong commitment to address such issues by creating the Environmental Equity Program within the Office of the Chief Clerk. The goals of the Environmental Equity Program are to: help citizens and neighborhood groups participate in regulatory processes; serve as the agency contact to address allegations of environmental injustice; serve as a link for communications between the community, industries, and the government; and thoroughly consider all citizens' concerns and handle them fairly. Additional information can be found on the TCEQ's Environmental Equity Program Web page (http://www.tceq.texas.gov/agency/hearings/envequ.html). No changes were made in response to this comment.

TCEQ Leadership Needed

Keep America Moving and one individual expressed general frustration that the commissioners do not attend public hearings. The Denton Drilling Awareness Group and Frack Free Denton commented that the state and federal government need to protect the public and not create conditions that make the public sick. The League of Women Voters of Irving and an individual commented that Texas government makes the public sick and that people are being harmed by bad politics and bad public policy, and further stated that all that matters to the TCEQ is adhering to the rigid party line no matter how much science is denied in the process; TCEQ leadership has no political will to make hard decisions and yet the state government is taking credit for federal gains in clean air that were done despite the state's resistance. Public Citizen commented that the commissioners and the governor have failed and failure should never be rewarded, and it's time for somebody who will actually do the job to step in and take over.

An individual commented that the TCEQ does not have the political will nor the fortitude to implement a SIP that would enable the area to attain compliance with the Clean Air Act. An individual commented that the public should come first and leaders should protect the people and not industry. An individual expressed dissatisfaction that the commissioners will not take the public's side but rather, the polluters when it comes to decisions regarding air quality. Five individuals were concerned that the TCEQ doesn't listen when citizens warn of toxic air in DFW that is making children sick and challenged the TCEQ to protect citizens and not repeat what happened in Flint, Michigan when state government ignored the problem.

The TCEQ appreciates and understands the concerns and frustrations expressed by the commenters. The commission is kept apprised of comments and approve these responses, as well as the SIP revision. In making decisions regarding proposed and final SIP revisions, the commission carefully considers public comments and concerns, which are a valued part of the SIP revision process. As discussed elsewhere in this response, air quality has improved dramatically as a result of state, local, and federal air pollution control measures. Additionally, specific health effects associated with air quality are discussed further elsewhere in this response to comments document. No changes were made in response to these comments.

Economic Effects and Profits Over Public Health

Congresswoman Johnson commented that effective regulations will have a positive economic impact by promoting job creation, encouraging scientific innovation, and promoting the creation of new technologies. The Sierra Club and Downwinders commented that reductions in ozone levels from the curtailment of emissions at the five largest coal plants in East Texas would not only result in significant improvement in public health but would yield substantial economic development and the creation of jobs.

The TCEQ agrees generally that effective regulations should minimize negative economic impact. Whether the curtailment of emissions at the five largest coal plants in East Texas would yield substantial economic development and creation of jobs is outside the scope of this DFW nonattainment area SIP revision. For general information on ozone impact on public health, see the Health Benefits section on page 14 of this response to comments document. No changes were made in response to this comment.

An individual commented that the TCEQ's proposed SIP is outrageous and unacceptable and proves once again that the TCEQ sadly cares more about polluters' profits than about the public health. The Sierra Club of Dallas was concerned that the State of Texas only cares about corporations that give campaign contributions to legislators; clean air is a basic human right, not something that the State of Texas should be allowed to take away from the people and give to the oil and gas companies. The Texas Campaign for the Environment commented that often times a state environmental agency acts as a rubber stamp for polluting companies.

The DFW Chapter of System Change Not Climate Change commented that the bad air quality in this state is due to leaders who are on the side of industry and polluters. Keep America Moving was very concerned that if oil and gas companies go bankrupt, there will be hundreds of injection wells full of contaminated fracking fluid and frack ponds that will need to be cleaned up. Further, the concern is that the state budget will lose income from the same oil and gas companies and may not be able to provide funding for the TCEQ to do the cleanup. Two individuals were concerned about corporate greed and people not having the will to enforce policy.

An individual was concerned about chronic air pollution in DFW and compared it to a time in 19th century England when the government backed the smoke-producing monopolists rather than the public health. An individual was concerned that leaders protect industry over people. An individual is concerned that the State of Texas prioritizes financial gain in the oil and gas industry ahead of public health concerns. An individual was very concerned that big oil's profits are worth more than health to the government. An individual commented that state and local policy leaders only respond to those representing industry profits, the economy, and jobs, so it's senseless to have repeated hearings on how to protect clean air and water, better health and quality of life, and reduction in premature death.

An individual was concerned that big government says that any type of control will cause a weak economy and loss of jobs, but employers lose about 14 million workdays every year when asthma keeps an adult out of work and $650 million a year in productivity is lost. An individual commented that the State of Texas clean air plan is a shellgame influenced by elected officials who protect the oil and gas industry and profits. The commenter also stated that people put trust in the EPA and the TCEQ to protect the air for kids with respiratory issues who suffer and die under regulatory capture.

The TCEQ appreciates the concerns expressed by the commenters but does not agree that it is only concerned with industry profits or the economy. As discussed elsewhere in this response, the TCEQ takes its responsibilities seriously and

strives to protect the state's human and natural resources consistent with sustainable economic development, as required by the general powers and duties granted to the commission by the Texas Legislature. The DFW area has made considerable improvement in air quality while steadily increasing in population and gross metropolitan product.

For example, between 2000 and 2014, the eight-hour ozone design value has trended downward 21 ppb. The number of days in the DFW area where the daily eight-hour ozone peak exceeded 75 ppb has also decreased from 63 to 12 over the same period. The DFW area design values by monitor ranged from 88-102 ppb in 2000, but ranged from 67-81 ppb as of 2014 with 45% of these monitors either at or below the 75 ppb standard. According to the most recent data from the United States (U.S.) Bureau of Economic Analysis website (http://bea.gov), from 2000 to 2014, the DFW metropolitan area's economy grew from $254.5 billion to $504.4 billion while the Combined Statistical Area population increased by 37.5% according to the Census Bureau website (http://census.gov). No changes were made in response to these comments.

An individual expressed general dissatisfaction with TCEQ permitting, TCEQ SIP planning, and alleged inadequate TCEQ responses to past EPA requests.

The TCEQ is aware of the general dissatisfaction with SIP planning noted by several commenters. SIP planning is a detailed and highly technical process that involves both technical and policy objectives. As discussed further elsewhere in this response to comment document, the TCEQ takes its responsibility in SIP planning extremely seriously and values public input in this process. There were no specific issues mentioned in the comments, therefore, the TCEQ cannot further address this comment. No changes were made in response to this comment.

State of Texas Usurping Local Control

The Denton Drilling Awareness Group and Frack Free Denton commented that the people of Denton voted by an overwhelming margin to take measures to clean up the air in Denton, and the State of Texas saw fit, at the urging of the oil and gas industry, to "swat down" Denton's effort to protect itself and to breathe clean air. An individual commented that Denton citizens tried to correct negative impacts of fracking in their community but legislators on the side of the energy industry took away local control. An individual expressed concern that an oil and gas CEO once verified for a group of folks at a homeowner's association meeting that talk of peaceful protesting in Denton has people on a Homeland Security watch list and if they can't buy policymakers, they resort to open intimidation.

An individual commented that local elections curbing drilling and fracking are just nullified at the state level. An individual commented that even if the city council were to deny future drilling, the state's going to sue them, so there is nobody to turn to. An individual commented that Texas law turns a blind eye to the dangers of fracking showing more concern for oil and gas production than for protecting the land upon which they live and work and play and breathe. The commenter further stated that even if the majority of property owners in an urban area vote to disallow fracking in their neighborhoods, they essentially have no say in the matter as per Texas' new laws unless they can prove that fracking is not commercially beneficial to the state.

Comments regarding legislative support for local and regional governments or legislative funding priorities are outside the scope of the commission's authority. No changes were made in response to these comments.

HEALTH EFFECTS

Congresswoman Johnson, Commissioner Daniel, Public Citizen, the Sierra Club of Dallas, the Dallas County Medical Society, the Texas Medical Association, Liveable Arlington, the Sierra Club and Downwinders, the Fort Worth League of Neighborhood Associations, Empowering Oak Cliff, and 40 individuals expressed concern for the DFW area's air quality and its impact on human health. One individual expressed concern about getting nosebleeds upon moving to the area. Congresswoman Johnson, Public Citizen, Liveable Arlington, and one individual noted concern that the American Lung Association has given the DFW area air quality a failing grade. One individual stated that she couldn't encourage someone to move to the area because the air is worse in the Dallas area than it is in New York City, Boston, and Providence and it would endanger her friend's infant's health.

Several individuals and organizations expressed concern about area asthma. The Sierra Club and Downwinders and 24 individuals expressed concern about the incidence and prevalence of asthma and other respiratory and cardiovascular diseases in North Texas. The Sierra Club of Dallas, Empowering Oak Cliff, and five individuals expressed that they or their loved one(s) are suffering with asthma. One individual commented that, as a former teacher, she has seen an increase in childhood asthma and autism in her school. Liveable Arlington, the Fort Worth League of Neighborhood Associations, and 25 individuals commented that the DFW area has an asthma rate that is three times higher than the national average. The Sierra Club and Downwinders stated that 14% of adults in the DFW area have asthma, which is the highest prevalence rate in Texas, and more than 13% of Texas children will have asthma over the course of their childhood. The Sierra Club and Downwinders, and three individuals expressed concern that asthma disproportionately affects minorities. Three individuals described the difficulties of living with asthma. The Sierra Club and Downwinders, stated that ozone both exacerbates existing asthma and increases the risk of developing asthma with every 10 ppb increase in annual mean or eight-hour average ozone concentration.

The Sierra Club and Downwinders and seven individuals expressed that they or their loved one(s) have been diagnosed with pulmonary disease, such as bronchiectasis, bronchitis, or pulmonary fibrosis. Public Citizen noted the story of a member who had asthma and blamed upwind power plants for the lung cancer that she developed later in life.

The Sierra Club and Downwinders state that epidemiology studies consistently demonstrate that ozone is linked with various respiratory impacts, such as "lung function decrements, increases in respiratory symptoms, pulmonary inflammation in children with asthma, increases in respiratory-related hospital admissions and emergency department visits." The commenters also state that there is evidence that "repeated exposure over time causes additional health impacts which may even be more severe and less reversible."

In addition to respiratory morbidity, the Sierra Club and Downwinders stated that ozone exposure can lead to health impacts in the central nervous, cardiovascular, and reproductive systems, as well as perinatal and developmental impacts. Examples of cardiovascular impacts include increased risk of hospitalization for acute myocardial infarction, coronary atherosclerosis, stroke, and heart disease, as well as increased risk of children developing cardiovascular disease later in life. The commenters also expressed concern that ozone exposure caused reduced birth weight, premature delivery, and birth defects.

Commenters also expressed concern over ozone-mediated mortality. The Sierra Club and Downwinders and four individuals expressed concern that ozone levels in the DFW area caused the deaths of area residents and children. The Sierra Club and Downwinders stated that a 10 ppb increase in peak ozone concentration was associated with a 0.52% increase in mortality the following week and that ozone concentrations below 60 ppb were still associated with increased mortality. One individual stated that 76 to 100 people a year die needlessly in the area and that the TCEQ's "toxicologists of ill-refute" [sic] claim that "smog doesn't kill people, and they can claim there's no down side."

The Dallas County Medical Society, the Texas Medical Association, and three individuals expressed concern over comments from the TCEQ regarding ozone-induced health effects. The Dallas County Medical Society and the Texas Medical Association expressed surprise that the TCEQ stated that 70 to 80 ppb ozone does not hurt humans and is "actually beneficial to humans' lungs." One individual suggested that the TCEQ mistakenly believes that ozone does not destroy human lung tissue. Another individual expressed alarm that the TCEQ used taxpayer money to contract with Gradient Corporation to challenge the science behind the ozone standard and argue that health benefits are not worth the cost of regulation. A third individual expressed frustration that the TCEQ's chief toxicologist tells residents to stay inside on high ozone days.

Congresswoman Johnson, Commissioner Daniel, the Dallas County Medical Society, the Texas Medical Association, Liveable Arlington, the Sierra Club and Downwinders, and two individuals noted the economic savings of attaining a lower ozone standard. Specifically, Congresswoman Johnson noted poor air quality leads to higher healthcare costs and lost productivity. Commissioner Daniel, the Sierra Club and Downwinders, the Dallas County Medical Society, the Texas Medical Association, and two individuals referenced a study by Dr. Robert Haley showing a savings to northeast Texas of $650 million a year and prevention of 95 to 100 deaths annually for a 5 ppb reduction in ozone. The Dallas County Medical Society used the EPA's benefits-mapping computer model to estimate that a 5 ppb reduction in ozone would "prevent 165 hospital admissions, 350 emergency room visits, 150,000 restricted activity days, ... 120,000 school absences, and 77 deaths per year from lung and heart disease catastrophes, with an economic valuation to the area of over $500 million" per year in the DFW nonattainment area. Liveable Arlington stated that decreasing benzene emissions would lower smog and improve "other public health situations."

The FCAA requires the EPA to set the primary ozone NAAQS at levels that protect the health of the public, including infants, children, the elderly, and those with pre-existing conditions, such as asthma. The TCEQ takes the health and concerns of Texans seriously and, through regulatory and voluntary efforts with area industry, communities, and individuals, concentrations of ozone and ozone precursors have steadily decreased in Texas and in the DFW area over the last 15 years. Specifically, between 2000 and 2014, the eight-hour ozone design value in the DFW area has decreased 21 ppb.

Concern was raised about general air quality in light of the failing grade the American Lung Association gave Texas. The grading system used by the American

Lung Association in its annual State of the Air report has drawn public criticism from a variety of organizations, including the EPA, Colorado Department of Public Health and Environment, Indiana Department of Environmental Management, Maryland Department of the Environment, and Hamilton County Department of Environmental Services (Kerrigan 2015). Among many issues, the report authors do not take into consideration the varying ambient concentrations within an area or an individual's actual exposure, which would be necessary to conduct an assessment of health risk in urban areas.

Ambient ozone concentrations have decreased considerably from 2000 to 2014 in the DFW area despite the population increasing by 32%. For more information, see the air monitoring data available on the TCEQ's Air Web page (http://www.tceq.state.tx.us/agency/air_main.html).

As noted by commenters and the media, the TCEQ has invested staff resources and state allocated funds in the analysis of ozone health effect data in an effort to provide a scientific peer review of an important ambient chemical that has many far-reaching regulatory implications. The TCEQ has never stated that ozone is beneficial to human lungs. In fact, the TCEQ has repeatedly agreed with the EPA that ozone is an irritating chemical that can cause acute respiratory symptoms at high enough doses, as described more fully in the sections below. The TCEQ's analysis, however, did note many inconsistent results, biases, and errors in both the ozone health data and how it was analyzed, as well as uncertainties in modeling and extrapolation of the data to real-world exposure scenarios. The TCEQ's work and official comments to the EPA highlighted these shortcomings and filled in some gaps in the EPA's analysis that were important to understanding the health effects of ozone.

The TCEQ's choice to analyze the ozone literature is consistent with its mission to protect our state's public health and natural resources consistent with sustainable economic development. The ozone analyses suggest additional scientific dialogue and evaluation are necessary to determine the point at which further lowering of ozone concentrations will have negligible benefits for human health. The TCEQ looks forward to additional collegial work with the EPA, ozone scientists, and public health experts to ensure regulatory standards are necessary and provide meaningful protection to Texans.

With respect to concerns about reducing time outdoors, the TCEQ encourages a broader understanding of pollutant exposure when determining whether to spend time indoors or outdoors. As detailed more fully in the section below, human subjects exposed to ambient-relevant ozone concentrations only experienced statistically significant health effects when they both vigorously exercised and were exposed over 6.6 hours. Vigorous outdoor exercise conducted over several hours during a day with ozone concentrations greater than 70 ppb is not a common combination, which makes the public less likely to experience adverse health effects. Conversely, the EPA has identified and characterized significant risks to public health from indoor environmental contaminants that are commonly found in homes, schools, offices, and other buildings, such as radon, tobacco smoke, molds, irritants in cleaning supplies, and combustion by-products.

According to the Texas Department of State Health Services, it is possible for indoor levels of air pollutants to reach up to two to five times higher, and occasionally even 1,000 times higher, than outdoor levels (TDSHS 2012). The TCEQ encourages individuals to consider more than ozone levels, such as the risk of extreme heat and exposure to indoor air pollutants, when making choices about whether to limit outdoor activities and stay indoors when ambient ozone concentrations are elevated above 75 ppb.

Responses to specific health-related concerns expressed by commenters are provided below.

Asthma

Current scientific literature does not provide a definitive link between ambient ozone levels and asthma development. Although earlier studies indicated asthma diagnosis was increasing, the 2010 Texas Asthma Burden Report noted that lifetime or current asthma prevalence in either Texas adults or children did not change significantly from 2005 to 2009, and the 2014 Texas Asthma Burden Report noted a similar plateau effect for the 2011 to 2013 period (TDSHS 2010, TDSHS 2014). , Figure 1: *2011 Asthma Prevalence Rates in the U.S., Texas has one of the lowest prevalence rates of asthma in the country (CDC 2013a)* in this response to comments document, page 22, overall, Texas has one of the lowest adult lifetime asthma prevalence rates in the country. According to 2013 Behavioral Risk Factor Surveillance System (BRFSS) survey, 17 states had higher childhood asthma prevalence rates than Texas (CDC 2013b). Furthermore, the 2013 prevalence of parents reporting that their child has been diagnosed with asthma and still has asthma in Health Service Region (HSR) 3, which includes the DFW nonattainment area, was lower than the prevalence rate in HSR 4, which includes Tyler, and HSR 10, which includes El Paso (TDSHS 2014). The 2014 eight-hour ozone design values in these areas were 71 ppb (Tyler) and 72 ppb (El Paso), well below the DFW design value of 81 ppb. This suggests that ozone concentrations do not readily predict asthma prevalence for these areas in Texas. In addition, contrary to comments received, the asthma rates for the region including DFW (HSR 3) are *not* three times higher than national averages (HSR 3: 8% for adults and 11% for children versus national averages of 7.4% for adults and 8.6% for children) (CDC 2014). These data suggest that childhood asthma rates in the DFW area are actually *lower* than some areas of the state and are only slightly elevated above national averages.

The trends in asthma prevalence and the lack of a definitive link between ambient ozone concentrations and asthma rates is consistent on the national scale. Abinkami et al. (2016) recently reported a plateau effect in nationwide childhood asthma prevalence. Large, multi-city studies, which have included Dallas, have not indicated a correlation between current ambient concentrations of ozone and increased incidence of asthma symptoms (O'Connor et al. 2008, Schildcrout et al. 2006). In addition, a more recent study has shown that the most important factors affecting asthma incidence are ethnicity and poverty (Keet et al. 2015). Finally, the EPA's analysis completed as part of the 2015 ozone NAAQS does not anticipate a statistically significant reduction in asthma exacerbations as a result of the lower standard (Table 6-20, USEPA 2015). Therefore, because asthma rates have

remained steady while ambient levels of both ozone and ozone precursors have been steadily decreasing and asthma rates can be higher in areas with lower ozone, it does not appear that ambient ozone concentrations are a significant contributing factor to asthma rates. Further, if ozone does not contribute to asthma incidence, then additional decreases in ambient ozone concentrations would not be expected to reduce the cost of illness nor would the reduction offer greater protection of children's health from new-onset asthma.

Although the causes of asthma are not fully understood, there are many factors that influence the development and exacerbation of asthma. According to the World Health Organization, one of the strongest risk factors for developing asthma is genetic predisposition. In addition, indoor allergens (dust mites, pet dander, and presence of pests such as rodents or cockroaches) together with outdoor allergens (pollen and mold), tobacco smoke, or other triggers such as cold air, extreme emotions (anger or fear), and physical exercise can all provoke symptoms in those with asthma. Some scientists have also suggested that changes in exposure to microorganisms (hygiene hypothesis) or the rise in sedentary lifestyle (affecting lung health) and obesity, which results in inflammation, may be to blame.

Again, the TCEQ agrees that breathing ground-level ozone at higher than typical ambient concentrations for hours while vigorously exercising may cause acute respiratory problems like cough and respiratory irritation and may aggravate the symptoms of asthma. Clinical studies in humans exposed to ozone verify this result and indicate that health effects can generally resolve quickly once an individual is no longer exposed to high ozone levels. The TCEQ uses this information to discuss and encourage meaningful regulatory policy and remains committed to ensuring the air is safe to breathe in all areas of Texas.

Ozone-Induced Mortality

The TCEQ does not support the assertion that ambient concentrations of ozone are causing death because the scientific data do not support it.

Clinical studies on hundreds of human subjects have shown only a range of mild, reversible respiratory effects in people that were exposed to between 60 ppb and 120 ppb ozone (representative of ambient concentrations) for up to eight hours while exercising vigorously (Adams 2006, Schelegle et al. 2009). Ethical standards preclude scientists from giving human subjects potentially lethal doses of chemicals, and none of the human subjects in these studies died as a result of their exposure to ozone. Basic toxicological principles indicate that concentrations of ozone (or any other chemical) that only cause a mild, reversible effect cannot also increase the incidence of all causes of death, even in a very sensitive individual. The dose of ozone that is lethal to experimental animals is orders of magnitude higher than ambient levels of ozone (Stokinger et al. 1957) and the National Institute for Occupational Safety and Health (NIOSH) Immediately Dangerous to Life or Health value for ozone is 5,000 ppb (NIOSH 2005). Therefore, the available information does not support assertions that there is a mechanism for ambient ozone to contribute to mortality. Epidemiology studies suggesting the possibility of ozone-mortality associations make the crucial error of not considering the actual

exposure of the people in the study. Rather, these studies assume that people are exposed to the level of ozone measured at the ambient monitor (sometimes to the highest ambient monitor in the entire metropolitan area), which could be up to 10-times higher than their actual exposure (Lee et al. 2004) and may not correlate at all with the person's actual exposure (Sarnat et al. 2001, Sarnat et al. 2005).

Furthermore, the epidemiology studies that are the basis for the conclusions about long-term exposure to ozone affecting mortality are, in fact, not consistent. The relationship between long-term ozone exposure and mortality has been investigated in at least 12 epidemiology studies. Rather than build its position on the entirety of available data, the EPA concludes that there is a likely causal relationship between ozone and long-term respiratory mortality based on a single epidemiology study (Jerrett et al. 2009). Only Jerrett et al. (2009) showed a statistically significant (but very small) correlation between ozone and respiratory mortality. Interestingly, the effect was only observed at temperatures above 82°F. Paradoxically, the effect was not observed in U.S. regions with the highest ozone concentrations (southern California) nor in areas with the highest number of respiratory deaths (the Northeastern U.S. and the industrial Midwest). Other studies that looked at the same population of people as Jerrett et al. (2009) did not find an association between long-term ozone exposure and cardiopulmonary mortality (Pope et al. 2002, Jerrett et al. 2005, Atkinson et al. 2016). Most recently, a study analyzing 14 publications from eight cohorts determined that there was "no evidence of associations between long-term annual O_3 [ozone] concentrations and the risk of death from all causes, cardiovascular or respiratory diseases, or lung cancer" (Atkinson et al. 2016).

<u>Respiratory Effects of Ozone</u>

The lowest concentration of ozone tested in human-controlled exposure studies that caused both a decrease in lung function and symptoms (the American Thoracic Society's definition of an adverse respiratory health effect; ATS 2000) was 72 ppb. These effects were mild and reversible, and the study subjects had to be exposed for 6.6 hours while vigorously exercising to show those mild effects (Schelegle et al. 2009). As stated above, this is a relatively uncommon combination of events (the person would also have to be outdoors), and in addition, these lung function effects may or may not even be detectable to the person experiencing them. Interestingly, rather than being more sensitive, children and asthmatics have been shown to have similar lung function effects after ozone exposure as healthy adults (McDonnell et al. 1985, Koenig et al. 1987, Holz et al. 1999, Stenfors et al. 2002). In addition, clinical studies have not shown increased lung function responses to ozone in people with chronic obstructive pulmonary disease (COPD), which includes chronic bronchitis, compared to healthy individuals (Gong et al. 1997). Indeed, there is little consistent data from epidemiology studies showing lung function effects of ozone on individuals with COPD (Peacock et al. 2011, Lagorio et al. 2006). There is also little evidence to suggest that ozone negatively impacts lung development. A recent study of children in the Los Angeles area, which has much higher levels of ozone than the DFW area (the 2014 eight-hour ozone design value was 102 ppb in Los Angeles versus 81 ppb in DFW) has shown that ozone has no effect on lung development (Gauderman et al. 2015).

Cardiovascular Effects of Ozone

Several recent studies have integrated all of the evidence for both short-term and long-term ozone exposure effects on cardiovascular disease and mortality. For both short-term and long-term exposure, the study authors found that the evidence was “below equipoise,” meaning that the evidence was not enough to conclude that either short-term or long-term exposure to ambient concentrations of ozone causes cardiovascular health effects (Goodman et al. 2014, Prueitt et al. 2014).

Other Health Effects

None of the available literature indicates that repeated exposure to ozone causes additional or more severe health impacts. In fact, two studies specifically noted an adaptive lung function response (that is, a decrease in response when exposure occurs constantly or repeatedly) to ozone exposure. Zanobetti and Schwartz (2008) noted that ozone mortality effects diminished in the later parts of the ozone season when individuals are presumed to have experienced repeated or prolonged potential for ozone exposure. In addition, Hackney et al. (1977) noted that lung function decrements (forced vital capacity, forced expiratory volume in one second, delta nitrogen, total respiratory resistance, and symptom scores) in study individuals who were “unusually” responsive to ozone had almost returned to control values by the fourth successive day of exposure.

Many different health effects have been investigated after ozone exposure. However, because data from minimal or inconsistent studies do not provide the WoE necessary to substantiate the association between pollutant exposure and the health outcome, only those health outcomes with consistent, robust data should be considered in the TCEQ’s and the EPA’s health risk assessments. Those that do not have robust datasets, and therefore are not included in the risk assessment, include: nose bleeds, autism, cancer, and perinatal, reproductive, and central nervous system impacts.

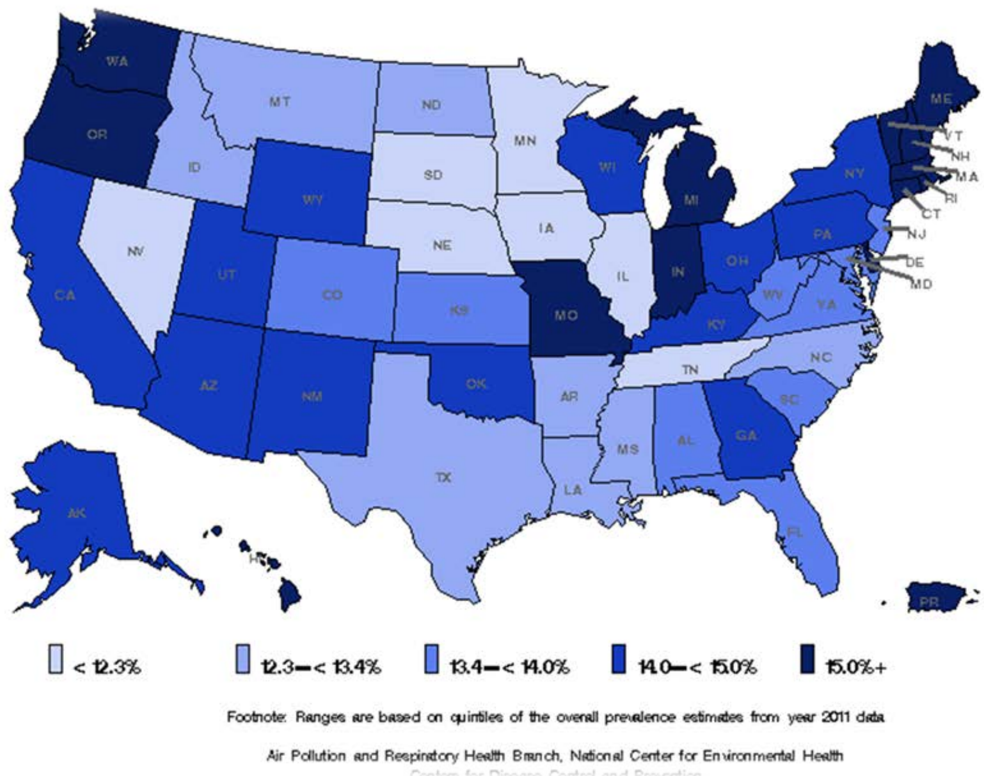


Figure 1: 2011 Asthma Prevalence Rates in the U.S., Texas has one of the lowest prevalence rates of asthma in the country (CDC 2013a).

<u>Benefits of ozone reduction</u>

The analysis provided by Dr. Robert Haley used the EPA's Benefits Mapping and Analysis Program (BenMAP) to calculate the health impacts of a 5 ppb reduction in ambient ozone concentrations in the DFW area. Most (over 90%) of the monetary benefits of reducing ozone in BenMAP are derived from a reduction in premature mortality. However, as explained above, the scientific data suggesting an association between ozone exposure and premature death are tenuous at best. The EPA also expressed a lack of confidence in the mortality data saying that "the PA [Policy Assessment] places relatively less weight on epidemiologic-based risk estimates", (USEPA 2014), and that "The determination to attach less weight to the epidemiologic-based estimates reflects the uncertainties associated with mortality and morbidity risk estimates, including the heterogeneity in effect estimates between epidemiologic study areas, the potential for epidemiologic-based exposure measurement error, and uncertainty in the interpretation of the shape of the concentration-response functions at lower ozone concentrations." Therefore, the projected prevention of up to 100 deaths per year is highly suspect. In addition, the EPA's own modeling analysis conducted as part of the 2015 ozone NAAQS indicates that, statistically, no fewer asthma attacks or respiratory hospital admissions are anticipated as a result of lowering ambient design values from 75 ppb to 70 ppb (USEPA 2015).

No changes were made in response to these comments. References for all studies are provided at the end of the document.

Oil and Gas Health Effects

Liveable Arlington, the Sierra Club of Dallas, and five individuals expressed concern over the health effects related to emissions from oil and gas activity. The Sierra Club of Dallas expressed concern about methane, propane, benzene, xylene, propargyl alcohol, dichloromethane, trichloroethylene, and cyclohexane leaking from fracking operations. Liveable Arlington expressed concern about methane, nitric oxide, nitrogen dioxide, and VOCs, including benzene, toluene, ethyl benzene, and xylene, as well as the impact these compounds have on ozone formation. The Sierra Club of Dallas further stated that Texas doesn't care about the people in the Metroplex and that the TCEQ's chief toxicologist tells people to stay inside and not to think about the people repairing streets and building buildings. Two individuals stated concern about health effects, including rashes, sneezing, nosebleeds, and bronchitis, experienced by themselves and family members. One individual expressed concern over her husband's exposure to ambient pollutants as an outdoor construction worker. One individual stated that the "TCEQ lowered its own acceptable amount of benzene exposure 40% and weakened protections for a slew of other chemicals" following the shale boom. Liveable Arlington expressed concern for the potential health effects of long-term exposure to drilling emissions and the costs of medication, lost wages, and emotional costs of a chronically ill child. Liveable Arlington and one individual asked for a change in allowable levels of pollutant emissions.

The TCEQ takes its mission of protecting our state's public health and natural resources seriously and has, therefore, heavily invested in conducting extensive air monitoring for chemicals associated with oil and gas operations in the DFW area. Since 2009, staff have collected over 1,700 individual air samples that have been analyzed for 84 individual VOCs, including propane, benzene, ethyl benzene, toluene, xylenes, dichloromethane, trichloroethylene, and cyclohexane. In addition to individual canisters collected by staff, the TCEQ receives hourly concentration data from 16 nitrogen dioxide monitors and 15 VOC monitors, as well as 24-hour air samples collected once every six days from 13 sampling sites in the DFW region alone.

The TCEQ uses a peer-reviewed process to derive air monitoring comparison values (AMCVs) that are used to evaluate this ambient air monitoring data, and criteria air pollutants such as ozone and nitrogen dioxide are compared to the NAAQS. The TCEQ first derives a conservative interim AMCV, then follows up with a more in-depth evaluation of available toxicity data and, if necessary, revises the AMCV through a transparent process. The public is encouraged to provide the TCEQ with scientific data on chemical toxicity at any time, as well as to provide comments on draft documents during the public comment period. The benzene AMCVs were revised in this manner separate and apart from the activities in the Barnett Shale area. Short-term AMCVs are based on potential effects following short-term exposures of one hour and, in the case of some chemicals, 24 hours and are compared to measured 1-hour or 24-hour concentrations. Long-term AMCVs are protective of chronic adverse cancer and non-cancer health effects following a lifetime of exposure and are compared to annual averages of chemical concentrations. The TCEQ's revised unit risk factor, which is used to derive the

long-term benzene AMCV (TCEQ 2015), is consistent with the unit risk factor the EPA derived for benzene (USEPA 2003).

None of these stationary monitoring data indicates ambient concentrations of pollutants are at levels that would be expected to cause adverse health effects after long-term (i.e., lifetime) exposure. In some instances, short-term concentrations of some VOCs were monitored at levels that would be expected to cause odors, which is consistent with citizen odor complaints and staff investigator reports. None of these air samples have indicated any off-site, short-term concentrations that would be expected to cause adverse health effects after short-term exposure. Finally, the DFW area has always been in attainment of both the one-hour and annual nitrogen dioxide standards.

Air monitoring data and associated toxicological evaluations addressing oil and gas-related air quality issues in the DFW area are publicly available on the TCEQ's Barnett Shale Web page (https://www.tceq.texas.gov/airquality/barnettshale). Toxicological evaluations of Region 4 ambient air network monitoring data are publicly available on the TCEQ's Toxicology Division Web page (http://www.tceq.texas.gov/toxicology/regmemo/AirMain.html).

As stated previously, the TCEQ encourages a broader understanding of pollutant exposure when determining whether to spend time indoors or outdoors. The TCEQ provides information about monitored levels of pollutants and toxicological evaluations of the monitoring data to the public and has consistently noted that concentrations are not at levels that pose potential short- or long-term health risks. Indoor pollutant exposures are often times higher and unmonitored, so individuals must consider the benefits of outdoor air quality and physical exercise when making choices about whether to limit outdoor activity. No changes were made in response to these comments.

CONTROL STRATEGY COMMENTS

Stationary Sources

East Texas Electric Generating Units (EGU)

Public Citizen commented that installing pollution controls on the coal-fired power plants located to the southeast of the DFW ozone nonattainment area would dramatically decrease the ozone levels in the DFW ozone nonattainment area. Public Citizen cited a 2007 Environ study that indicated installing pollution controls on three East Texas coal-fired power plants would decrease the emissions that cause air pollution in the DFW nonattainment area. Public Citizen further stated that three years prior to the date of this proposed DFW AD SIP revision, the Texas Medical Association and the Dallas County Medical Society released a study indicating the DFW area would likely come close to or perhaps attain the ozone standard if selective catalytic reduction (SCR) technology was installed on the same three East Texas coal-fired power plants.

As part of the reasonably available control measures (RACM) analysis conducted for the 2017 DFW AD SIP revision, the TCEQ considered the potential impact of increasing the stringency of the existing East and Central Texas EGU rules located in 30 Texas Administrative Code (TAC) Chapter 117, Subchapter E, Division 1. The TCEQ previously implemented these rules in attainment counties in East and

Central Texas to address NO_X emissions and ozone transport from EGUs, including the three East Texas coal-fired power plants referenced by the commenter and the subject of the Texas Medical Association and the Dallas County Medical Society study. The total capital costs of achieving SCR control on the eight affected units located at the three East Texas coal-fired power plants are estimated to be $1,878,585,000.

As discussed on page 61 of the response to comments for the 2018 DFW AD SIP revision adopted in June 2015 (Non-Rule Project No. 2013-015-SIP-NR) regarding the June 2006 Environ study on East Texas EGU controls, the impact of SCR as the suggested NO_X controls on East Texas EGUs is not expected to have a substantive impact on the Denton Airport South monitor, nor the other monitors, in the DFW area.

The 2017 DFW AD SIP revision demonstrates attainment of the 2008 eight-hour ozone NAAQS by July 20, 2018 based on a photochemical modeling analysis of reductions in NO_X emissions from existing control strategies and a WoE analysis. The peak ozone design value in 2017 for the DFW nonattainment area is projected to be 77 ppb using EPA official modeling guidance from April 2007 and 76 ppb using draft modeling guidance released by the EPA in December 2014. Given the substantial costs associated with the suggested control measure cited in previous studies, the insufficient time available to implement controls in time to advance attainment, the limited ozone reduction benefit to the DFW area from these sources outside the DFW area, and the current modeling results and WoE indicating that the DFW area will demonstrate attainment, the TCEQ has determined that imposing additional controls on these attainment county EGUs is not justified at this time and is not RACM. No changes were made in response to these comments.

The Dallas County Medical Society and the Texas Medical Association commented that the TCEQ should require the incorporation of reasonably available control technology (RACT) on three East Texas coal-fired power plants. The Dallas County Medical Society and the Texas Medical Association further commented that their previously submitted petition for rule change asking the TCEQ to control emissions from the three East Texas coal-fired power plants was rejected on the basis that it was premature in light of an upcoming SIP revision. The commenters stated that the 2018 DFW AD SIP revision adopted in June 2015 (Non-Rule Project No. 2013-015-SIP-NR) ignored their concerns and contained no effort to control the emissions from the three coal-fired power plants. The Dallas County Medical Society and the Texas Medical Association commented that computer modeling of DFW air quality data performed by the University of North Texas showed that an average of 5 ppb of ozone to the DFW nonattainment area could be eliminated by controls on the three East Texas coal-fired power plants.

In the petition for rule change mentioned by the commenters, a request was made for the three East Texas coal-fired power plants to either install and operate SCR or convert to natural gas. Considering the SIP modeling and the RACM analysis, the TCEQ has determined that the controls requested in the petition are not necessary to demonstrate attainment of the 2008 eight-hour ozone NAAQS.

The three East Texas coal-fired power plants would not be subject to a RACT analysis given their location outside the ozone nonattainment area and that RACT requirements cannot be extended to emission sources located outside an ozone nonattainment area. RACM is evaluated based on multiple criteria, and although the EPA allows states the option to consider control measures outside the ozone nonattainment area that can be shown to advance attainment, such as the existing requirements for East and Central Texas EGUs, states are not required to exercise this option under the FCAA. The TCEQ does not agree that the University of North Texas (UNT) modeling shows a reduction of 5 ppb to the eight-hour ozone design value in the DFW area. This is explained more fully in a separate comment response below under the heading of *UNT Modeling* on page 71.

As discussed in the response to the previous comment, the TCEQ considered the potential impact of increasing the stringency of the existing East and Central Texas EGU rules, and has determined that imposing additional controls on these attainment county EGUs is not justified at this time and is not RACM.

The TCEQ appreciates stakeholder technical input relating to control strategy development and may be able to use valid information for future air quality planning purposes. No changes were made in response to these comments.

The Sierra Club and Downwinders suggested three RACM strategy options to decrease ozone season NO_X emissions from five East Texas coal-fired power plants. The first option would implement staggered NO_X mass emission limits based on reductions from the 2015 ozone season average NO_X tons per day (tpd) rate: a 40% mass emissions reduction commencing on March 1, 2017, increasing to a 60% reduction commencing on March 1, 2018, and a final increase to an 80% reduction commencing on March 1, 2019, with the goal to install and commence operation of SCR on all units at the five East Texas coal-fired power plants by March 1, 2019. Each unit's 2015 NO_X tpd baseline rate excluded reductions achieved by selective non-catalytic reduction (SNCR), but included reductions achieved by combustion modifications, where applicable. The Sierra Club and Downwinders provided information that other states have taken a similar approach, and provided an example from Georgia.

The second option would impose a mass-based, tons per hour emission limit on each boiler located at the five East Texas coal-fired power plants. The third option would create mass-based caps for all units owned and operated by Luminant, NRG, and American Electric Power.

The Sierra Club and Downwinders commented that in the 2018 DFW AD SIP revision adopted in June 2015 (Non-Rule Project No. 2013-015-SIP-NR) the TCEQ dismissed emission limits on the referenced five East Texas coal-fired power plants and other EGUs as RACM based on substantial cost, limited ozone reduction benefits, and modeling results indicating that the DFW area would demonstrate attainment. However, according to the Sierra Club and Downwinders, the TCEQ's modeling for the 2017 DFW AD SIP revision demonstrated that the DFW area will not attain by its attainment date. The Sierra Club and Downwinders stated that other, independent modeling results showed that there would be substantial ozone reduction benefits if the TCEQ required post-combustion control technology to reduce NO_X emissions from the five East Texas coal-fired power plants.

The commenters assert that the accepted metric to justify the cost effectiveness of control is dollar per ton ($/ton), and that the commenters' previous discussion of the $/ton costs of NO_X controls on coal-fired power plants confirmed the well-established point that SCR on coal-fired power plants is a highly cost-effective NO_X control technology. The Sierra Club and Downwinders cited other research showing capital costs for SCR on the units located at the five East Texas coal-fired power plants ranging from $1.4 billion to $2.5 billion, a fraction of the TCEQ's alleged unsupported claim of $8 billion to install SCR on 69 EGUs.

Commissioner Daniel commented that the TCEQ should require the East Texas coal-fired power plants to use reasonably available pollution controls, as defined in the FCAA, to control pollution from these plants drifting toward North Texas. An individual commented that it was time to immediately stop coal-fired power plants from spewing filth and respiratory irritants as well as carcinogens into the air of the DFW area.

The purpose of the 2017 DFW AD SIP revision is to demonstrate attainment of the 2008 eight-hour ozone standard in accordance with the EPA's guidance and FCAA requirements. Other existing regulations, such as the Mercury and Air Toxics Standards and National Emission Standards for Hazardous Air Pollutants address other pollutants, and these regulations are beyond the scope of this SIP revision.

For a state's RACM analysis, the EPA allows states the option to consider control measures outside the ozone nonattainment area that can be shown to advance attainment; however, the state does not have to exercise this option to maintain consistency with the FCAA. As discussed in the responses to the previous two comments, the TCEQ researched the potential impact of increasing the stringency of the existing East and Central Texas EGU rules and East Texas combustion rules for sources of NO_X located outside the DFW nonattainment area. Given the change in attainment date for the DFW moderate ozone nonattainment area to July 20, 2018 with a 2017 attainment year, the TCEQ is considering only those control strategies for the 2017 DFW AD SIP revision that can be implemented by March 1, 2017. Therefore, control strategies implemented after this time are not pertinent to the RACM analysis for the 2017 DFW AD SIP revision. The TCEQ has previously implemented controls in attainment counties in East and Central Texas to address NO_X emissions and ozone transport from stationary sources outside the DFW area, including East Texas coal-fired power plants, at a time when these measures were determined to meet RACM criteria. These measures were included as part of the DFW AD SIP revision for the 1997 eight-hour ozone NAAQS adopted in April 2000 (Project No. 1999-055-SIP-AI). However, the TCEQ has determined that imposing additional controls, such as SCR, or imposing mass-based emission caps, on EGUs or on the companies that own or operate EGUs in East Texas attainment counties is not justified at this time.

The TCEQ disagrees with the commenters that $/ton is the only accepted metric for determining cost effectiveness of a control measure. While $/ton is one factor to consider in an economic analysis, it is not the only factor. Overall capital costs, annual operating costs, $/ton, who is impacted (e.g., small businesses), even secondary costs, such as impacts to cost of electricity, may be relevant in determining the economic feasibility of a potential RACM measure.

The TCEQ disagrees with the commenters' assertions that the TCEQ's reported number of $8 billion to install SCR on 69 EGUs is unsupported. As discussed in the response to comments for the 2018 DFW AD SIP revision adopted in June 2015 (Non-Rule Project No. 2013-015-SIP-NR), the TCEQ evaluated EGU emissions and process rate data for reporting year 2012 from the EPA's Air Markets Program Database. The TCEQ also evaluated available literature cost data for SCR control on coal-fired power plants from Sargent and Lundy and the Edison Electric Institute. Cost information was based on either 2008 or 2009 U.S. dollars. The commenters cite $2.5 billion as a possible maximum for SCR capital costs for five East Texas coal-fired power plants, 10 EGUs in total. The TCEQ's analysis of these 10 units, using the emission and process rate data and literature cost data for SCR control that was used in the 2018 DFW AD SIP revision adopted in June 2015, results in SCR capital costs of approximately $2.3 billion as a possible maximum for the same 10 EGUs, which is very close to the $2.5 billion estimated by the commenters. While the TCEQ agrees that the cost of installing SCR for those 10 EGUs would be less than the $8 billion estimated for all 69 EGUs, this substantial capital cost is still not justified because, as discussed above, the resulting NO_X reductions would not advance attainment, nor would there be sufficient time to implement SCR by March 1, 2017.

No changes were made in response to these comments.

The Sierra Club and Downwinders commented that implementing RACM for coal fired power plants in east Texas would assist in meeting its interstate transport obligation for the 2008 ozone NAAQS as well as the next regional haze submittal, due in 2018. The commenters further assert that RACM on these sources is mandated by Section 110(l) of the FCAA because it would interfere with the DFW area's ability to attain the NAAQS as expeditiously as practicable.

The obligation for states to implement RACM has no connection to the independent obligations regarding interstate transport and regional haze. Additionally, the coal-fired power plants in East Texas are not within the DFW ozone nonattainment area, and thus, there is no obligation for states to implement RACM for them. The TCEQ does not agree that FCAA, Section 110(l) requires RACM on east Texas coal plants or any other emissions source. Section 110(l) is intended to prevent the EPA from approving a SIP revision that would allow a relaxation of SIP regulations already approved by the EPA that would interfere with the state's ability to meet an applicable requirement of the FCAA; this is known as anti-backsliding. No changes were made in response to these comments.

Commissioner Daniel commented that either new pollution controls should be required on coal plants to the east of the area or the coal plants should be included in the larger DFW nonattainment area since pollution from the plants drifts into the DFW area.

As discussed in the previous response to comment, the TCEQ determined that imposing additional controls on EGUs or on the companies that own or operate EGUs in East Texas attainment counties is not justified at this time.

While states may make recommendations on nonattainment areas to the EPA during the designations process, establishment of nonattainment area boundaries,

as described in Section 107(d)(B) of the FCAA, is the duty of the EPA Administrator. One of the criteria the EPA considers in determining the boundaries of an ozone nonattainment area is emissions and emissions-related data. The EPA evaluates whether monitors that do not meet the NAAQS are significantly impacted by emissions sources in nearby counties. The EPA's 2012 designation of the 10-county DFW nonattainment area for the 2008 ozone NAAQS contemplated the impact of emissions from outside the nine-county ozone nonattainment area for the 1997 eight-hour ozone NAAQS. No changes were made in response to this comment.

The Sierra Club and Downwinders commented that the five East Texas coal-fired power plants could choose to comply with a mass-based cap by decreasing generation at these units and that decreased generation could be temporarily offset by increased generation from other fossil fuel-fired units, energy storage, and from solar and wind power, noting that Texas added over 2.5 gigawatts (GW) of wind power and over one GW of combined cycle natural gas power plants in 2015. The commenters suggested that electricity demand could also be reduced by energy efficiency and demand response measures, including air conditioning efficiency improvements. The Sierra Club and Downwinders commented that the DFW area and Texas ranked low in energy efficiency (EE) relative to other locations and that efficiency measures exist that can be installed quickly. The commenters further suggested that Texas adopt "net metering" to compensate customer-side solar electricity generators for energy sent to the electric grid.

The commenters' suggested net metering changes are beyond the scope of the 2017 DFW AD SIP revision. Regulating electric markets or requiring renewable energy (RE) generation, as suggested by the commenter, extends beyond the TCEQ's direct authority. The TCEQ's authority is limited to setting standards of performance for emissions of air pollutants from stationary sources, which the TCEQ has done in its RACM analysis regarding East Texas coal-fired power plants. The assumption that decreased generation from certain targeted coal-fired units would be offset by increased generation from other gas-fired combustion turbines and RE generating resources does not account for possible changes to existing transmission infrastructure and grid reliability, potential loss of load, or significant interruption to the power grid. Further, the complex nature of the electrical grid makes accurately quantifying emission reductions from EE/RE measures difficult. If electrical demand is reduced in a nonattainment area due to local EE measures, the resulting emission reductions from power generation facilities may occur in any number of locations around the state, not necessarily these specific coal-fired units.

The TCEQ supports EE/RE energy programs and it recognizes the air quality benefits of these programs. The Texas Legislature has implemented many EE/RE programs, including mandates for installation of new capacity of wind and other renewable energy generation. As discussed in Chapter 5: *Weight of Evidence*, Section 5.4.1.1: Energy Efficiency and Renewable Energy (EE/RE) Measures, Senate Bill (SB) 5, 77th Texas Legislature, 2001, which established the Texas Emissions Reduction Plan (TERP), set goals for political subdivisions in affected counties to implement measures to reduce energy consumption from existing facilities by 5% each year for five years from January 1, 2002 through January 1, 2006. In 2007, the 80th Texas Legislature passed SB 12, which extended the

timeline set in SB 5 and made the annual 5% reduction a goal instead of a requirement. The State Energy Conservation Office (SECO) is charged with tracking the implementation of SB 5 and SB 12. Also during the 77th Texas Legislature, the Energy Systems Laboratory (ESL), part of the Texas Engineering Experiment Station, Texas A&M University System, was mandated to provide an annual report on EE/RE efforts in the state as part of the TERP under THSC, §388.003(e).

Texas is a leader in RE such as wind energy. Installation of new wind generation facilities has greatly exceeded the milestones mandated by the legislature. Texas' current installed wind power capacity, as of December 31, 2015, is approximately 17,713 Megawatts, which is more than 2.5 times the current installed wind power capacity of the state with the next highest capacity. Texas is also seventh in the nation in terms of installed solar photovoltaic system capacity and tenth in terms of average cost of solar systems on a dollar per watt basis. The effects of existing EE and demand response measures are included in the WoE analysis in Chapter 5 of the 2017 DFW AD SIP revision. No changes were made in response to these comments.

Natural Gas

An individual requested that the TCEQ stop hydraulic fracturing.

This comment is beyond the scope of the 2017 AD SIP revision. Additionally, the TCEQ does not have the regulatory authority to stop hydraulic fracturing. As noted in Appendix G, drilling activity is under the jurisdiction of the Railroad Commission of Texas (RRC). The TCEQ notes however, that oil and gas activities are not unregulated; requirements exist under TCEQ rules in 30 TAC Chapters 115 and 117, and are prescribed under the air permitting program and in federal rules at 40 Code of Federal Regulations (CFR) Part 60 Subpart OOOO. No changes were made in response to this comment.

Cement Kilns

The Sierra Club and Downwinders commented that an SCR system is operating on a long dry cement kiln in Joppa, Illinois, and has demonstrated 80% NO_X control. The commenters further noted that the EPA commented in February 2015 that a new RACT evaluation is needed for Ellis County cement kilns, that the ozone impact of potential NO_X reductions appear significant, and speculated that the EPA would not be able to approve this 2017 DFW AD SIP revision without it.

The commission acknowledges that an SCR system has been successfully demonstrated on a long dry cement kiln in Joppa, Illinois. However, the TCEQ does not consider SCR on Portland cement kilns to be adequately demonstrated with regard to technological or economic feasibility and, therefore, is not RACT for the existing Ellis County cement kilns. As further discussed in Appendix G: *RACM Analysis* of this DFW AD SIP revision, the publically available version of the SCR demonstration report for the Joppa kiln does not include detailed design information, total cost numbers, or operational data, so it is insufficient for evaluating the feasibility of applying the technology to the Ellis County cement kilns or to establish an emission limit for the purposes of this AD.

The TCEQ also acknowledges that the EPA submitted comment regarding the TCEQ's cement kiln RACT analysis included with the 2018 DFW AD SIP revision adopted in June 2015 (Non-Rule Project No. 2013-015-SIP-NR). These comments were addressed in the Response to Comments section of the 2018 DFW AD SIP revision. The 2017 DFW AD SIP revision does not include a RACT analysis because the change to the 2017 attainment year did not impact the RACT analysis adopted by the commission in June 2015. As discussed in Appendix F: *RACT Analysis* of the 2018 DFW AD SIP revision, the EPA has previously approved the current Ellis County ozone season NO_X source cap in 30 TAC Chapter 117, Subchapter E, Division 2 as meeting the RACT requirements for these sources, and the three companies subject to the cap, Ash Grove Cement Company (Ash Grove), Holcim U.S., Inc. (Holcim), and Martin Marietta (formerly TXI) have been operating well under their source caps due to low product demand and replacement of higher-emitting wet kilns with dry kilns.

The RACT analysis included discussion of the reconstruction of kiln #3 at Ash Grove, which is subject to the 1.5 lb NO_X/ton of clinker emission standard in the New Source Performance Standards (NSPS) for Portland Cement Plants. The NSPS therefore satisfies RACT for Ash Grove. The RACT analysis also asserted that the current source cap of 5.3 tpd NO_X for Holcim satisfies RACT. As further discussed in Appendix G: *RACM Analysis* of the 2017 DFW AD SIP revision, Holcim currently has two dry preheater/precalciner (PH/PC) kilns equipped with SNCR. During the 2009 through 2011 ozone seasons, Holcim ran both kilns with SNCR at reduced output at or below 1.6 lb NO_X/ton of clinker. In the 2012 through 2014 ozone seasons, for economic reasons, Holcim ran only one kiln with SNCR and reported less than 1.5 lb NO_X/ton of clinker. Thus, although Holcim's NO_X emissions have been lower in recent years, this is due to decreased production resulting from lower demand for Portland cement. Additionally, while Holcim's emission rate of less than 1.5 lb/ton of clinker is less than the 1.7 lb/ton of clinker factor used for dry PH/PC kilns in calculating the source cap, this emission rate for Holcim's kilns is an average rate over the ozone season whereas the cap is enforced on a 30-day rolling average basis. Given the inherent variability in NO_X emissions from Portland cement kilns on a short-term basis and the 30-day enforcement period of the standard in the rule Chapter 117, the 1.7 lb/ton of clinker factor in the cap equation is still appropriate. Therefore, the 5.3 tpd source cap for Holcim continues to satisfy RACT.

As part of the SIP planning process, the TCEQ evaluates available technologies for potentially affected sources or emission source categories and, in accordance with EPA RACT guidance and the FCAA, implements those technologies when necessary. The compliance date for potential control measures used in the 2017 DFW AD SIP revision precludes consideration of technologies such as SCR that cannot be installed and made operational on cement kilns prior to March 1, 2017. No changes were made in response to these comments.

Compressor Emissions

The Sierra Club and Downwinders commented that replacement of either the largest or all natural gas-fired engines powering natural gas compressors with electric motors is a RACT measure, as indicated by cost data in the industry's literature.

The TCEQ is aware of several electric motor-driven large compressors in the DFW area and recognizes that powering compressors with electric motors supplied by grid electricity is technologically feasible for some affected sources. However, this is not an appropriate RACT measure because it would require replacement of some or all of the engines powering natural gas compressors with electric motors, which is not economically or logistically feasible at this time. Published articles indicate logistical concerns with this strategy, as described in Appendix G, Section 4.2.2: *Engines* of the 2017 DFW AD SIP revision. Concerns include the need for additional equipment beyond just the electric motor at the compressor station, potential electric service upgrades, and potential replacement of the compressor, all of which need to be considered in addition to the cost of the electric motor itself. Published information also indicates that delivery time for necessary equipment and time required to install additional equipment at all affected sites renders a strategy of complete replacement unreasonable to accomplish by the regulatory deadline. No changes were made in response to this comment.

An individual expressed concern because sites with less than 25 tons per year (tpy) of VOC emissions are not required to use catalytic converters on their lift compressors or vapor recovery systems on their storage tanks. The individual further commented that lift compressors do not have to be controlled by vapor recovery during blowdown. Another individual questioned the reason emission controls on compressor stations in urban areas are not required.

Emissions from all compressor stations are regulated by the TCEQ. Minor sources of air pollutants are required to obtain authorization to emit air pollutants, either through a case-by-case NSR authorization, or an NSR permit by rule (PBR). The requirements for PBRs limit total actual emissions of various pollutants, for example, 25 tpy VOC. Individual sources that use a PBR must meet the requirements of the appropriate PBR. Each PBR holder shall establish, implement, and update, as appropriate, a maintenance program for all facilities that is consistent with good air pollution control practices, or alternatively, manufacturer's specifications and recommended programs applicable to facility performance and the effect on emissions. These PBR requirements apply to all facilities regardless of their location, rural or urban.

In addition to NSR permitting requirements, the TCEQ implements RACT and RACM rules based on EPA-designated nonattainment areas classified moderate nonattainment and higher, and does not distinguish between urban areas and rural areas. The rules in 30 TAC Chapters 115 and 117 for VOC and NO_X, respectively, specify control requirements for certain compressor station fugitive VOC emissions and compressor engine NO_X emissions. The VOC compressor station rules were implemented in the DFW nonattainment area to satisfy RACT requirements and the NO_X compressor engine rules were implemented to satisfy both RACT and RACM obligations. All compressor engines subject to the NOx compressor engine rules, including those at sites with less than 25 tpy of VOC emissions, must meet the specified emission limits. Companies typically install catalytic converters on the compressor engines to meet the specified emission limits.

No additional controls on catalytic converters on compressors have been determined to be necessary for compressors at this time. When compressor units are shut down, typically the high pressure gas remaining within the compressors and associated piping is vented to the atmosphere (blowdown) or controlled by a flare. Routing the blowdown to a storage tank is not an effective control option because storage tanks are not designed to contain or process gases at the pressures and volumes associated with compressor blowdowns. No changes are made in response to these comments.

One individual commented that the blowdown emissions from oil and gas drilling caused more warming, exacerbating ozone.

Both the draft and official versions of EPA modeling guidance require the TCEQ to model baseline year meteorology (which is 2006 for the DFW 2017 AD SIP revision), including temperature, and predict the effect of changed emissions in the attainment year, in this case 2017. Discussion of the photochemical modeling conducted for this SIP revision is located in Chapter 3. Any warming effect of methane emissions from compressor blowdowns in the DFW area on temperatures and ozone formation from the 2006 baseline year to 2017 is likely to be imperceptible. No changes are made in response to this comment.

General Reasonably Available Control Technology (RACT) Demonstration and Reasonably Available Control Measure (RACM) Demonstration

The North Texas Renewable Energy Group commented that Governor Rick Perry ordered expedited permit approvals of eight Texas Utilities (TXU) coal-burning power plants justified by the governor's forecast of an increase in natural gas and the capability of coal-burning power plants to generate power at a low cost. The individual further commented that in spite of the governor's claim, every new coal-burning power plant would have cost approximately a billion dollars and the money to pay for these plants would have been recouped through electric rates. The commenter stated that as a result of litigation surrounding the eight coal-burning power plant permits finding the governor overstepped his constitutional authority, TXU withdrew the permits. The commenter asserted that the governor's goal was to get the permits approved prior to effective dates of EPA air quality standards. The commenter estimated the governor collected around $325,000 beginning in 2000 from TXU executives associated with the proposed permits.

These comments are beyond the scope of this 2017 DFW AD SIP revision. No changes were made in response to this comment.

The Sierra Club and Downwinders commented that the TCEQ must include additional RACM in the DFW area, such as previously recommended NO_X emission reduction strategies for East Texas power plants, cement kilns, and electrification of compressors, to provide for attainment in a timely manner, sooner than will be attained with this proposed SIP, providing Texans and the TCEQ with numerous other benefits. An individual commented that Appendix G identified some viable control measures that could be incorporated into the SIP but disagreed with the TCEQ's response that the potential control measures would not advance attainment. The commenter further stated that the DFW area could reach attainment with the 2008 ozone NAAQS if enough of the potential control strategies were incorporated into the SIP.

The TCEQ disagrees that the 2017 DFW AD SIP revision must include additional control measures as RACM. The TCEQ acknowledges its obligation to conduct a RACM analysis consistent with FCAA requirements and EPA RACM guidance, and provides its analysis and determination in Appendix G of the 2017 DFW AD SIP revision. During a RACM analysis, the TCEQ considers several factors and bases its determination on technical merit that does not always support adopting new controls. In addition, any public comment received on a TCEQ-proposed SIP revision or rulemaking is evaluated for RACT or RACM viability, as necessary, and summarized and responded to.

As detailed in Appendix G: *RACM Analysis*, implementing additional controls at this time is not justified, partially due to modeling results and WoE indicating the DFW area will attain the 2008 eight-hour ozone NAAQS by the July 20, 2018 attainment date.

The TCEQ further disagrees with the commenter's assertion that that RACM controls must be adopted for East Texas power plants, which are beyond the DFW nonattainment area boundaries. Further discussion is included in the responses to comment on those specific control measures in the above sections of this RTC document: *East Texas Electric Generating Units (EGU)*, *Cement Kilns*, and *Compressor Emissions*. No changes were made in response to these comments.

The Sierra Club and Downwinders commented that RACM cannot be retroactively implemented. The commenters disagreed with the March 1, 2016 date as a RACM implementation deadline because this SIP revision will not be final and approved by then.

The TCEQ acknowledges that in order for a control measure to meet the criteria of advancing attainment by at least a year, potential control measures would need to be in place no later than March 1, 2016. However, as explained in Appendix G, the TCEQ also evaluated March 1, 2017 as a RACM compliance deadline consistent with §172 of the FCAA. Neither of these impending deadlines provide a sufficient amount of time for an affected source to employ any of the control measures evaluated. Based on this, in addition to other factors discussed in Appendix G and in the responses to comments above, the TCEQ concluded that no potential control measures met the criteria to be considered RACM. The deadlines evaluated in this RACM analysis are in accordance with EPA-accepted RACM guidance and the FCAA.

The TCEQ agrees with the commenters' statement that a RACM regulation cannot possess a retroactive compliance date. The TCEQ notes that while a rulemaking must be adopted by the commission prior to the compliance deadline, it does not have to be approved by the EPA prior to the compliance deadline. No changes were made in response to these comments.

The Sierra Club and Downwinders claimed that there is no evidence in this 2017 DFW AD SIP revision demonstrating the DFW area will attain the ozone NAAQS by July 20, 2018. The Sierra Club and Downwinders asserted the modeling and WoE does not support attainment as the TCEQ claims. The Sierra Club and Downwinders stated that control measures that advance attainment to before 2021 should be considered RACM based on the TCEQ's monitoring data and trend analysis. The commenters further stated that measures reducing ozone and meeting the RACM criteria, other than the ability to advance attainment of the NAAQS, should be considered RACM strategies.

The TCEQ disagrees that its modeling and WoE do not support attainment by July 20, 2018 in the DFW nonattainment area as further discussed in the *Technical Analysis* section of this RTC.

The TCEQ further disagrees with the commenter's interpretation that the compliance deadlines should be ignored for the RACM analysis. Control measures considered to be RACM would need to be able to be implemented no later than March 1, 2017. Advancing the attainment date by one year to July 20, 2017 would require controls to be installed and in operation no later than March 1, 2016. This compliance deadline would allow time to realize the emissions reduction benefit from implementing the control measures. The TCEQ anticipates that without requiring operation of a control a year prior to the attainment year, the full benefit/effect of a control measure would not be realized in monitoring data and may not, in reality, actually advance attainment of the NAAQS by at least a year. If a control measure does not meet this criteria point, it is not a valid RACM control.

As explained in Appendix G of the 2017 DFW AD SIP revision, the implementation deadlines for RACM are established by the EPA's interpretation of FCAA, §172(c)(1) that states incorporate into their SIP all RACM that would advance a region's attainment date after determination that such measures are reasonably available for implementation in light of local circumstances (57 FR 13498). This interpretation was subsequently upheld by several courts. The use of 2021 as an evaluation date for RACM is inappropriate, since that date is beyond the July 20, 2018 attainment date. No changes were made in response to these comments.

<u>RACT Demonstration</u>

An individual questioned the use of 2011 emissions inventory data instead of relying on more current data for the RACT analysis.

The TCEQ bases policy decision-making on the most complete, comprehensive, and quality-assured data available for any given project, including the RACT analysis for the 2018 DFW AD SIP revision adopted in June 2015 (Non-Rule Project No. 2013-015-SIP-NR). The 2011 emissions inventory data year met these standards making it the best selection at the time the RACT analysis commenced in 2013 for the 2018 DFW AD SIP revision adopted in June 2015. A new RACT analysis is not required to be conducted as part of the 2017 DFW AD SIP revision and thus the RACT analysis remains unchanged.

The TCEQ performed a RACT analysis during the 2018 DFW AD SIP revision adopted in June 2015 and determined that the VOC and NO_X rulemakings that were adopted concurrently (Rule Project Nos. 2013-048-115-AI and 2013-049-117-AI) and the rules already in place satisfied RACT for all existing sources in the DFW area. The 2017 DFW AD SIP revision does not include a RACT analysis because the change to the 2017 attainment year did not impact the RACT analysis

adopted by the commission in June 2015. No changes were made in response to this comment.

An individual commented that Appendix F lacks the information necessary for vendors to identify permitted point sources needing help with emission control. The individual further commented that this lack of information also impedes the ability for the public to make purchase decisions based on emission controls installed. The commenter suggested that if the TCEQ has this information from permitting and air sampling, that it be added as an appendix in the SIP. The commenter indicated that without information specifying businesses doing well and businesses needing help from pollution-reducing competitors, the free market cannot function as it should.

The TCEQ disagrees with the commenter's suggestion. Providing the type of information suggested by the commenter is not the purpose of the RACT analysis and determination in Appendix F: *RACT Analysis*. Appendix F of the 2018 DFW AD SIP revision adopted in June 2015 (Non-Rule Project No. 2013-015-SIP-NR), serves to demonstrate that RACT is in place for source categories addressed in an EPA control techniques guideline (CTG) and for non-CTG major sources as required by FCAA, §172(c)(1) and §182(b)(2) and (f). The TCEQ RACT analyses are conducted in accordance with FCAA requirements and consistent with EPA RACTguidance.

RACT rules are adopted to prescribe emission limits but are prohibited from mandating specific types of emission control technology. Sources subject to a RACT rule are required to comply with such rules but are free to meet those rules by installing emissions controls it chooses or modify operations in the manner it chooses. Supplying information to support consumer decisions is beyond the scope of Appendix F and would not contribute to fulfilling the objective of the RACT requirements under the FCAA.

Although separate from Appendix F, the Texas SIP contains EPA-approved TCEQ air permitting rules, eliminating the need to submit each air permit and air permit revision as an individual revision to the SIP. All air permits are available to the public, as is the monitoring data acquired throughout the state. Therefore, codifying each and every permit and air sampling data is redundant and unnecessary to continue providing quality information to the public. No changes were made in response to these comments.

An individual commented that polluting sources are grandfathered-in and only need to meet RACT standards instead of best available control technology (BACT) standards. The commenter expressed skepticism that none of the point sources in the SIP have made substantial revisions or repairs warranting the application of BACT standards instead of RACT standards. The individual further commented that by not differentiating between BACT and RACT in Appendix F, the TCEQ misses an opportunity for the free market to solve the nonattainment problem. The commenter suggested the TCEQ rely on crowd sourcing to help the DFW area meet attainment. In addition, the commenter expressed disappointment that there are also no point sources identified in the SIP as needing to meet maximum achievable control technology (MACT) or lowest achievable emission rate (LAER) standards.

RACT requirements for moderate and higher ozone nonattainment areas are included in the FCAA to assure that source categories covered by a CTG and significant source categories at major sources of ozone precursor emissions are controlled to a reasonable extent but not necessarily to BACT or MACT levels. Because the FCAA requires RACT apply to all existing sources addressed in a CTG and all existing non-CTG major sources, there is no grandfathering of sources as claimed by the commenter. At the time of the effective date, any source meeting the applicability criteria for an adopted RACT rule would be subject to such rule regardless of operation commencement date, or repairs or revisions made to the source.

BACT and LAER are permitting requirements that apply to new sources and modified sources meeting certain criteria and are implemented in the DFW nonattainment area through the TCEQ's air permitting process. Similarly, MACT is a requirement of 40 Code of Federal Regulations (CFR) Part 63 regulations and is separate from SIP requirements. Sources in the DFW area subject to MACT regulations are required to meet those standards. MACT, BACT, and LAER fulfill different FCAA obligations for programs outside of those included in the 2017 DFW AD SIP revision. For these reasons, these standards are not contemplated as part of this plan.

RACT requirements contemplated as part of an AD SIP revision apply to sources independent and regardless of BACT, LAER, and MACT control levels prescribed to a source through federal rules or air permitting means. However, the state can conclude that BACT controls prescribed in a source's permit are at least as stringent as RACT-level controls determined for the source, eliminating the need to replicate such control requirements as a SIP rule. Accordingly, as noted by the commenter, the TCEQ determined that the BACT level of control was at least as stringent as RACT level of control for the source listed in Appendix F.

Differentiating between RACT and BACT for each source is not a requirement for the RACT analysis. Access to additional information on control technologies is available at the [EPA's RACT/BACT/LAER Clearinghouse](https://cfpub.epa.gov/rblc/) Web page (https://cfpub.epa.gov/rblc/).

As detailed in Appendix F, the TCEQ conducted a RACT analysis and determined the level of RACT for various sources of VOC and NO_X in the DFW 2008 eight-hour ozone nonattainment area. This RACT determination resulted in the DFW VOC and NO_X RACT rulemakings (Rule Project Nos. 2013-048-115-AI and 2013-049-117-AI, respectively), which were submitted concurrently with the 2018 DFW AD SIP revision adopted in June 2015 (Non-Rule Project No. 2013-015-SIP-NR). No changes were made in response to these comments.

An individual disagreed with the TCEQ's finding that additional control for RACT is not economically feasible given the lack of information in the SIP to make such a claim.

The TCEQ disagrees with the commenter's claim that the RACT determination is not supported. In accordance with the FCAA and EPA RACT guidance, the TCEQ performed a RACT analysis as part of the 2018 DFW AD SIP revision adopted in

June 2015 (Non-Rule Project No. 2013-015-SIP-NR) to identify existing sources within the nonattainment area and to implement controls determined to be economically and technologically feasible for all sources addressed in a CTG and all non-CTG major sources. As part of the RACT analysis, the TCEQ is required to consider the economic and technological feasibility of potential control options. If, after this review, the TCEQ finds that a potential control option is not economically and technologically feasible, then the control option does not meet the requisite RACT criteria and cannot be considered RACT. As explained in the RACT analysis in the 2018 DFW AD SIP revision adopted in June 2015, the TCEQ determined that RACT was already in place or was being implemented through the concurrent NO_X and VOC rulemakings (Rule Project Nos. 2013-048-115-AI and 2013-049-117-AI) and provided justification that no additional controls identified met both the technological and economic feasibility components to be considered RACT. No changes were made in response to this comment.

<u>RACM Demonstration</u>

Four individuals expressed concern about the social health costs that they accrue and whether or not those costs are considered by the TCEQ. The individuals posed questions regarding pollution control technology and how the health benefits of adding those controls were considered when establishing the RACM analysis.

The primary NAAQS are established by the EPA as necessary to protect public health, including sensitive members of the population such as children, the elderly, and those with pre-existing conditions. These standards are health-based standards that take into account health-related costs of ozone. The TCEQ bases its RACM analysis on the ability for these measures to advance attainment of the ozone NAAQS as well as other criteria established by EPA RACM guidance, e.g., technological and economic feasibility, enforceability, etc. No changes were made in response to these comments.

The Denton Drilling Awareness Group and Frack Free Denton commented that the TCEQ consistently determined potential VOC RACM, including leak detection and repair requirements, would not help reduce ozone in the North Texas area. The groups disagreed with the TCEQ's conclusion that modeling indicated additional VOC control measures will not advance attainment of the ozone standard. One individual commented that Appendix G: *RACM Analysis* identified some viable control measures that could be incorporated into the SIP but disagreed with the TCEQ's response that the potential control measures would not advance attainment. The individual further stated that the DFW area could reach attainment with the 2008 ozone NAAQS if enough of the potential control strategies were incorporated into the SIP.

As discussed in responses to comments above and as further detailed in Appendix G, none of the measures suggested met the multiple criteria to be considered RACM. VOC control measures have been determined to not meet RACM criteria in the DFW area because photochemical modeling indicates VOC reductions will not advance attainment. As also discussed in responses to comment above, implementing additional NO_X controls at this time is not justified. No changes were made in response to these comments.

The Sierra Club and Downwinders commented that the TCEQ relied on control measures beyond the DFW nonattainment area, including the utility electric generation in East and Central Texas and East Texas combustion sources rules in 30 Texas Administrative Code Chapter 117, in the past as strategies to reduce ozone for the DFW area.

The TCEQ acknowledges that it has adopted rules in the past implementing RACM strategies for sources outside of the DFW nonattainment area to address ozone transport from coal-fired power plants and other sources of NO_X emissions as a result of modeling indicating NO_X emission reductions were needed to demonstrate attainment of the ozone NAAQS. For the 2017 DFW AD SIP revision, however, modeling results and WoE indicate that the DFW ozone nonattainment area will demonstrate attainment, rendering additional RACM unnecessary. No changes were made in response to these comments.

The Texas Campaign for the Environment commented that ignoring the EPA's direction to make changes with this SIP revision that result in pollution reduction from major industries like coal plants, cement kilns, and oil and gas, means the EPA will have to make such changes. Fort Worth League of Neighborhood Associations and Texas Campaign for the Environment commented that the TCEQ lacks emission control requirements on major polluters, including power plants, Midlothian cement kilns, and oil and gas sources. The Fort Worth League of Neighborhood Associations further supported the Texas Medical Association's resolution for the state to implement RACM capable of meeting the ozone NAAQS, based on the UT Southwestern Medical School and UNT validated models. Councilmember Grayson commented that the SIP needs to be more proactive in cutting pollution from every source, especially sources that are outside the DFW area.

The EPA-directed changes claimed by the commenter are not specifically identified and therefore the underlying issues cannot be individually addressed. The TCEQ acknowledges its obligation to perform RACT and RACM analyses and to consider the EPA's comments on the 2017 DFW AD SIP revision. The TCEQ adopts rules based on technical merits and reasoned decision-making in accordance with the FCAA and EPA RACT/RACM guidance.

The TCEQ disagrees with the commenter indicating pollution reduction is needed from every source, including those outside the DFW area. RACT and RACM are FCAA obligations and the state's means to impose control requirements as a result of thorough technical analyses supporting either the need for additional control or demonstrating no additional controls are necessary. RACT requirements are only required to be evaluated for major sources of NO_X and VOC and certain non-major sources of VOC in a nonattainment area classified as moderate and higher, such as the 2008 DFW area, but not beyond the boundaries of such a nonattainment area.

The EPA's RACT guidance provides states the option to either make a demonstration that RACT is in place with existing control requirements and that additional controls are not necessary, make a negative declaration, or adopt new requirements implementing RACT for major sources of NO_X and other FCAA-specified sources of VOC, including major sources. Consistent with this RACT guidance, the TCEQ conducted rulemaking to assure RACT was satisfied (Rule Project Nos. 2013-048-115-AI and 2013-049-117-AI) concurrent with the 2018 DFW

AD SIP revision adopted in June 2015 (Non-Rule Project No. 2013-015-SIP-NR). For all other emission source categories not addressed in those rulemakings, the existing RACT regulations or negative declarations provided continue to satisfy VOC and NO_X RACT for the 2008 ozone DFW nonattainment area. The 2017 DFW AD SIP revision does not include a RACT analysis because the change to the 2017 attainment year did not impact the RACT analysis adopted by the commission in June 2015.

As discussed in responses to comment above, the TCEQ includes a RACM evaluation as part of the 2017 DFW AD SIP revision and provides its analysis of potential control measures, including controls contemplated for the source categories mentioned by the commenters, and its determination that there are none that met the criteria to be considered RACM.

Section 172 of the FCAA requires RACM only for sources in nonattainment areas although the EPA allows states the option to consider control measures outside the nonattainment area that can be shown to advance attainment. States are not required to exercise this option under the FCAA. Further, the TCEQ has determined that imposing additional controls is not justified at this time. No changes were made in response to these comments.

TECHNICAL ANALYSIS

Monitoring Data and Trends

The EPA, the Sierra Club, and Downwinders commented that the DFW area's peak eight-hour ozone design value using 2013-2015 monitoring data is 83 ppb and questioned how the 75 ppb eight-hour ozone standard would be achieved by the end of the 2017 ozone season. The commenters reference Figure 5-1: *One-Hour and Eight-Hour Ozone Design Values in the DFW Area from 1997 through 2014* of the SIP narrative showing a historical linear relationship indicating that the design value has dropped at an average rate of 1.1 ppb per year in DFW since 1997. The Sierra Club and Downwinders state the 2010 and 2014 were low ozone years in DFW and that the 75 ppb standard is not likely to be met until 2021. Commissioner Daniel commented that ozone levels increased from 2014 to 2015. The EPA notes that the fourth highest ozone levels at various monitors in 2014 were lower than those in 2012 and 2013. The EPA mentions the meteorology in those years with 2012 having "higher winds than average most of the time, so ozone exceedances were not overly severe or frequent," and that 2013, 2014, and 2015 were all years that had meteorology that was not conducive for ozone formation.

The TCEQ acknowledges that the DFW area's peak eight-hour ozone design value at Denton Airport South increased from 81 ppb in 2014 to 83 ppb in 2015. The Denton Airport South monitor has often measured the highest average ozone levels in the DFW area since it began operating in 1997. Denton Airport South had an eight-hour design value of 102 ppb in 2000, which is based on the first full three seasons of ozone measurements available for this monitor. Table 1: *Denton Airport South Eight-Hour Design Values from 2000 through 2015* shows the annual change in the eight-hour ozone design value at this monitor from 2000 through 2015.

Table 1: Denton Airport South Eight-Hour Design Values from 2000 through 2015

Calendar Year	Eight-Hour Design Value (ppb)	Change from Previous Year (ppb)
2000	102	N/A
2001	101	-1
2002	99	-2
2003	97	-2
2004	96	-1
2005	93	-3
2006	95	2
2007	94	-1
2008	91	-3
2009	85	-6
2010	80	-5
2011	83	3
2012	83	0
2013	87	4
2014	81	-6
2015	83	2

Achieving the 75 ppb standard by the end of the 2017 ozone season will require a reduction of 8 ppb in two years. As Table 1 shows, the Denton Airport South design value dropped by 6 ppb from both 2008 to 2009 and, most recently, from 2013 to 2014. It also dropped by 5 ppb from 2009 to 2010. The largest two-year reduction in the Denton Airport South design value was 11 ppb from 2008 to 2010. Due to meteorological variation from year to year, constant incremental reductions in a monitor's design value are not expected. Nonetheless, there is a precedent at the Denton Airport South monitor for design value reductions exceeding 4 ppb in one year, and over 8 ppb in two years.

The TCEQ does not concur with the EPA's statement that the four successive years of 2012 through 2015 all had meteorological patterns that were not conducive to high ozone formation. The EPA does not provide any analytical support for this statement.

The EPA only referenced the DFW area meteorology from 2012 through 2015 in its comments but did not reference the significant reductions in both NO_X emissions and monitored NO_X concentrations, which are documented in Section 5.2.2, *NO_X Trends*, in the 2017 DFW AD SIP revision. Section 5.2.2.1, *NO_X Emission Trends*, summarizes the reductions in point, on-road, and non-road emission reductions that have occurred in the DFW area since 1997. Section 5.2.2.2, *Ambient NO_X Trends*, demonstrates how these reduced NO_X emissions over time are reflected in

downward trends in NO_X concentrations at various DFW area monitors. The TCEQ disagrees that reductions in ozone are simply related to meteorology, but does recognize the impact of meteorology on ozone formation and that meteorology in future years is not directly controllable or known. No changes were made in response to these comments.

The Sierra Club and Downwinders commented that the number of days that ozone was measured above the 75 ppb level is higher in 2015 than in 2007, 2010, and 2014, and conclude that there is not a downward trend in ozone levels after 2007. The Sierra Club and Downwinders cited the following three-year periods where a downward trend was not evident: 2009-2011, 2010-2012, and 2011-2013.

The TCEQ disagrees that a downward trend in ozone is not evident after 2007. A trend in monitored ozone levels is not based simply on the number of days per year that levels above 75 ppb are measured but is rather driven more by the magnitude of the ozone measured. For example, if one year had 10 days monitored at 76 ppb and another year had five days monitored at 80 ppb, the fourth high of the latter year would be greater than that from the former.

In 2007, none of the DFW area monitors had eight-hour ozone design values at or below 75 ppb. The 2007 values ranged from a low of 76 ppb at Greenville and Kaufman to a high of 95 ppb at Eagle Mountain Lake. As of 2015, 13 of the 20 DFW area monitors have eight-hour ozone design values at or below 75 ppb. These 2015 values range from a low of 64 ppb at Kaufman to a high of 83 ppb at Denton Airport South. The lowest and highest eight-hour ozone design values among all DFW area monitors were both reduced by 12 ppb from 2007 to 2015. Such a reduction represents an unmistakable downward trend.

In accordance with EPA requirements, each monitor's design value is based on a three-year average of the fourth-highest measurement per year. While it is true that meteorological variation can cause the fourth-highest level to fluctuate from one year to the next, peak ozone levels have fluctuated in a downward direction over the span of several years as shown in Figure 1-1: *One-Hour and Eight-Hour Ozone Design Value and DFW Population*, in the 2017 DFW AD SIP revision. This decline in ozone levels is a direct result of the decline in monitored NO_X concentrations discussed in Section 5.2.2.2, *Ambient NO_X Trends*, of the 2017 DFW AD SIP revision. No changes were made in response to this comment.

The Sierra Club and Downwinders reference an EPA comment from February 2015 about how NO_X concentrations have been relatively flat at several western area monitors where growth in oil and gas have been prevalent, compared with the more steep NO_X declines at urban area monitors where on-road sources are prevalent. The Sierra Club and Downwinders state that the lack of control on gas industry pollution is linked to these flat trends.

The TCEQ disagrees with this comment. As noted in Section 3.5.4.4, *Area Sources*, of the 2017 DFW AD SIP revision, the TCEQ promulgated rules in Chapter 117 in 2007 that effectively reduced compressor engine NO_X by 93%. The issue of NO_X trends is addressed more fully in Figure 5-10: 90*th Percentile Daily Peak NO_X Concentrations in the DFW Area*, of the 2017 DFW AD SIP revision, which shows

that almost all of the 12 NO_X monitors throughout DFW show an ongoing decline in concentrations in the 18-year period from 1997 through 2014. As expected, the trends are particularly steep at the most urbanized locations such as Hinton where 90th percentile daily peak NO_X declined from over 60 ppb in 1997 to roughly 20 ppb in 2014. The TCEQ acknowledges that more rural monitors such as Parker show relatively flat profiles, but that is because levels of only 5-10 ppb have historically been monitored in such locations far away from major NO_X sources. The TCEQ response to this February 2015 EPA comment is included under the Emission Trends section on page 66 of the response to comments from the 2018 DFW AD SIP revision adopted in June 2015 (Non-Rule Project No. 2013-015-SIP-NR). No changes were made in response to this comment.

The Sierra Club and Downwinders commented that the TCEQ may try to dismiss ozone monitoring data from 2015 because it is not yet certified. The Sierra Club and Downwinders note that the TCEQ references ozone measurements through September 2015 in the SIP narrative and that the 2015 data will be certified by the time the EPA takes final action on this 2017 DFW AD SIP revision.

The TCEQ does not agree that it will "dismiss" ozone monitoring data from 2015 because it is not yet certified. The TCEQ reports ozone measurements in real time on its air monitoring Web page (https://www.tceq.texas.gov/cgi-bin/compliance/monops/aqi_rpt.pl). In accordance with EPA requirements, these measurements are quality assured and reported on a quarterly basis to the EPA's Air Quality System (AQS) three months after each quarter has ended. For example, measurements from October through December 2015 are reported to EPA's AQS by the end of March 2016. The final TCEQ certification for an entire calendar year is due by May 1 of the subsequent year, and the TCEQ has always met this requirement. The 2015 TCEQ certification data was sent to the EPA on April 27, 2015. No changes were made in response to this comment.

Commissioner Daniel, the League of Women Voters of Dallas, and the Lonestar Chapter of the Sierra Club commented that the peak ozone level in the DFW area was higher than that for Houston. The Denton Drilling Awareness Group and Frack Free Denton stated that the Denton area has some of the worst air in Texas and probably within the entire U.S.

The dominant wind direction during the DFW ozone season is southeasterly, which has resulted in the highest DFW area ozone levels historically being monitored north and west of the urban core. Due to its downwind location, the Denton Airport South monitor has had the highest eight-hour ozone design values in seven of the 16 years from 2000 through 2015. During the other nine years, the following four other monitors also located north and west of DFW have had the highest eight-hour ozone design values: Eagle Mountain Lake, Fort Worth Northwest, Grapevine Fairway, and Keller.

As of 2015, the Denton Airport South monitor has the highest eight-hour ozone design value in Texas at 83 ppb, which represents a reduction of 19 ppb from the 102 ppb design value that Denton Airport South had in 2000 when it first had three full years of ozone measurements. The current highest eight-hour ozone design value in the Houston-Galveston-Brazoria (HGB) area is 80 ppb at the

Manvel Croix Park monitor, which had a design value of 91 ppb in 2003 when it first had three full years of ozone measurements. Denton Airport South had a design value of 97 ppb in 2003, so it has been reduced by 14 ppb to its current level of 83 ppb during that time, while Manvel Croix Park has been reduced by 11 ppb.

For the entire U.S., the EPA currently only has ozone data through 2014 posted to its [Design Values](https://www3.epa.gov/airtrends/values.html) Web page (https://www3.epa.gov/airtrends/values.html). The detailed ozone information spreadsheet available at the EPA website indicates that 45 monitors located in 14 counties throughout the U.S. have eight-hour ozone design values higher than Denton Airport South. These monitors are located in California, Colorado, Connecticut, and Michigan. No changes were made in response to these comments.

Future Design Values and Attainment Test Methodologies

The EPA commented that the model is overestimating the amount of ozone reduction occurring between the 2006 base year and 2017 future year, which leads to modeling projections that are unrealistic. The EPA's basis for this claim is the over-prediction of modeled ozone from the base case on the episode days used in the relative response factor (RRF) attainment test calculations. The EPA notes that some of the episode days used in the RRF test had over-prediction in the range of 15-20 ppb or more. The EPA states that this over-prediction on RRF days seems to occur more at the "downwind" DFW area monitors that typically measure higher ozone rather than the "upwind" DFW area monitors that typically measure lower ozone. The EPA postulates that this over-prediction may make the downwind monitors overly sensitive to changes in local emissions, which in turn underestimates future projected design values. The EPA states that the cause of over-prediction should be further investigated.

The TCEQ acknowledges that over-prediction of modeled ozone is more common in the base case than under-prediction over the 67 total episode days. However, the TCEQ disagrees with the EPA's statement that this over-prediction in the base case leads to unrealistic future design values. In both its draft and official modeling guidance, the EPA acknowledges the unavoidable error and uncertainty associated with all photochemical modeling efforts. The EPA appropriately discourages the use of "absolute" attainment test methods, and instead recommends applying relative changes in modeled ozone to monitored design values.

Section 4.1, *Overview of model attainment test*, on page 96 of the EPA's draft modeling guidance states: "While good model performance remains a prerequisite for use of a model in an AD, problems posed by imperfect model performance on individual days are expected to be reduced when using the relative approach. An internal EPA analysis (USEPA, 2014b) considered whether daily ratios of model future/current maximum daily 8-hour ozone averages (MDA8) varied strongly as a function of site-specific base case model performance. The analysis determined that when modeled MDA8 ozone bias was relatively small (e.g., less than +/- 20 ppb), the average response ratios were not a strong function of the model MDA8 bias. This provides confidence that the model can detect the air quality response in the midst of reasonable levels of absolute bias and error."

In its comments on the 2017 DFW AD SIP revision, the EPA did not provide a quantitative analysis to accompany the claim that inclusion of episode days in the

attainment test with over-prediction of 15-20 ppb were having a significant impact on future design values. The TCEQ performed such an analysis by filtering out episode days in the RRF attainment tests where peak modeled eight-hour ozone exceeded monitored levels at separate thresholds of 15 ppb and 20 ppb. An aggregate summary across all monitors is provided in Table 2: *Changes in 2017 Future Design Values from Filtering Over-Predicted Days* showing the minimum, maximum, and average changes across all monitors in the 2017 future design values associated with the specific filtering scenarios.

Table 2: Changes in 2017 Future Design Values from Filtering Over-Predicted Days

Attainment Test Type and Over-Prediction Filtering Scenario	Minimum Change (ppb)	Maximum Change (ppb)	Average Change (ppb)
All Days Test with 15 ppb Filtering	-0.25	0.58	0.12
All Days Test with 20 ppb Filtering	-0.47	0.24	0.00
Top 10 Days Test with 15 ppb Filtering	-0.57	1.02	0.15
Top 10 Days Test with 20 ppb Filtering	-1.03	0.75	-0.05

As shown, there is relatively little average change for over-prediction thresholds of 15 ppb and 20 ppb when applied to both the all days and top 10 days attainment tests. More detailed tables are provided below showing the net changes for each monitor. For the all days attainment test, the number of episode days included in the RRF calculations was reduced after filtering occurred. For example, the Denton Airport South monitor had 35 episode days included in the RRF test. The 15 ppb threshold scenario filtered out four of these days, while the 20 ppb threshold scenario filtered out two of these days. Although the EPA states that this over-prediction would be more of a problem with downwind monitors, there is no clear pattern that filtering out over-prediction days impacts the "higher" downwind monitors more than the "lower" upwind ones. As shown, filtering out at thresholds of 15 ppb and 20 ppb actually reduces the Denton Airport South future design value for the all days test by 0.03 ppb and 0.07 ppb, respectively.

Table 3: Changes in 2017 Design Values in All Days Test for 15 ppb Filtering

2006 DFW Area Operational Monitor and Continuous Ambient Monitoring Station (CAMS) Code	RRF Days	Filtered Days	Change in Days	2017 DV_F (ppb)	Filtered DV_F (ppb)	DV_F Change (ppb)
Denton Airport South - C56	35	31	-4	77.85	77.82	-0.03
Eagle Mountain Lake - C75	28	24	-4	77.52	77.81	0.29
Grapevine Fairway - C70	33	23	-10	77.19	77.50	0.31
Keller - C17	32	27	-5	76.76	76.95	0.19
Fort Worth Northwest - C13	27	20	-7	75.94	76.52	0.58
Frisco - C31	34	26	-8	74.40	74.57	0.17
Dallas North #2 - C63	31	24	-7	73.34	73.14	-0.20
Dallas Executive Airport - C402	27	21	-6	72.21	72.25	0.04

2006 DFW Area Operational Monitor and Continuous Ambient Monitoring Station (CAMS) Code	RRF Days	Filtered Days	Change in Days	2017 DV_F (ppb)	Filtered DV_F (ppb)	DV_F Change (ppb)
Parker County - C76	20	17	-3	72.16	72.16	0.00
Cleburne Airport - C77	16	12	-4	71.10	71.33	0.24
Dallas Hinton Street - C401	31	24	-7	70.96	70.97	0.01
Arlington Municipal Airport - C61	30	18	-12	70.56	70.73	0.17
Granbury - C73	17	14	-3	68.73	69.17	0.45
Midlothian Tower - C94	19	11	-8	67.76	67.76	0.00
Pilot Point - C1032	33	26	-7	67.39	67.49	0.10
Rockwall Heath - C69	26	21	-5	65.65	65.40	-0.25
Midlothian OFW - C52	22	17	-5	63.17	63.56	0.39
Kaufman - C71	16	12	-4	62.04	61.84	-0.20
Greenville - C1006	16	13	-3	61.78	61.81	0.03

Table 4: Changes in 2017 Design Values in All Days Test for 20 ppb Filtering

2006 DFW Area Operational Monitor and CAMS Code	RRF Days	Filtered Days	Change in Days	2017 DV_F (ppb)	Filtered DV_F (ppb)	DV_F Change (ppb)
Denton Airport South - C56	35	33	-2	77.85	77.78	-0.07
Eagle Mountain Lake - C75	28	26	-2	77.52	77.53	0.02
Grapevine Fairway - C70	33	28	-5	77.19	77.27	0.08
Keller - C17	32	29	-3	76.76	76.90	0.14
Fort Worth Northwest - C13	27	24	-3	75.94	76.10	0.16
Frisco - C31	34	29	-5	74.40	74.42	0.03
Dallas North #2 - C63	31	26	-5	73.34	72.88	-0.47
Dallas Executive Airport - C402	27	23	-4	72.21	72.14	-0.07
Parker County - C76	20	18	-2	72.16	72.18	0.01
Cleburne Airport - C77	16	14	-2	71.10	71.28	0.19
Dallas Hinton Street - C401	31	27	-4	70.96	70.97	0.01
Arlington Municipal Airport - C61	30	23	-7	70.56	70.71	0.15
Granbury - C73	17	16	-1	68.73	68.88	0.16
Midlothian Tower - C94	19	15	-4	67.76	68.00	0.24
Pilot Point - C1032	33	29	-4	67.39	67.28	-0.11
Rockwall Heath - C69	26	21	-5	65.65	65.40	-0.25
Midlothian OFW - C52	22	20	-2	63.17	63.33	0.16
Kaufman - C71	16	13	-3	62.04	61.58	-0.45
Greenville - C1006	16	14	-2	61.78	61.87	0.09

In the case of the top 10 days attainment test, an episode day that exceeded the designated threshold would be filtered out, and then the next highest day would be

included to be sure that 10 episode days were still used. For example, the eight-hour ozone peak at the Denton Airport South monitor was over-predicted by 16.1 ppb on August 19, which was the fifth highest episode day in the 67-day episode for Denton Airport South, and was included in the original top 10 test days attainment calculation. It was removed and then the 11th highest day of June 28 was incorporated to ensure that the filtered results were still based on 10 total days. Since none of the 10 highest days for Denton Airport South were over-predicted by more than 20 ppb, there is no change in the 2017 future design value for this monitor when the 20 ppb filtering threshold was applied.

Table 5: Changes in 2017 Design Values in Top 10 Days Test for 15 ppb Filtering

2006 DFW Area Operational Monitor and CAMS Code	RRF Days	Filtered Days	Change in Days	2017 DV_F (ppb)	Filtered DV_F (ppb)	DV_F Change (ppb)
Denton Airport South - C56	10	10	0	76.25	76.52	0.27
Eagle Mountain Lake - C75	10	10	0	76.55	76.55	0.00
Grapevine Fairway - C70	10	10	0	75.65	76.22	0.57
Keller - C17	10	10	0	75.34	75.54	0.20
Fort Worth Northwest - C13	10	10	0	74.78	75.48	0.70
Frisco - C31	10	10	0	73.85	73.76	-0.09
Dallas North #2 - C63	10	10	0	72.22	71.72	-0.50
Dallas Executive Airport - C402	10	10	0	72.04	71.79	-0.25
Parker County - C76	10	10	0	72.39	72.25	-0.15
Cleburne Airport - C77	10	10	0	69.85	70.87	1.02
Dallas Hinton Street - C401	10	10	0	69.31	69.68	0.37
Arlington Municipal Airport - C61	10	10	0	69.85	70.46	0.60
Granbury - C73	10	10	0	68.41	69.25	0.85
Midlothian Tower - C94	10	10	0	67.43	67.51	0.08
Pilot Point - C1032	10	10	0	66.59	66.89	0.30
Rockwall Heath - C69	10	10	0	65.81	65.24	-0.57
Midlothian OFW - C52	10	10	0	62.56	63.02	0.46
Kaufman - C71	10	10	0	62.10	61.60	-0.50
Greenville - C1006	10	10	0	62.09	61.67	-0.42

Table 6: Changes in 2017 Design Values in Top 10 Days Test for 20 ppb Filtering

2006 DFW Area Operational Monitor and CAMS Code	RRF Days	Filtered Days	Change in Days	2017 DV_F (ppb)	Filtered DV_F (ppb)	DV_F Change (ppb)
Denton Airport South - C56	10	10	0	76.25	76.25	0.00
Eagle Mountain Lake - C75	10	10	0	76.55	76.55	0.00
Grapevine Fairway - C70	10	10	0	75.65	75.91	0.26

2006 DFW Area Operational Monitor and CAMS Code	RRF Days	Filtered Days	Change in Days	2017 DV_F (ppb)	Filtered DV_F (ppb)	DV_F Change (ppb)
Keller - C17	10	10	0	75.34	75.54	0.20
Fort Worth Northwest - C13	10	10	0	74.78	74.64	-0.13
Frisco - C31	10	10	0	73.85	73.76	-0.09
Dallas North #2 - C63	10	10	0	72.22	71.19	-1.03
Dallas Executive Airport - C402	10	10	0	72.04	71.79	-0.25
Parker County - C76	10	10	0	72.39	72.39	0.00
Cleburne Airport - C77	10	10	0	69.85	70.60	0.75
Dallas Hinton Street - C401	10	10	0	69.31	69.23	-0.08
Arlington Municipal Airport - C61	10	10	0	69.85	70.01	0.16
Granbury - C73	10	10	0	68.41	68.84	0.43
Midlothian Tower - C94	10	10	0	67.43	67.39	-0.05
Pilot Point - C1032	10	10	0	66.59	66.69	0.09
Rockwall Heath - C69	10	10	0	65.81	65.24	-0.57
Midlothian OFW - C52	10	10	0	62.56	62.56	0.00
Kaufman - C71	10	10	0	62.10	61.55	-0.55
Greenville - C1006	10	10	0	62.09	61.99	-0.10

The base case over-prediction referenced by the EPA is documented in Section 3.6.4, *Model Performance Evaluation*, of the 2017 DFW AD SIP revision and more fully in Appendix C, *Photochemical Modeling for the DFW Attainment Demonstration SIP Revision for the 2008 Eight-Hour Ozone Standard*. As explained in the 2017 DFW AD SIP revision, the over-prediction is more pronounced on lower ozone days, which by definition are not included in attainment test calculations. No changes were made in response to these comments.

The EPA commented that the TCEQ's use of 2006 baseline modeled ozone instead of 2006 base case modeled ozone in the attainment tests was leading to differences in the future design value projections. The EPA states that the baseline days used in the RRF calculations were typically 1-4 ppb higher than those for the base case, "thus biasing and increasing the uncertainty of the attainment demonstration results." The EPA uses the August 21 episode day as an example where the base case modeled value was 93.70 ppb, but the baseline value was 98.23 ppb. The EPA further states that use of the baseline values in the RRF calculations seems to overestimate the amount of ozone reduction from 2006 to 2017. The EPA commented that the TCEQ should investigate the differences in the meteorology and emission inventories between the base case and baseline modeling to determine what is driving the overestimation issue for days used in the RRF calculations.

The TCEQ disagrees with the assessment that base case modeled values should have been used for RRF calculations instead of baseline ones. Such an approach would contradict the EPA's modeling guidance. The use of baseline emissions instead of base case ones for RRF calculations is clearly recommended in the EPA's

official modeling guidance from April 2007, and the EPA provided no justification for departing from this guidance. Provided below are relevant excerpts:

- **Section 3.3, *Choosing model predictions to calculate a relative response factor (RRF) near a monitor*, on page 26: "The relative response factor (RRF) used in the modeled attainment test is computed by taking the ratio of the mean of the 8-hour daily maximum predictions in the future to the mean of the 8-hour daily maximum predictions with baseline emissions, over all relevant days."**

- **Section 3.5, *Which base year emissions inventory should be projected to the future for the purpose of calculating RRFs?*, on page 33: "One is the base case inventory which represents the emissions for the meteorology that is being modeled. These are the emissions that are used for model performance evaluations...Once the model has been shown to perform adequately, it is no longer necessary to model the base case emissions...The baseline emissions inventory is the inventory that is ultimately projected to a future year."**

For the DFW area, the 2006 base case and 2006 baseline emissions are identical for all source categories with the exception of wildfires and electric generating units (EGUs) based on Air Markets Program Data (AMPD). All other modeling inputs (e.g., non-EGU anthropogenic emissions, biogenic emissions, meteorological files, etc.) are identical between the 2006 base case and 2006 baseline. This is more fully explained in Section 3.5.2, *2006 Base Case*, and 3.5.3, *2006 Baseline*, of the 2017 DFW AD SIP revision. Much more detail about the differences in base case versus baseline emissions is provided in the following portions of Appendix B, *Emissions Modeling for the DFW Attainment Demonstration SIP Revision for the 2008 Eight-Hour Ozone Standard*: Section 2.1, *2006 Base Case Point Source Modeling Emissions Development*; and Section 2.2, *2006 Baseline Point Source Modeling Emissions Development*. The approach taken by the TCEQ complies with EPA modeling guidance to develop base case emissions specific to each episode day, but to take an averaging approach for developing representative baseline emissions for projection purposes. Such an averaging approach for the baseline reduces bias and uncertainty in the AD calculations, rather than increasing bias and uncertainty as the EPA states in its comment. Provided below are relevant excerpts from the EPA's official modeling guidance from April 2007:

- **Section 3.5, *Which base year emissions inventory should be projected to the future for the purpose of calculating RRFs?*, on page 34: "The base case inventory may include day specific information (e.g. wildfires, CEM data) that is not appropriate for using in future year projections. Therefore the baseline inventory may need to replace the day specific emissions with average or 'typical' emissions (for certain types of sources)."**

- **Section 17.3, *What Other Data are Needed to Support Emissions Modeling?*, on pages 172-173: "For point sources, hourly CEM data are recommended for use in model-evaluation runs. For future-year runs, we recommend**

creating an "average-year" or "typical year" temporal allocation approach that creates representative emissions for the "baseline inventory" but that also includes similar daily temporal variability as could be expected for any given year. Care should be taken to not reduce or increase day-to-day variability in the averaging approach, with the exception of eliminating year-specific outages or other year-specific anomalies within the years used for the model-attainment test."

For the future year, the TCEQ models EGU emissions at their Cross-State Air Pollution Rule (CSAPR) cap levels, even though these units historically operate at roughly half of their operating caps on a typical ozone season day. This is discussed more fully in Section 3.5.4, *2017 Future Case Emissions*, of the 2017 DFW AD SIP revision. This conservative approach of modeling the maximum allowable emission levels ensures that future estimates are not underestimated for these NO_X sources on high ozone days.

The TCEQ disagrees with the EPA's claim that future year modeled ozone reductions are overestimated simply because baseline values used in the attainment test are higher than base case ones. In a hypothetical situation where there would be no difference between base case and baseline emission inventories, both the official and draft versions of the EPA's modeling guidance ensure that the baseline modeled value for the attainment test will always be higher than the base case value used for performance evaluation. EPA modeling guidance recommends that the denominator of the RRF calculation for a single episode day be based on the maximum modeled value of the nine grid cells comprising the 3x3 array around the monitor of interest. The base case value used for the performance evaluation is a bi-linear interpolation of the four modeled values from the cell containing the monitor plus the three closest ones. Based on how the modeling guidance is structured, the maximum of nine values from the 3x3 array will always be higher than an interpolation of any four values within that same 3x3 array.

In the example of the August 21 episode day mentioned by the EPA, the 93.70 ppb base case value is the bi-linear interpolation from four cells, while the maximum in the 3x3 array surrounding the Denton Airport South monitor is 99.51 ppb modeled for cell 77-X/190-Y. The EGU emissions specific to August 21 are 16.13 NO_X tpd, while the baseline average emissions are 9.63 NO_X tpd. Use of the lower EGU emissions in the baseline inventory results in the maximum modeled value in the 3x3 array of 98.23 ppb, which is also in cell 77-X/190-Y. In this instance, use of the base case inventory suggested by the EPA would actually result in a higher modeled value of 99.51 ppb instead of the 98.23 ppb from the baseline inventory. No changes were made in response to these comments.

The EPA commented that the TCEQ modeling utilized the two RRF approaches based on the all days test and the top 10 days attainment tests. The EPA noted that under the all days test, four monitors have 2017 future design values above the 75 ppb standard: Denton Airport South (77), Eagle Mountain Lake (77), Grapevine Fairway (77), and Keller (76). The EPA also noted that under the top 10 days test, two of these monitors have 2017 future design values above the 75 ppb standard: Denton Airport South (76) and Eagle Mountain Lake (76). The EPA states that the future design values are likely underestimated by using the top 10 days test.

The TCEQ is reporting the results of both attainment tests because the EPA requested that this be done in a February 11, 2015 set of comments on the 2018 DFW AD SIP revision that was proposed in December 2014. In these comments, the EPA stated that its "current plan is to review comments and finalize the revised modeling guidance by the end of the year (2015). The guidance may change further based on comments. In this transitional period, we recommend that TCEQ continue to provide the attainment test analysis using both the existing 2007 modeling guidance approach and the new approach recommended in the December 2014 draft modeling guidance." Since the EPA has not yet finalized the draft modeling guidance, the TCEQ is continuing to report results for both the all days and top 10 days attainment tests.

Within the *Executive Summary* plus Sections 3.7.2, *Future Baseline Modeling*, and 5.5, *Conclusions*, of the 2017 DFW AD SIP revision, the TCEQ states that the 2017 design values for all four monitors above 75 ppb fall within the 73-78 ppb WoE range that applies for the all days test under EPA's official modeling guidance. Within these same portions of the 2017 DFW AD SIP revision, the TCEQ states that the peak 2017 design value of 76 ppb for two monitors under the top 10 days test meets the draft modeling guidance requirement of being "close to the NAAQS."

The EPA's statement that use of the top 10 days attainment test is underestimating the modeled future design values is inconsistent with the EPA's own modeling guidance. The EPA's preference in this comment for the all days test contradicts the draft EPA modeling guidance that recommends use of the newer top 10 days test instead of the older all days test. Following are excerpts from Section 4.2.1, *Model values to use in the RRF calculation*, on page 101 of the draft modeling guidance: "Since the form of the standard is also focused on the highest days of an ozone season (i.e., the fourth highest MDA8), the RRF calculation should also focus on days when the model predicts the highest ozone concentrations…Using the highest modeled days at each monitor is most likely to represent the response of the observed design value at a monitor…We therefore recommend calculating the RRF based on the highest 10 modeled days in the simulated period…Use of the highest 10 days in the mean RRF calculation yields a slightly better estimate of the actual observed ozone change than the previous guidance approach."

Further, in its recent 2017 future year modeling efforts based on a 2011 base case episode, the EPA uses the top 10 days attainment test instead of the older all days one, as noted in Section 3.2, *Approach for Projection 2017 Ozone Design Values*, on page 14 of the November 2015 *Air Quality Modeling Technical Support Document for the 2008 Ozone NAAQS Cross-State Air Pollution Rule Proposal*. No changes were made in response to these comments.

The Sierra Club and Downwinders commented that the EPA's 2017 future year modeling in support of the transport rule showed the highest DFW area monitor with an average design value of 79.6 and a maximum design value of 82.1 ppb. The Sierra Club and Downwinders state that since these EPA values are higher than the 76 ppb value claimed by the TCEQ, a WoE analysis cannot be used.

The TCEQ disagrees with this comment. The modeled design values referenced by the commenter are in Appendix B of the EPA's [Air Quality Modeling Technical Support Document for the 2008 Ozone NAAQS Cross-State Air Pollution Rule Proposal](https://www.epa.gov/sites/production/files/2015-11/documents/air_quality_modeling_tsd_proposed_rule.pdf), November 2015, (https://www.epa.gov/sites/production/files/2015-11/documents/air_quality_modeling_tsd_proposed_rule.pdf). The average design values reported by the EPA in Appendix B are consistent with the recommendations included in its draft modeling guidance where a baseline design value (DV_B) from five years of monitoring data is multiplied by an RRF based on the 10 highest modeled days for that monitor. For the purposes of addressing "maintenance sites," the EPA introduced the "maximum design value" approach, which uses a maximum value based on three consecutive years instead of five. This maximum design value approach is not referenced or recommended by the EPA in its draft or official modeling guidance for ADs and is used only in its transport rule modeling. In the 2017 DFW AD SIP revision, the TCEQ provides future design values based on both the all days and top 10 tests consistent with the official modeling guidance and draft modeling guidance, respectively, so any comparison with the maximum design values using other approaches is not consistent with EPA guidance.

The 79.6 average design value reported by the EPA in Appendix B has a monitor identification code of 484392003, which is the Keller monitor located in Tarrant County roughly 12 miles north of central Fort Worth. As of 2015, Keller has an eight-hour monitored design value of 76 ppb, based on a three-year average of fourth-high readings of 80 ppb (2013), 74 ppb (2014), and 76 ppb (2015). Keller is already very close to meeting the 75 ppb standard, and the fourth-high measurement of 80 ppb from 2013 will be removed from its design value calculation once the 2016 ozone season has completed.

Denton Airport South is located roughly 21 miles north of Keller and is the monitor with the current highest design value of 83 ppb. Since it began operation in February 1998, Denton Airport South has, on average, measured higher ozone values than the other monitors in the DFW area. The TCEQ modeling in the 2017 DFW AD SIP revision projects that Denton Airport South will have the highest 2017 design value of 76.25 ppb when the top 10 days attainment test is employed. Denton Airport South has a monitor identification code of 481210034, and the EPA's ozone transport modeling projects its 2017 design value to be 76.9 ppb. After applying the final truncation step outlined in the EPA's attainment test, both the TCEQ and EPA modeling predicts Denton Airport South to have a final 2017 design value of 76 ppb.

The EPA's transport rule modeling is not the only 2017 future case work it has done in the recent past. Appendix B of *Air Quality Modeling Technical Support Document: Proposed Tier 3 Emission Standards*, March 2013, provides DFW area design values by county rather than by individual monitor. These results report 2017 design values for Denton County at 74.73 ppb and Tarrant County at 76.25 ppb. No changes were made in response to these comments.

The Sierra Club and Downwinders state that use of the official EPA modeling guidance results in four monitors with 2017 future design values above 75 ppb, and that use of the draft EPA modeling guidance results in two monitors with 2017 future design values above 75 ppb. The Sierra Club and Downwinders also reference the unmonitored area peak of 78.6 ppb, and state that "there is no rational reason to truncate" these modeled design values.

The TCEQ disagrees with the statement that "there is no rational reason to truncate" modeled design values. Section 3.1 on page 24 of the EPA's official modeling guidance from April 2007 states: "For 8-hour ozone, it is recommended to round to the tenths digit until the last step in the calculation when the final future design value is truncated." Section 4.1.1 on page 99 of the draft modeling guidance from December 2014 makes the same statement. A footnote on page 100 of the draft modeling guidance emphasizes that this truncation approach to the modeled attainment test is recommended to be consistent with how monitoring data are used for determination of attainment. Both modeling guidance versions provide example future design value calculations that show how this truncation is to be performed as the final step in the attainment test. No changes were made in response to this comment.

The Sierra Club and Downwinders commented that the 2018 DFW AD SIP revision adopted in June 2015 showed a peak future design value at Denton Airport South of 76.7 ppb, but that this 2017 DFW AD SIP revision shows the same monitor at 77.8 ppb, which is roughly 1 ppb higher.

The TCEQ acknowledges that the 2018 DFW AD SIP revision had a future design value that is roughly 1 ppb lower than this 2017 DFW AD SIP revision. The June 2015 DFW AD SIP revision was based on a 2018 future year in accordance with EPA direction from 2012, while this revision is based on a 2017 future year in response to an EPA-required change in the modeled attainment year for moderate areas. Due to ongoing fleet turnover effects that result in lower emissions over time, it is expected that 2018 will have lower NO_X emissions than 2017, and therefore lower ozone formation as well. For example, the source apportionment results in Section 3.7.3, *Ozone Source Apportionment Tool and Anthropogenic Precursor Culpability Analysis*, show that the on-road source category is the largest local contributor to Denton Airport South ozone at 10-12 ppb depending on the type of attainment test used. The on-road emissions reported in these SIP revisions estimate 2017 at 130.77 NO_X tpd and 2018 at 119.69 NO_X tpd, which is a reduction of 11.08 NO_X tpd. No changes were made in response to this comment.

Ozone Episode Selection

The Sierra Club and Downwinders commented that the TCEQ should not have used a 67-day ozone episode from 2006 but instead should have first focused on the entire 2011 ozone season or, at worst, the 2012 ozone season. The Sierra Club and Downwinders referenced the case of *Mississippi Commission on Environmental Quality vs. EPA*, and noted that the EPA criticized the TCEQ for using only a June 2006 episode in its analysis. The Sierra Club and Downwinders stated that the addition of the August-September 2006 episode to the June 2006 one is not sufficient because westerly winds were not included, which would be necessary to cover a variety of meteorological conditions. The Sierra Club and Downwinders stated that the TCEQ does not demonstrate that its base modeling period is representative of a variety of meteorological conditions. They specifically disagreed with the TCEQ's position that 2011 is not a satisfactory year to model because it is not representative of historic norms, citing the EPA's modeling guidance that calls for a variety of meteorological conditions to model.

The TCEQ does not agree with these comments. Both the EPA official and draft modeling guidance documents do not require a full ozone season for AD modeling purposes. Section 2.3.1, *Choosing Time Periods to Model*, of the draft modeling guidance specifically says to "model time periods both before and following elevated pollution concentration episodes to ensure the modeling system appropriately characterizes low pollution periods, development of elevated periods, and transition back to low pollution periods through synoptic cycles." Figure 3-4: *Maximum Eight-Hour Ozone by Monitor from May 31 through July 2, 2006* of the 2017 DFW AD SIP revision shows how the 33-day June portion of the episode has three full synoptic cycles of low-high-low ozone periods. Figure 3-5: *Maximum Eight-Hour Ozone by Monitor from August 13 through September 15, 2006* of the 2017 DFW AD SIP revision shows how the 34-day August-September portion of the 2006 episode has four full synoptic cycles of low-high-low periods.

The TCEQ disagrees with the commenter's interpretation of the EPA's guidance on modeling a variety of meteorological conditions. In both the EPA's official modeling guidance and the more recent draft version, the EPA does not simply say to include all possible types of meteorological conditions when selecting an episode. The following excerpt from Section 2.3.1, *Choosing Time Periods to Model*, on page 16 of the draft version addresses this issue: "Choose time periods which reflect a variety of meteorological conditions that frequently correspond with observed 8-hour daily maxima concentrations greater than the level of the NAAQS at monitoring sites in the nonattainment area." Section 14.0, *How are the Meteorological Time Periods (Episodes) Selected?*, from the official version contains very similar direction about focusing on meteorological conditions that frequently occur at times when high ozone is measured, rather than all possible meteorological conditions that may occur within a given year.

Appendix D, *Conceptual Model for the DFW Attainment Demonstration SIP Revision for the 2008 Eight-Hour Ozone Standard*, of the 2017 DFW AD SIP revision provides an extensive discussion of meteorological conditions associated with high ozone levels in the DFW area. Section 1.2, *Ozone in the Dallas-Fort Worth Area*, discusses the dominance of south and southeasterly winds during ozone season rather than winds originating from the north and west. Section 3.6, *Meteorological Characterization and Trends*, provides analyses of the correlation of wind speed, wind direction, and ozone levels based on monitoring data collected from 1997 through 2013. The wind rose plots per monitor in Figure 3-21: *Wind Speeds by Wind Direction on High Ozone Days* substantiate that high ozone occurs in the DFW area when the dominant wind directions are south and southeasterly, while the westerly contribution is negligible. If winds from the west and northwest were correlated to high ozone days, there would be detectable patterns when the DFW area ozone monitors in the west and northwest (e.g., Denton Airport South and Grapevine Fairway) would have the lowest ozone measured and those to the east and southeast (e.g., Rockwall Heath and Kaufman) would have the highest ozone measured.

There are some days during the 2006 episode when micro-scale wind direction is westerly, and this tends to occur due to stagnation and/or flow reversal. This is shown in the 2017 DFW AD SIP revision in Figure 3-6: *Eagle Mountain Lake*

***Monitor Back Trajectories for May 31 through July 2, 2006* and Figure 3-7: *Denton Airport South Monitor Back Trajectories for August 13 through September 15, 2006*, which show the 48-hour wind back trajectories for each of the 67 episode days. When the primary wind direction over a 48-hour period is viewed per day, the macro-scale origin is dominantly south and east with some occasional north and northeastern contribution. Micro-scale westerly flow is detected on certain days of the 2006 episode such as June 1, June 23, and August 15 where the "parcel" of air begins its 48-hour trajectory southeast of DFW (such as in the Gulf of Mexico), travels to the west of the DFW area where its speed is lowered, and then reverses direction traveling east towards DFW at a slow rate. However, as shown in Figures 3-4 and 3-5, these all happen to be days in the episode when no DFW area monitors measured above 75 ppb. This further corroborates the conceptual model's statements in Appendix D that westerly winds are not a frequent occurrence when high ozone is measured in the DFW area.**

The TCEQ disagrees with the commenter's statement that the EPA "criticized TCEQ before for failing to use an entire ozone season it its modeling" in the case of *Mississippi Commission on Environmental Quality vs. EPA*. In that case, the TCEQ was petitioning the court to review the EPA's designation of Wise County as nonattainment and used source apportionment modeling from the June 2006 episode. The EPA's comment on the TCEQ source apportionment work was that the historical high ozone pattern in the DFW area is bimodal with peaks occurring in June and August/September. The inclusion of the 34-day August/September period in this AD with the 33-day June one covers the bimodal high ozone distribution that the EPA discussed. Figure 3-2: *DFW Eight-Hour Ozone Days Above 75 ppb by Month from 1991 through 2014* in the 2017 DFW AD SIP revision presents this bimodal distribution of June and August/September peaks using historical monitoring data.

The TCEQ disagrees that the 2011 ozone season would be more representative than 2006 for attainment modeling purposes. Table 3-1: *DFW Days with Ozone Above 75 ppb by Month from 2006 through 2014* of the 2017 DFW AD SIP revision shows that 2006 not only had more days above 75 ppb than any other subsequent year, but it also has them occurring during the peak times of June, August, and early September, which matches the historical pattern. Compared to this historical bimodal pattern in DFW, 2011 had a very skewed distribution towards the latter portion of the ozone season with relatively few high ozone days in June, and the bulk occurring in late August and September. In addition, 2011 was an atypical year for meteorology because it was the highest drought year on record for Texas.

Under the EPA's official modeling guidance from April 2007, the attainment test is based on all days modeled above the 75 ppb standard. Under the draft modeling guidance, from December 2014, only the 10 highest modeled days are included in the attainment test. In both modeling guidance documents, the EPA recommends choosing episodes that have at least 10 days per monitor above the relevant standard to be included in these tests. Simply adding more weeks and months with low ozone in a base case episode does not necessarily help. For example, Table 7: *Episode Days Modeled Above 75 ppb in 2006 TCEQ Episode and 2011 EPA Episode* compares the number of days modeled above 75 ppb by DFW area monitors in the

TCEQ's 67-day episode from 2006 and the EPA's 153-day May-September episode from 2011. Even though the 2011 EPA episode is more than twice as long as the 2006 TCEQ one, only five of the monitors in the 2011 case reach the minimum of 10 recommended days above 75 ppb for the attainment test calculations. In the case of the 2006 TCEQ episode, even the "lowest" monitors of Cleburne Airport, Greenville, and Kaufman have 16 days out of the 67 with modeled ozone above 75 ppb. For the "highest" ozone monitor of Denton Airport South, the 67-day 2006 episode from the TCEQ has 35 days modeled above 75 ppb, while the 153-day 2011 episode from the EPA has only 12.

Table 7: Episode Days Modeled Above 75 ppb in 2006 TCEQ Episode and 2011 EPA Episode

DFW Area Monitor and CAMS Code	67-Day TCEQ 2006 Episode	153-Day EPA 2011 Episode	Difference in Days
Denton Airport South - C56	35	12	23
Eagle Mountain Lake - C75	28	9	19
Grapevine Fairway - C70	33	13	20
Keller - C17	32	11	21
Fort Worth Northwest - C13	27	5	22
Frisco - C31	34	12	22
Dallas North #2 - C63	31	8	23
Dallas Executive Airport - C402	27	3	24
Parker County - C76	20	3	17
Cleburne Airport - C77	16	2	14
Dallas Hinton Street - C401	31	3	28
Arlington Municipal Airport - C61	30	4	26
Granbury - C73	17	3	14
Pilot Point - C1032	33	10	23
Rockwall Heath - C69	26	4	22
Midlothian OFW - C52	22	5	17
Kaufman - C71	16	0	16
Greenville - C1006	16	3	13

In selecting a new episode for future SIP development, the TCEQ has chosen the 2012 ozone season because it is a far better match than 2011 and other recent years for reflecting the historical pattern of meteorological conditions that frequently correspond with eight-hour daily maximum concentrations, as required by both the draft and official versions of EPA's modeling guidance. To date, the TCEQ has completed a preliminary set of photochemical modeling inputs for the June 2012 period, and these are available via the TCEQ's Texas Air Quality Modeling - Files and Information (2012 Episodes) Web page (https://www.tceq.texas.gov/airquality/airmod/data/tx2012). The TCEQ is currently improving these June 2012 inputs along with developing ones for additional months from May through September in the 2012 ozone season. When

these are complete, they will be posted to the 2012 modeling page for public access. No changes were made in response to these comments.

The Sierra Club and Downwinders stated that the TCEQ modeling is unreliable and that the EPA has already rejected it "at face value, that is without adjustments, because it significantly underestimates ozone values." The Sierra Club and Downwinders provide an excerpt from a June 2, 2015 decision by the U.S. District of Columbia (D.C.) Circuit Court of Appeals in the case of *Mississippi Commission on Environmental Quality versus EPA.*

The TCEQ disagrees both that the modeling is unreliable and that the EPA has already rejected it at face value. As discussed in a response above about this court case, the court decision excerpt referenced by the commenter simply says that the EPA should fully evaluate a modeling submission and not accept it at face value. The TCEQ concurs that all modeling work should be fully evaluated, whether that modeling is performed by the TCEQ, the EPA, or any other organization that does this type of complex work.

In referencing the June 2, 2015 court decision, the commenter did not note that AD modeling was not the subject of this case. The TCEQ joined other Texas petitioners in challenging the EPA's designation of Wise County as nonattainment under the 2008 eight-hour ozone standard. The court rejected the Texas petitioners and upheld the EPA's nonattainment designation for Wise County. Photochemical modeling for the DFW nonattainment area to support an AD was not an issue in this case and was not rejected by either the court or the EPA as unsuitable.

The excerpt mentioned by the commenter is from Section III.F.2.ii of the decision (http://caselaw.findlaw.com/us-dc-circuit/1702787.html) where the court addresses the EPA's review of the source apportionment modeling submitted by the TCEQ in support of excluding Wise County from the DFW nonattainment area. The court was addressing the EPA's observation that the DFW ozone season is bimodal, but that the TCEQ source apportionment modeling submitted was only for June 2006. At the time the TCEQ submitted this source apportionment modeling, it was relying on the best available information, which was modeling that was included in the December 2011 DFW AD SIP revision for the 1997 eight-hour ozone standard of 84 ppb.

The bimodal distribution referenced by the EPA is summarized in Figure 3-2: *DFW Eight-Hour Ozone Days Above 75 ppb by Month from 1991 through 2014* of the 2017 DFW AD SIP revision, showing DFW area ozone peaks typically occurring in both June and August/September. Section 3.3, *Episode Selection*, of the 2017 DFW AD SIP revision discusses how the 33-day June 2006 episode previously used was combined with a 34-day portion from August and September 2006 to better reflect this bimodal distribution pattern for the DFW area. In addition to extending the 2006 episode, multiple modeling improvements were made by the TCEQ with respect to emissions, meteorological, and photochemistry inputs as detailed in Section 3.6.4.3, *Diagnostic Evaluations*, of the 2017 DFW AD SIP revision. No changes were made in response to these comments.

Emissions Inventory Development

The Sierra Club and Downwinders commented that the 2017 oil and gas emissions estimated by the TCEQ are 27.5 NO_X tpd and 50.4 VOC tpd for a total of roughly 78 precursor tpd, which makes it the fourth largest total of any major source category. One individual also commented that oil and gas emissions were the fourth largest major source category, while another individual commented that oil and gas emissions were a leading cause of air pollution. The Sierra Club and Downwinders stated that projected NO_X levels have increased over 50% from the 2018 estimates included in the June 2015 DFW AD SIP revision. They stated that this increase makes it more important to control compressor engine NO_X emissions.

The TCEQ does not agree with the oil and gas emission figures referenced by one of the commenters. The emission summary tables for 2017 are included within the *Executive Summary* and several locations in Chapter 3. These tables show that the combined oil and gas categories for production, drilling, and point total 30.37 NO_X tpd and 57.98 VOC tpd for 2017. The 2018 DFW AD SIP revision adopted in June 2015 shows that the 2018 estimates for these same categories total 27.50 NO_X tpd and 50.47 VOC tpd. The net increases from 2018 to 2017 of 2.87 NO_X tpd and 7.51 VOC tpd reflect changes of 10% and 15%, respectively, instead of the 50% level referenced by the commenter. As shown in the trends from Figure 3-13: *Barnett Shale Drilling and Natural Gas Production from 1993-2015*, it is expected that 2018 oil and gas emission estimates would be slightly lower than those for 2017. The Barnett Shale drilling boom peak in 2008 led to a subsequent production peak in 2012, which has been steadily declining due to the significant reduction in drilling of new wells that started in 2009.

The TCEQ concurs that unregulated compressor engines could be a significant NO_X source, and this is why the TCEQ adopted rules in Chapter 117 in 2007 that effectively reduced DFW area compressor engine NO_X by 93%. This is explained in more detail in Section 3.5.4.4, *Area Sources*, of the 2017 DFW AD SIP revision. These effects are also evident by comparing the various summary tables containing 2006 and 2017 emission estimates. The oil and gas production category was estimated to emit 61.84 NO_X tpd in 2006 prior to implementation of the Chapter 117 rules, and is expected to emit 10.80 NO_X tpd in 2017.

When comparing ozone precursor totals in a NO_X-limited environment such as DFW, it is misleading to combine NO_X and VOC for ranking purposes. When relatively large amounts of reactive biogenic VOC are present (e.g., isoprene from oak trees), small changes in relatively non-reactive anthropogenic VOC emissions have a negligible impact on ozone formation. Numerous summary tables included in the 2017 DFW AD SIP revision show that the on-road source category is the primary source of both NO_X emissions and ozone formation at critical monitors such as Denton Airport South. No changes were made in response to this comment.

The Sierra Club and Downwinders stated that the TCEQ overestimates 2006 on-road emissions, which in turn leads to an overestimate of the ozone reductions that will be achieved by 2017. The Sierra Club and Downwinders stated that the 2006 gasoline passenger truck emission rate of 1.508 grams/mile of NO_X used by the TCEQ is too high. The Sierra Club and Downwinders cited an EPA document that indicates light-duty truck NO_X emission rates for 2008 are 0.95

grams/mile. The name of this document is *Average Annual Emissions and Fuel Consumption for Gasoline-Fueled Passenger Cars and Light Trucks*, EPA420-F-08-024, October 2008.

The TCEQ disagrees with this comment. The October 2008 EPA document states that the emission rate figures listed are based on the MOBILE6.2 model, which was initially released by the EPA in 2002 and last updated in 2004. The EPA replaced MOBILE6.2 with the 2010 version of the Motor Vehicle Emission Simulator (MOVES2010) model back in March of 2010. Upon its release, MOVES became the required on-road emission model for SIP development by states. The EPA's typical policy is to require that the latest version available at the time SIP development work commences of their on-road emission model be used. The 2017 DFW AD SIP revision makes multiple references to use of the MOVES2014 version of the model, which was first released in July 2014.

Texas does not arbitrarily choose its own emission rates for on-road inventory development but rather, uses output from MOVES2014. When developing and/or revising their on-road models, the EPA incorporates the effects of vehicle emission standards required of manufacturers. When developing an on-road emissions inventory for a specific calendar year to be used in a SIP (e.g., 2006 or 2017), states input local data that characterize the age distribution, composition, and overall activity from the fleet. The model then reports separate emission rates for each vehicle type based on all the data sets and algorithms incorporated by the EPA. No changes were made in response to this comment.

The Sierra Club and Downwinders stated that the TCEQ "2017 modeling underestimates mobile source on-road emissions because TCEQ used the 2018 mobile source on-road emission estimate for the 2017 modeling."

The TCEQ disagrees with this statement. Compared to the 2018 future year, the 2017 on-road emission estimates for the DFW area are higher by 11.08 NO_X tpd and 2.71 VOC tpd. The *Executive Summary* of the 2018 DFW AD SIP revision reports 2018 on-road emission estimates for DFW at 119.69 NO_X tpd and 62.20 VOC tpd. The *Executive Summary* of the current 2017 DFW AD SIP revision reports 2017 on-road emission estimates for the DFW area at 130.77 NO_X tpd and 64.91 VOC tpd. Within both of these DFW AD SIP revisions, these on-road emission estimates are referenced multiple times in Chapter 3, Chapter 4, and Appendix B. All of the DFW area on-road emission inventory development files for these AD SIP revisions are available in the following FTP directories:

- **ftp://amdaftp.tceq.texas.gov/pub/Mobile_EI/DFW/mvs/2006/ for 2006;**
- **ftp://amdaftp.tceq.texas.gov/pub/Mobile_EI/DFW/mvs/2017/ for 2017; and**
- **ftp://amdaftp.tceq.texas.gov/pub/Mobile_EI/DFW/mvs/2018/ for 2018.**

No changes were made in response to this comment.

The Sierra Club and Downwinders commented that there is no evidence that Tier 3 regulations will improve ozone levels in DFW in 2017. The Sierra Club and Downwinders stated that the number of Tier 3 compliant vehicles in 2017 will be a negligible portion of the on-road fleet. To demonstrate that Tier 3 reduction emission estimates exist in 2018 but not 2017, the Sierra Club and Downwinders provided a fact sheet entitled *EPA Sets Tier 3 Motor Vehicle Emission and Fuel Standards*, EPA-420-F-14-009, March 2014. Table 1 of this fact sheet provides the EPA's estimated annual emission reductions for the entire U.S. for both 2018 and 2030. The Sierra Club and Downwinders disputed the use of the annual average gasoline sulfur caps associated with the Tier 3 rule as inputs for on-road emission inventory development. They stated that "if EPA believed that sulfur levels would definitely be lower on any given day during 2017 in DFW, it would have lowered the refinery gate and downstream caps." The Sierra Club and Downwinders also claimed that the on-road emission inventory is underestimated since gasoline at the pump can have up to 15% ethanol (E15), which will lead to higher emission of ozone precursors.

The TCEQ disagrees with these comments. The second sentence of the EPA fact sheet referenced states "Starting in 2017, Tier 3 sets new vehicle emissions standards and lowers the sulfur content of gasoline..." This fact sheet is available along with several other detailed documents through the EPA's Tier 3 Vehicle Emission and Fuel Standards Program Web page (http://www3.epa.gov/otaq/tier3.htm). The following reports prepared by the EPA are available on this site:

- ***Air Quality Modeling Technical Support Document: Proposed Tier 3 Emission Standards*, EPA-454/R-13-006, March 2013, http://www3.epa.gov/otaq/documents/tier3/454r13006.pdf; and**

- ***Air Quality Modeling Technical Support Document: Tier 3 Motor Vehicle Emission and Standards*, EPA-454/R-14-002, February 2014, http://www3.epa.gov/otaq/documents/tier3/454r14002.pdf.**

The EPA's March 2013 document summarizes the 2017 benefits that EPA modeled for the proposed Tier 3 rule. Page 12 of this document states: "The maximum projected decrease in an 8-hour ozone design value in 2017 is 1.09 ppb in Tarrant County, Texas." Appendix B of the March 2013 document includes the eight-hour ozone design value changes modeled by the EPA for the 2017 calendar year for various U.S. counties from Tier 3. Appendix B of the February 2014 document includes similar information by U.S. county for the 2018 calendar year. Table 8: *Tier 3 Ozone Reductions Modeled by EPA for 2017 and 2018* summarizes these results for DFW area counties.

Table 8: Tier 3 Ozone Reductions Modeled by EPA for 2017 and 2018

Texas County	2017 Ozone Reduction (ppb)	2018 Ozone Reduction (ppb)
Collin	0.89	0.92
Dallas	0.90	0.81
Denton	1.07	0.79
Ellis	0.86	0.58
Hood	1.02	0.50

Texas County	2017 Ozone Reduction (ppb)	2018 Ozone Reduction (ppb)
Hunt	0.46	0.42
Johnson	0.88	0.51
Kaufman	0.45	0.46
Rockwall	0.54	0.58
Tarrant	1.09	0.73

It is true that the penetration of Tier 3 compliant vehicles will be minimal in the 2017 calendar year because 2017 is the first model year for Tier 3 vehicles to start entering the fleet, and the full phase-in of these standards is not complete until the 2025 model year. However, the largest immediate benefit from the Tier 3 program comes from reducing the gasoline sulfur levels from 30 parts per million (ppm) to 10 ppm, which makes the catalytic converters from in-use vehicles more effective, and therefore reduces their emissions. The first page of the fact sheet referenced by the commenter states that "the Tier 3 gasoline sulfur standard will make emission control systems more effective for both existing and new vehicles…" This is fully documented in an EPA report entitled *The Effects of Ultra-Low Sulfur Gasoline on Emissions from Tier 2 Vehicles in the In-Use Fleet*, EPA-420-R-14-002, March 2014, (http://www3.epa.gov/otaq/models/moves/documents/420r14002.pdf). This study was conducted by the EPA and its results were incorporated into the MOVES2014 model that was used to develop 2017 on-road emission inventories for this 2017 DFW AD SIP revision.

The EPA appropriately incorporated the effects of both Tier 3 standards and 10 ppm sulfur gasoline into the MOVES2014 model, which it requires states to use for SIP emissions inventory development. The TCEQ disagrees that the EPA intended for states to model the refinery gate and downstream sulfur caps instead of the annual average sulfur cap of 10 ppm. The EPA provides direction to states on this issue in Section 4.9.1, *Fuel Formulation and Fuel Supply Guidance*, of their *MOVES2014 and MOVES2014a Technical Guidance: Using MOVES to Prepare Emission Inventories for State Implementation Plans and Transportation Conformity*, EPA-420-B-15-093, November 2015, (http://www3.epa.gov/otaq/models/moves/documents/420b15093.pdf). The following excerpt is from pages 46 and 47: "The Tier 3 rule establishes a national average of 10 ppm sulfur beginning in 2017…MOVES2014 assumes a sulfur level of 10 ppm for all regions. MOVES2014 can provide benefits of sulfur reduction down to 5 ppm. Do not use values for gasoline sulfur below 5 ppm." In accordance with EPA MOVES technical guidance on how to model Tier 3, the TCEQ specified a gasoline sulfur input of 10 ppm for the 2017 calendar year.

The EPA Tier 3 regulations require an annual average of 10 ppm sulfur content, but do allow a refinery gate cap of 80 ppm to account for occasional equipment problems that can occur at an individual refinery. However, for each day of a given year that a refinery would provide 80 ppm sulfur gasoline, 5 ppm sulfur gasoline would have to be provided for a total of 14 days to still meet the 10 ppm annual average.

According to the EPA's [E15](https://www.epa.gov/fuels-registration-reporting-and-compliance-help/e15-fuel-registration) Web page (https://www.epa.gov/fuels-registration-reporting-and-compliance-help/e15-fuel-registration), E15 can be sold for use in 2001-and-newer model year light-duty motor vehicles, subject to certain conditions. E15 cannot be sold for use in 2000-and-older model year light-duty vehicles, motorcycles, heavy-duty vehicles (e.g., buses and delivery trucks), non-road vehicles and equipment (e.g., boats, lawnmowers, and chain saws). Since many vehicles and types of equipment cannot use E15, it has very limited availability nationwide. According to the Ethanol Retailer website (http://www.ethanolretailer.com/e15-resource-center/whitepaper-e15), "E15 has been available for three years and by the end of 2015 will be available at more than 300 major retail locations in 20 states." According to the American Petroleum Institute's Service Station FAQs Web page, there are 152,995 locations nationwide selling gasoline (http://www.api.org/Oil-and-Natural-Gas-Overview/Consumer-Information/Service-Station-FAQs). These 300 retail locations selling E15 represent 0.2% of the nationwide total, and are heavily concentrated in the Midwestern states of Illinois, Iowa, Kansas, Minnesota, Nebraska, North Dakota, and Wisconsin with only three known locations in Texas.

The TCEQ typically contracts out surveys in three-year increments to obtain fuel properties throughout various Texas regions. The last such study was done for 2014 and is entitled *2014 Summer Fuel Field Study*, Eastern Research Group, January 2015 (http://www.tceq.state.tx.us/assets/public/implementation/air/am/contracts/reports/mob/5821199776FY1420-20140815-ergi-summer_2014_fuels.pdf). The survey shows that 10% is the maximum ethanol content in gasoline sold throughout Texas. If future fuel survey work shows that this ethanol content starts increasing to 15%, the TCEQ will revise its on-road modeling inputs accordingly.

In both of the air quality modeling technical support documents referenced above for the Tier 3 program, the EPA used gasoline properties for both 2017 and 2018 of 10 ppm sulfur and 10% ethanol. As recommended by EPA MOVES2014 technical guidance and consistent with how the EPA modeled Tier 3, the TCEQ used these same inputs in its 2017 on-road inventory development. No changes were made in response to these comments.

The Sierra Club and Downwinders commented that the Tier 3 on-road emission benefits will be zero in 2015 and 2016, which are two of the years that will be used to calculate the DFW area design value at the end of the 2017 ozone season.

The TCEQ concurs that there will be no benefits from Tier 3 in the 2015 and 2016 calendar years because this federal rule does not take effect until January 1, 2017. Since 2017 represents the full ozone season preceding the DFW area attainment date of July 20, 2018, it is the appropriate future year for this AD modeling. The lack of Tier 3 on-road benefits in 2015 and 2016 has no impact on the modeled ozone and emission levels in 2017. No changes were made in response to this comment.

The Sierra Club and Downwinders commented that the TCEQ did not increase the VOC emissions in its modeling to account for the decommissioning of Stage II vapor control equipment that was approved by the EPA on March 17, 2014. The Sierra Club and Downwinders stated this would have a very small impact on both VOC emissions and modeled ozone.

The TCEQ does not agree that it failed to increase VOC emission estimates to account for the decommissioning of Stage II. Refueling emission inventories for 2017 were modeled without Stage II benefits for all Texas counties. Development of refueling emission inventories with MOVES2014 for the 2017 future year is documented in an August 2015 report available on the TCEQ FTP site at ftp://amdaftp.tceq.texas.gov/pub/Mobile_EI/Statewide/mvs/reports/mvs14_att_tex_17_technical_report_final_aug_2015.pdf. References to the disabling of Stage II benefits are addressed on pages 4, 15, 19, and 41 of the report. A similar MOVES2014 report from December 2014 is available on the TCEQ FTP site for development of 2006, 2012, and 2018 on-road emission inventories: ftp://amdaftp.tceq.texas.gov/pub/Mobile_EI/Statewide/mvs/reports/mvs14_att_tex_06_12_18_technical_report_final_dec_2014.pdf. Stage II benefits were included for 2006 and 2012 when this program was still in effect, but not for 2018. This is addressed on pages 4, 16, 36, 37, 42, 57, 58, 59, 73, and 91 of the report.

The TCEQ agrees with the comment that any increases in VOC emissions and ozone formation from decommissioning of Stage II are minimal. This was fully documented in the Stage II Vapor Recovery Program SIP Revision adopted by the TCEQ on October 9, 2013 and approved by the EPA on March 17, 2014 (https://www.tceq.texas.gov/assets/public/implementation/air/sip/miscdocs/2361SIP.pdf). In order to report a small increase in 2017 VOC emissions from removing Stage II in this 2017 DFW AD SIP revision, the refueling inventories documented above would have to be developed for both "with Stage II" and "without Stage II" scenarios, and then the difference reported as the increase. This was done for the October 9, 2013 Stage II SIP revision as summarized in Table 12.1: *Stage II VOC Emission Reduction Benefit Loss Estimates Summary in Tons per Day*, which includes VOC increases in two-year increments from 2012 through 2030 as a result of Stage II decommissioning. The 2017 refueling inventories for all counties exclude Stage II in the 2017 DFW AD SIP revision. No changes were made in response to this comment.

The Sierra Club and Downwinders commented that the emission inventory of stationary and area sources used in the modeling is too low because the TCEQ has assumed that sources with emission limits will not emit ozone precursors at rates higher than those emission limits. The Sierra Club and Downwinders asserted that the Texas SIP's affirmative defense is a defect in the SIP that invalidates that assumption. Specifically, the Sierra Club and Downwinders stated that the inclusion of an affirmative defense in the SIP disincentivizes compliance with emission limits, and therefore the TCEQ cannot accurately claim that emissions used in the model properly reflect actual emissions. The Sierra Club and Downwinders stated that the TCEQ must remove the illegal affirmative defense provisions before its attainment demonstration can be deemed sufficient.

The TCEQ disagrees with this comment. Inclusion of the affirmative defense in the Texas SIP does not invalidate the 2017 DFW AD SIP revision. The best estimate of area source emissions is developed for each county with EPA-approved methodologies, and uses activity data such as the county's population. For major

stationary point sources, emissions inventory requirements include reporting of all actual emissions at each site regardless of the authorization status for these emissions. These emissions include those that are both authorized and unauthorized. Unauthorized emissions include, but are not limited to, emissions from events and unplanned maintenance, along with startup and shutdown activities for which an affirmative defense is available. The use of an affirmative defense does not create disincentives from compliance, since these emissions must still be reported and evaluated in the SIP planning process.

Despite Texas' use of the affirmative defense, the base case stationary point source emissions that were modeled are greater than the actual authorized emissions reported for that year. First, emission events (such as upsets) plus scheduled maintenance, startup, and shutdown reported emissions are added to the daily modeled inventory of authorized emissions for each point source. In general, these additions are not significant amounts of ozone precursors. Second, the TCEQ inflates the VOC emission inventory of point sources via the use of rule effectiveness, which accounts for the fact that not all controls on all sources are likely operating at 100% effectiveness all the time. For the 2006 base case that was modeled, this rule effectiveness factor added approximately 21% more VOC across the state, 8% in the 10-county DFW nonattainment area, and 34% in the eight-county HGB nonattainment area. These rule-effectiveness values represent the VOC emissions that are reported in the base case point source section of Appendix B, summarized in a table at the end of Section 2.1.4, *Summary of June 2006 Base Case Point Sources*. For the EGUs throughout the state, NO_X emissions were modeled directly from the EPA's AMPD.

In the future case, the TCEQ added more emissions to the reported emissions in an effort to model a conservative, yet realistic emission inventory of point sources, as these emissions are projected into the future attainment year of 2017. The projection base year modeled for the non-EGUs was 2012. An inventory for 2012 was developed using the same procedures as discussed above for 2006. For the 2012 projection base year, rule effectiveness added 20% more VOC across the state, 14% in the 10-county DFW nonattainment area, and 31% in the eight-county HGB nonattainment area above and beyond what was reported. The rule effectiveness factors vary based on the reported stationary source category and type of equipment. The 2017 non-EGUs were grown from 2012 via projection factors, primarily derived from economic analytics and applied by business sector. As the table and associated discussions of Section 2.3.3.1.2, *NAA Non-EGU Projections of Control Implementation*, of Appendix B demonstrate, this overall non-EGU projected growth was flat for DFW for 2012 through 2017, so no banked emissions credits would be expected to be used. Other areas of the state were projected to increase in emissions. Within the DFW nonattainment area, the Midlothian cement kilns were modeled at their conservative capped levels of 17.6 NO_X tpd, which is approximately twice what they actually emitted in 2012.

For the EGUs in the state, 2014 emissions were extracted from the EPA's AMPD. Sections 2.3.2, *Attainment Areas of Texas*, and 2.3.3, *Nonattainment Areas of Texas*, of Appendix B describe how post-2014 EGU growth via newly-permitted units was added to the 2017 future case at permitted levels, and then compared to

ERCOT's projection to make sure that the TCEQ has accounted for enough electrical demand growth. These 2017 EGU NO_X emissions were then limited by the EPA CSAPR cap-and trade rules as they apply to Texas. The summary table at the end of Section 2.3.3 of Appendix B demonstrates that across Texas, the modeled CSAPR caps allow more NO_X EGU emissions than were emitted in 2014. All of these factors combined demonstrate that the TCEQ models more point source emissions than are reported and models more emissions in the future than are projected to be emitted on a typical ozone season day. No changes were made in response to these comments.

The Sierra Club and Downwinders commented that the EGU emission inputs modeled by the TCEQ for the 2017 future year were unjustifiably low. The Sierra Club and Downwinders cited a sentence from page 3-30 of the 2017 DFW AD SIP revision, and state that the description does not satisfactorily explain how the 2014 EGU operational profiles were used, how high-demand days were considered, and how the hourly variation in NO_X emissions was addressed. The Sierra Club and Downwinders disputed the TCEQ's statement that the 13.98 NO_X tpd for 2017 CSAPR cap is conservative when compared to an 8.25 NO_X tpd average for 2012. The Sierra Club and Downwinders stated that actual emission data from the EPA Clean Air Markets database should be used for ozone modeling purposes.

The TCEQ concurs that data from the EPA Clean Air Markets Web page should be used for modeling purposes. This information is referenced in the 2017 DFW AD SIP revision as a primary data source by both its former name of Acid Rain Data and the newer one of AMPD. Multiple references to use of these data sets are included within Chapter 3 of the 2017 DFW AD SIP revision, with a far more extensive discussion provided in Section 2 of Appendix B about how these data sets are used for developing 2017 future-year EGU emissions for modeling. At the time emissions were developed for this 2017 DFW AD SIP revision, 2014 was the latest full year for which AMPD information was available. Section 2.3.2.1.1, *EGUs*, provides details on how the 2014 hourly NO_X emissions per EGU from AMPD were projected to the 2017 future year.

The 8.25 NO_X tpd of the DFW area EGU emissions reported in Chapter 3 is based on the 2012 ozone season average and not an annual average basis as presumed by the commenter. Similarly, the 9.63 NO_X tpd of DFW area EGU emissions referenced in Chapter 3 is based on the 2006 ozone season average rather than an annual one. The 13.98 NO_X tpd CSAPR cap for 2017 is 4.35 NO_X tpd higher (45% increase) than the 2006 level, and 5.73 NO_X tpd higher (69% increase) than the 2012 level. Since the 13.98 NO_X tpd CSAPR cap is modeled for each of the 67 episode days in the future case, these figures show that the 2017 EGU projections are conservative because this value is higher than the reported emission values. The 2017 case is composed of CSAPR caps with average temporal profiles from June 1 through September 30, 2014. This approach of using CSARP caps represents a conservative high demand scenario since it uses a summer profile. The TCEQ does not model the absolute highest electric demand day (HEDD) for every episode day in the future year because this would not be representative of every day modeled in the future, and there is much evidence to show that HEDDs do not necessarily correspond to high ozone. No changes were made in response to this comment.

One individual commented that increased flight activity at Love Field due to the repeal of the Wright Amendment would increase emissions but that this is regulated at the federal level and not by the TCEQ, so the 2017 DFW AD SIP revision does not consider this.

The TCEQ concurs that aircraft emissions are regulated by the federal government and not by Texas. However, the 2017 DFW AD SIP revision does include emission estimates for Love Field, DFW International, and smaller regional airports. Love Field emissions are reported at 1.22 NO_X tpd for 2006 in Table 3-12: *2006 Base Case Airport Modeling for 10-County DFW Area*, and at 1.70 NO_X tpd for 2017 in Table 3-25: *2017 Future Case Airport Modeling Emissions for 10-County DFW*. As documented in a report entitled *Emissions Inventory of Airport-Related Sources: Dallas Love Field*, June 2014, the increased activity as a result of the Wright Amendment repeal is included in the future-year emission estimates. This report is available at ftp://amdaftp.tceq.texas.gov/pub/Offroad_EI/Airports/DFW/. No changes were made in response to this comment.

The EPA commented that it looks forward to receiving the motor vehicle emissions budget (MVEB) for this attainment demonstration.

This information is provided in Table 4-2: 2017 *Attainment Demonstration MVEB for the 10-County DFW Area*, and is listed as 130.77 NO_X tpd and 64.91 VOC tpd. These on-road MVEB figures are also reported in the Executive Summary, Chapter 3, and Appendix B. No changes were made in response to this comment.

The North Texas Renewable Energy Group commented that Texas leads the nation in industrial carbon dioxide (CO_2) emissions and expressed concerns about climate change. An individual was concerned about climate change and the potential impacts to agriculture and ultimately food availability, citing statistics and forecasts from various sources.

The 2017 DFW AD SIP revision is intended to demonstrate attainment of the 2008 eight-hour ozone NAAQS. Comments related to climate change and greenhouse gas pollution, including CO_2 emissions, are outside the scope of the 2017 DFW AD SIP revision. No changes were made in response to these comments.

Sierra Club and Downwinders stated that the on-road mobile source emissions used in the modeling are "lower than actual emissions because there has been widespread cheating on mobile source emission compliance...The cheating mobile sources are all for model years after 2006 which means that TCEQ's claimed reduction in mobile source emissions post-2006 are inflated." To support this comment, Sierra Club and Downwinders attached a January 4, 2016 complaint filed against Volkswagen (VW) and its subsidiaries by the U.S. Department of Justice on behalf of EPA.

The EPA reports that 16 light-duty diesel make/model combinations for the 2009-2016 model years manufactured by VW and its subsidiaries were designed to circumvent accurate emissions testing. Table 9: *Affected Light-Duty Diesel Make and Models* is a summary of these vehicles as reported on EPA's *Volkswagen Light Duty Diesel Vehicle Violations for Model Years 2009-2016* page, which is available at http://www.epa.gov/vw. These make and models match those reported in

Appendices A and B of the January 4, 2016 complaint referenced by the commenter.

Table 9: Affected Light-Duty Diesel Make and Models

Make/Model	Affected Model Years
Audi A3	2010-2015
Audi A6 Quattro	2014-2016
Audi A7 Quattro	2014-2016
Audi A8	2014-2016
Audi A8L	2014-2016
Audi Q5	2014-2016
Audi Q7	2009-2016
Porsche Cayenne	2013-2016
VW Beetle	2013-2015
VW Beetle Convertible	2013-2015
VW Golf	2010-2015
VW Golf Sportwagen	2015
VW Jetta	2009-2015
VW Jetta Sportwagen	2009-2014
VW Passat	2012-2015
VW Touareg	2009-2016

Table 10: *Available Light-Duty Vehicles by Fuel Type from 2009-2016* summarizes the number of light-duty make/model combinations by fuel type available from all manufacturers for the 2009-2016 model years, according to the EPA Green Vehicle Guide, which is available at http://www.fueleconomy.gov/feg/download.shtml. As shown, the individual make/models available range from a low of 1,010 in the 2011 model year to a high of 1,227 in the 2009 model year. The percentage of vehicles not complying with the federal emission standards under this complaint ranges from 0.3% in 2009 to 1.3% in 2014.

Table 10: Available Light-Duty Vehicles by Fuel Type from 2009-2016

Fuel Type	2009	2010	2011	2012	2013	2014	2015	2016
Gasoline	1,147	1,018	869	970	916	957	1,006	993
Gasoline/Ethanol	63	60	75	150	74	61	46	69
Diesel	16	37	56	54	67	93	129	22
Electricity	0	0	5	8	13	15	16	13
Electricity/Gasoline	0	0	0	3	4	9	11	10
Natural Gas	1	1	2	2	2	2	1	0
Natural Gas/Gasoline	0	0	0	1	1	1	2	1

Fuel Type	2009	2010	2011	2012	2013	2014	2015	2016
Hydrogen	0	2	3	0	0	1	1	2
Total	1,227	1,118	1,010	1,188	1,077	1,139	1,212	1,110
Number of Affected Diesel VW/Audi/Porsche Models	4	6	6	7	10	15	15	8
Affected Diesel Portion of Total	0.3%	0.5%	0.6%	0.6%	0.9%	1.3%	1.2%	0.7%

The EPA has issued two notices of violation against VW, one in September 2015 and another in November 2015, but this matter has not yet been fully resolved. The affected vehicles are expected to be subject to a recall and may be repaired or replaced prior to 2017. In a similar situation with heavy-duty diesel engine manufacturers back in the 1990s, the EPA incorporated the effects of both the higher emissions and the corrective action into its on-road mobile model for use by states for SIP development. To date, EPA has not updated the MOVES model to incorporate the effects of either the higher emissions or the corrective action for the affected 2009-2016 model year light-duty diesel vehicles. The TCEQ has requested EPA guidance on how to handle this matter regarding the MOVES model. If EPA updates the model, the TCEQ will incorporate them in future SIP revisions.

Table 3-6: *VMT and Emissions by Vehicle Type for 2017 DFW On-Road Inventory* in Appendix B list reports the 2017 DFW area vehicle miles traveled (VMT) and on-road emission estimates by combination of fuel type and category. A small portion of the on-road NO_X emissions inventory is represented by the affected light-duty diesel vehicles. For 2017, all diesel passenger cars are projected to contribute 1,148,364 VMT (0.54%) out of a daily on-road fleet total of 211,862,471. Using these VMT figures in combination with emission rates from the MOVES2014 model, the total 2017 diesel passenger car NO_X is estimated to be 0.20 NO_X tpd (0.15%) out of a daily total of 130.77 NO_X tpd. No change was made in response to this comment.

<u>**Emissions Impacts on Ozone**</u>

The EPA commented that the large year-to-year reductions in the DFW ozone nonattainment area only occurred when emission reduction measures were being implemented, such as in 2008. The EPA stated that a review of historical emissions and design value trends indicates that achieving the 75 ppb standard by 2017 would require additional NO_X reductions of roughly 100-200 tpd in the local area, or a combination of local and even larger upwind NO_X reductions.

The TCEQ disagrees with these comments. The 2008 peak eight-hour ozone design value of 91 ppb at Denton Airport South has been reduced to 83 ppb as of 2015. These ozone improvements would not have occurred without the benefit of the ongoing NO_X reductions that have occurred within the DFW area over several years even as growth in human population continually occurred. Section 3.7.3, *Ozone Source Apportionment Tool and Anthropogenic Precursor Culpability Analysis*, of the 2017 DFW AD SIP revision provides the 2017 ozone source apportionment results by source category for both the all days and top 10 days attainment tests. Section 3.7.3 shows that the on-road source category is the

largest single local contributor to Denton Airport South ozone at 9.82 ppb for the all days test and 11.81 ppb for the top 10 days test, and that the non-road source category is the second largest local ozone contributor at 3.68 ppb for the all days test and 4.68 ppb for the top 10 days test. Section 5.2.2 shows the significant ongoing NO_X emission reductions that are occurring in both of these source categories of primary ozone precursors.

Most of these on-road and non-road reductions are due to fleet turnover effects where older high-emitting vehicles and equipment are removed from the fleet and replaced with newer low-emitting vehicles and equipment. The rather large on-road NO_X reduction from 2016 to 2017 is due in part to the lowering of gasoline sulfur levels from 30 ppm to 10 ppm starting in January 2017. This Federal requirement is expected to substantially reduce NO_X emissions by making the catalytic converters of in-use vehicles more efficient. The EPA incorporated these effects into the MOVES2014 model, and they are also documented in an EPA study entitled *The Effects of Ultra-Low Sulfur Gasoline on Emissions from Tier 2 Vehicles in the In-Use Fleet*, EPA-420-R-14-002, March 2014.

The EPA states that an additional 100-200 NO_X tpd would be required in the local DFW area or in combination with upwind sources to attain the standard by the attainment deadline, but references no detailed analysis of how these estimates were reached or how such reductions could be achieved. Multiple emission summary tables within the 2017 DFW AD SIP revision demonstrate how the NO_X in the DFW nonattainment area is projected to be reduced from 582 tpd in 2006 to 297 tpd in 2017, which reflects a 49% decrease of 285 tpd. It is unclear if the 100-200 NO_X tpd reduction referenced by the EPA is from the 2006 baseline level or the 2017 future level. If the reduction is from the 2006 baseline, then the 2017 DFW AD SIP revision already demonstrates how 285 tpd will be achieved. If from the 2017 future case, then reducing an additional 100-200 NO_X tpd from a total of 297 tpd implies further reductions in 2017 on the scale of 1/3 to 2/3 of the entire anthropogenic NO_X emissions inventory, which is unsupported by the photochemical model. No changes were made in response to these comments.

The Sierra Club and Downwinders commented that an unprecedented four-year drop of 10 ppb in the peak ozone design value occurred from 2007 through 2010 due to implementation of the cement kiln NO_X reduction rules passed by the TCEQ in 2007. As evidence of this claim, the Sierra Club and Downwinders cite Section 5.2.2, *NO_X Trends*, and Figure 5-5, *Reported Point Source NO_X Emissions by County*, from the SIP narrative.

The TCEQ disagrees that the reduction of ozone in the DFW nonattainment area from 2007 through 2010 was due solely to reductions in cement kiln NO_X emissions. The peak ozone design value in 2007 was 95 ppb at the Eagle Mountain Lake monitor. The peak ozone design value in 2010 was 86 ppb at the Keller monitor. This 9 ppb reduction was due to combined NO_X reductions from the on-road, non-road, off-road, and point source categories within the DFW nonattainment area.

The TCEQ concurs that some reduction in ozone is due to lower NO_X emissions at cement kilns. However, these NO_X reductions are confined to the Midlothian area

within Ellis County and have a reduced ozone impact at relatively distant monitors such as Denton Airport South, Eagle Mountain Lake, and Keller. Figure 5-5 referenced by the commenter does show large point source NO_X reductions within Ellis County after implementation of the cement kiln rules in 2007, but it also shows large point source reductions in other counties occurring in previous years.

The commenter references Section 5.2.2 of the 2017 DFW AD SIP revision but does not acknowledge the significant on-road, non-road, and EGU NO_X reductions also discussed. Section 3.5.4, *2017 Future Case Emissions*, shows how ongoing fleet turnover effects enable on-road and non-road NO_X in 2017 to be reduced by 154 tpd and 53 tpd, respectively, from 2006 levels. The source apportionment results in Section 3.7.3, *Ozone Source Apportionment Tool and Anthropogenic Precursor Culpability Analysis*, clearly show that the primary ozone-contributing categories to the Denton Airport South monitor are on-road (10-12 ppb) and non-road (4-5 ppb), with the cement kilns being the smallest local contributor in the range of 0.2 ppb. No changes were made in response to this comment.

The Sierra Club and Downwinders referenced a February 2015 set of comments from the EPA that requested modeling results to support the TCEQ's position that the Midlothian area cement kilns have only a slight contribution to ozone formation in DFW. The Sierra Club and Downwinders claim that the TCEQ did not provide any such modeling.

The TCEQ disagrees with this comment. The EPA comments referenced were submitted to the TCEQ in February 2015 regarding the 2018 DFW AD SIP revision adopted in June 2015 (Non-Rule Project No. 2013-015-SIP-NR). That proposal from December 2014 included 2018 modeled source apportionment results showing that the DFW area cement kilns were the smallest ozone contributor of all local source categories. These results are currently available in Table 3-46: *2018 Ozone DV_F Denton, Parker, and Kaufman Contributions* in the 2018 DFW AD SIP revision adopted in June 2015. The results show that the DFW area cement kilns contribute 0.21 ppb at Denton Airport South, 0.17 ppb at Parker County, and 0.03 ppb at Kaufman County.

During a presentation in November 2015 held at the North Central Texas Council of Governments (NCTCOG) offices, the TCEQ presented the results of a 2017 modeling scenario where the DFW area cement kiln NO_X was reduced from 17.6 to 12.2 NO_X tpd, which is a 5.4 NO_X tpd reduction. This scenario reduced the 2017 future design value at the Denton Airport South monitor by 0.14 ppb for the all days test and 0.11 ppb for the top 10 days test. A summary for all monitors in the DFW area is available on slide 24 of *DFW Area Future Case Ozone Modeling for the 2017 Attainment Year* (http://www.nctcog.org/trans/committees/aqtc/110615/Item_4.pdf). The EPA attended this meeting. No changes were made in response to this comment.

The Sierra Club and Downwinders commented that June 9 and June 15 are the two highest ozone days in the episode, and that the non-DFW EGUs category is the largest or second largest contributor to ozone formed on these days at the Denton Airport South monitor. As evidence for this claim, the Sierra Club and Downwinders cite the ozone source apportionment results provided by the TCEQ on page 3-72 of the SIP narrative.

The TCEQ disagrees with this assessment of ozone contribution for the June 9 and June 15 episode days. Figure 3-31, *2017 Ozone Contributions for Denton Airport South from May 31 through June 16*, on page 3-72 graphically presents the ozone contribution results for the 17 days in the first half of the June 2006 episode. Table 11: *Relative 2017 Ozone Contributions at Denton Airport South for June 9 and June 15* presents the results for just these two episode days. As shown, the two largest anthropogenic categories for both episode days are DFW on-road and non-Texas anthropogenic sources. No changes were made in response to this comment.

Table 11: Relative 2017 Ozone Contributions at Denton Airport South for June 9 and June 15

Geographic Area and Source Type Group	June 9	June 15
DFW On-Road	17.78%	7.75%
DFW Non-Road	7.47%	2.81%
DFW Off-Road - Airports and Locomotives	3.29%	2.74%
DFW Area Sources	4.10%	1.62%
DFW Oil/Gas - Drilling and Production	0.08%	0.09%
DFW Point - Electric Utilities	1.07%	0.44%
DFW Point - Cement Kilns	0.04%	0.39%
DFW Point - Oil/Gas and Other	0.68%	1.80%
Non-DFW Texas - On-Road	3.46%	2.33%
Non-DFW Texas - Non-Road, Off-Road, and Area Sources	3.15%	2.91%
Non-DFW Texas - Oil/Gas Drilling and Production	3.06%	1.80%
Non-DFW Texas Point – EGUs	4.62%	3.92%
Non-DFW Texas Point - Cement Kilns, Oil/Gas, and Other	2.25%	3.03%
Non-Texas - All Anthropogenic	16.98%	32.27%
Biogenic - All Geographic Areas	5.85%	5.16%
Boundary Conditions	25.89%	30.91%
Initial Conditions	0.23%	0.04%
2017 Maximum Eight-Hour Modeled Ozone	100.00%	100.00%

The Sierra Club and Downwinders commented that reducing the non-DFW Texas EGU emissions by half would reduce 2017 ozone by 1.13 ppb and bring the Denton Airport South monitor into compliance with the 75 ppb standard. As evidence for this claim, the Sierra Club and Downwinders cited the ozone source apportionment results provided by the TCEQ on page 3-75 of the 2017 DFW AD SIP revision. The Sierra Club and Downwinders claimed that the non-DFW Texas EGU category represents a “but for” cause of the Denton Airport South monitor not meeting the 75 ppb standard, meaning that this monitor would meet the standard if this source category had no precursor emissions.

The TCEQ disagrees with this comment. The non-DFW Texas EGU category is comprised of 118 individual facilities located throughout Texas, but outside of DFW, and were modeled at their 2017 CSAPR emission caps of 463.50 NO_X tpd. The ozone contribution to Denton Airport South for this category is reported in

Section 3.7.3, *Ozone Source Apportionment Tool and Anthropogenic Precursor Culpability Analysis*, as 2.40 ppb for the all days test and 2.27 ppb for the top 10 days test.

An across-the-board 50% reduction of all these non-DFW Texas electric utilities would not automatically reduce ozone contributions from these sources in half to 1.1-1.2 ppb. First, the chemistry of ozone formation is non-linear, so a 50% reduction in NO_X precursors will not automatically yield a 50% reduction in ozone. Second, these 118 facilities are scattered throughout the 244 Texas counties outside of the 10-county DFW nonattainment area. Many of these sources are located either downwind or relatively far away from DFW, so a 50% reduction on such sources will have little to no impact on ozone levels at Denton Airport South. No changes were made in response to this comment.

The North Texas Renewable Energy Group commented that emissions from four coal plants formerly owned by TXU are one of the main reasons why the DFW area is in nonattainment of the ozone standard.

The TCEQ disagrees with this comment. Section 3.7.3, *Ozone Source Apportionment Tool and Anthropogenic Precursor Culpability Analysis*, of the 2017 DFW AD SIP revision provides ozone source apportionment results by 17 combinations of source category and geographic area. The non-DFW Texas EGUs are shown to account for 2.3-2.4 ppb, while the largest local ozone contributor, DFW on-road, accounts for 10-12 ppb. The four TXU plants referenced by the commenter are included within the 118 facilities that are grouped under the non-DFW Texas EGUs category. These 118 facilities located throughout Texas, but outside of the 10-county DFW ozone nonattainment area, were modeled at their 2017 CSAPR emission caps of 463.50 NO_X tpd. No changes were made in response to this comment.

Councilmember Grayson commented that Texas cannot count on federal efforts to cut gas mileage as a means of achieving the 75 ppb eight-hour ozone standard.

The TCEQ does not rely on fuel economy changes over time in the on-road fleet to reduce ozone levels within the DFW area or other Texas cities. On a per-mile basis, a direct correlation does not exist between the amount of fuel consumed by the engine and the amount of NO_X or VOC emitted at the tailpipe. For example, the EPA's Green Vehicle Guide available on the U.S. Department of Energy's Download Fuel Economy Data Web page (http://www.fueleconomy.gov/feg/download.shtml) shows that there are 925 vehicle make/model combinations available for the 2015 model year that are certified to the current Tier 2 Bin 5 federal standard of 0.07 grams per mile. Of these 925 vehicles, the minimum fuel economy is 10 miles per gallon (mpg), the maximum is 40 mpg, and the average is 23 mpg, yet they all emit the same amount of NO_X and VOC. For vehicles that meet the same emissions standard, the ones with larger engines that consume more fuel generally have more catalytic converter capacity in the exhaust stream than those with smaller engines that consume less fuel. No changes were made in response to this comment.

University of North Texas (UNT) Modeling

The Dallas County Medical Society, the Texas Medical Association, the Sierra Club and Downwinders commented that a 5 ppb ozone reduction could be achieved in DFW by applying selective catalytic reduction to the five largest coal-burning EGUs in East Texas. Public Citizen commented that application of the same pollution controls that have been on cars since 1977 on these EGUs would reduce ozone by 1 ppb in DFW. The five facilities where these EGUs operate are identified by the commenters as Big Brown, Martin Lake, Monticello, Limestone, and Welsh. The commenters cited modeling work performed by UNT using the 2018 future-year modeling files developed by the TCEQ for the attainment demonstration SIP that was adopted in June 2015. UNT performed two modeling scenarios where NO_X reductions were applied to EGUs at these five East Texas facilities for the 2018 future case: Scenario A represents a 90% NO_X reduction; and Scenario B represents a 100% NO_X reduction. The Sierra Club and Downwinders provide two separate tables of the results and both tables include the following in the heading: "*Maximum absolute difference of 8hr-mean O3 predicted in 3x3 cells nearby CAMS (Scenario – FY18)*".

The commenter is correct that catalytic converters on cars and SCR pollution control technology for combustion sources are similar in that both technologies use catalysts to reduce emissions of NO_X. The commission also acknowledges that SCR has been demonstrated on coal-fired EGUs. However, as discussed elsewhere in this Response to Comments document, the commission has determined that requiring additional NO_X control on coal-fired EGUs in East Texas is not justified given the commission's modeling results in this attainment demonstration for the 10-county DFW nonattainment area.

Additionally, the TCEQ disagrees with the commenter's interpretation of the UNT modeling results. The values reported in the comment are the maximum absolute difference of eight-hour ozone modeled at each monitor for the entire 67-day episode. This is not the approach recommended by EPA modeling guidance for assessing the modeled impact on future ozone design values at specific monitors. The absolute results are reported rather than the future design values that would result from application of the RRF attainment test. On page 18 of its official modeling guidance, the EPA states "we recommend a modeled attainment test in which model predictions are used in a relative rather than an absolute sense." Instead of reporting absolute results, the modeled attainment test figures reported in Section 3.7.2, *Future Baseline Modeling*, of the 2017 DFW AD SIP revision appropriately use the RRF approach for both the older and newer attainment tests from the EPA. For each monitor over a 67-day episode, there are a total of 1,608 absolute modeled ozone differences to choose from for reporting purposes (24 hours per day times 67 days). The ozone changes reported by the commenter are simply the maximum of 1,608 absolute modeled results per monitor from each scenario. For each scenario and monitor, no indication is given if these maximum values were modeled on low days (that are excluded from the attainment tests) or high days (that are included in the attainment test). No changes were made in response to these comments.

The Sierra Club and Downwinders commented that the UNT modeling shows a reduction of 3.8-4 ppb that could be achieved at the Denton Airport South Monitor from a combination of various proposed controls. The Sierra Club and Downwinders reference Scenario G from the

UNT modeling study, which included the following combination of reductions: 90% NO_X reduction from the five East Texas EGUs; 90% NO_X reduction to the three Midlothian cement kilns; and 50% NO_X reduction from 647 large compressors within DFW. Immediately prior to the table of results, the Sierra Club and Downwinders state that this combination is "enough to put the Denton air monitor under 75 ppb, or a 3.8-4 ppb improvement from the final results of the proposed TCEQ DFW SIP."

The TCEQ disagrees with this interpretation of the UNT modeling results. Table 12: *Scenario G Eight-Hour Ozone Reductions Reported by UNT* shows the 2018 future design value at the Denton Airport South monitor reducing from 75.8 ppb to 74.8 ppb, which is a 1 ppb reduction and not the 3.8-4 ppb range stated by the Sierra Club and Downwinders for this scenario.

Table 12: Scenario G Eight-Hour Ozone Reductions Reported by UNT

DFW Area Ozone Monitor	2006 DV_B (ppb)	TCEQ Projection RRF	TCEQ Projection FY18 DV_F (ppb)	Scenario G RRF	Scenario G DV_F (ppb)
Fort Worth Northwest - C13	89.33	0.8209	73.3	0.8067	72.1
Keller - C17	91.00	0.8169	74.3	0.8050	73.3
Frisco - C31	87.67	0.8266	72.5	0.8159	71.5
Midlothian OFW - C52	77.00	0.8255	63.6	0.8038	61.9
Denton Airport South - C56	93.33	0.8127	75.8	0.8009	74.8
Arlington Municipal Airport - C61	83.33	0.8260	68.8	0.8114	67.6
Dallas North #2 - C63	85.00	0.8365	71.1	0.8268	70.3
Rockwall Heath - C69	77.67	0.8436	65.5	0.8320	64.6
Grapevine Fairway - C70	90.67	0.8196	74.3	0.8086	73.3
Kaufman - C71	74.67	0.8522	63.6	0.8297	62.0
Granbury - C73	83.00	0.8146	67.6	0.7971	66.2
Eagle Mountain Lake - C75	93.33	0.8061	75.2	0.7960	74.3
Parker County - C76	87.67	0.8250	72.3	0.8136	71.3
Cleburne Airport - C77	85.00	0.8187	69.6	0.7938	67.5
Midlothian Tower - C94	80.50	0.8246	66.4	0.8031	64.7
Dallas Hinton Street - C401	81.67	0.8294	67.7	0.8173	66.7
Dallas Executive Airport - C402	85.00	0.8322	70.7	0.8207	69.8
Greenville - C1006	75.00	0.8335	62.5	0.8204	61.5
Pilot Point - C1032	81.00	0.8140	65.9	0.8038	65.1

The TCEQ notes that the UNT modeling does not replicate the TCEQ's 2018 future baseline design values for each monitor. UNT uses the term "TCEQ Projection" and reports associated RRF and future design values based on the top 10 days test for 2018 at each monitor, but these do not match any of the RRF and future design values reported by the TCEQ in the AD analysis for 2018 that was adopted in June 2015. For each DFW area ozone monitor, Table 13: *Comparison of UNT and TCEQ*

Future Design Values for 2018 **multiplies the 2006 DV_B by the RRF reported by UNT. This table uses the correct DV_B of 75.00 ppb for Midlothian OFW instead of the incorrect one of 77.00 ppb used by UNT. The UNT future design value figures are reported to two decimal places and compared to both the all days and top 10 days results reported by the TCEQ in Section 3.7.2,** ***Future Baseline Modeling*****, of the 2018 DFW AD SIP revision.**

Table 13: Comparison of UNT and TCEQ Future Design Values for 2018

DFW Area Ozone Monitor	2006 DV_B (ppb)	UNT RRF	UNT DV_F (ppb)	TCEQ All Days DV_F (ppb)	TCEQ Top 10 DV_F (ppb)
Fort Worth Northwest - C13	89.33	0.8209	73.33	73.73	72.67
Keller - C17	91.00	0.8169	74.34	75.08	73.58
Frisco - C31	87.67	0.8266	72.47	73.11	72.37
Midlothian OFW - C52	75.00	0.8255	61.91	62.67	62.27
Denton Airport South - C56	93.33	0.8127	75.85	76.72	75.25
Arlington Municipal Airport - C61	83.33	0.8260	68.83	69.47	68.50
Dallas North #2 - C63	85.00	0.8365	71.10	71.61	70.68
Rockwall Heath - C69	77.67	0.8436	65.52	65.74	65.57
Grapevine Fairway - C70	90.67	0.8196	74.31	75.70	73.84
Kaufman - C71	74.67	0.8522	63.63	62.22	62.73
Granbury - C73	83.00	0.8146	67.61	67.73	67.30
Eagle Mountain Lake - C75	93.33	0.8061	75.23	75.88	74.12
Parker County - C76	87.67	0.8250	72.33	71.21	71.40
Cleburne Airport - C77	85.00	0.8187	69.59	70.27	68.59
Midlothian Tower - C94	80.50	0.8246	66.38	67.20	66.75
Dallas Hinton Street - C401	81.67	0.8294	67.74	68.87	67.20
Dallas Executive Airport - C402	85.00	0.8322	70.74	70.88	70.68
Greenville - C1006	75.00	0.8335	62.51	61.97	62.07
Pilot Point - C1032	81.00	0.8140	65.93	66.62	65.62

For the all days attainment test, the UNT difference ranges from 1.39 ppb lower at the Grapevine Fairway monitor to 1.41 ppb higher at the Kaufman monitor. For the top 10 days test, the UNT difference ranges from 0.37 ppb lower at the Midlothian Tower monitor and 1.11 ppb higher at the Eagle Mountain Lake monitor. In a November 6, 2015 meeting held at the NCTCOG offices in Arlington, UNT modeling staff acknowledged these differences in future design values between their work and TCEQ efforts but did not provide an explanation for what caused them.

The TCEQ understands that the UNT modeling project began in July 2014 under the sponsorship of the North Texas Air Quality Modeling Project (NTAQP). In a July 2014 letter to the TCEQ, NTAQP requested "an enumeration of conditions and protocols that this local modeling effort would have to meet or adhere to in order for the TCEQ to give the results due consideration." In an August 2014 reply to this

request, the TCEQ provided direction on obtaining modeling files and stated that a critical starting point for the local modeling effort would be to replicate the base case, baseline, and future-case Comprehensive Air Model with Extension(s) (CAMx) runs for the 2006 episodes and that, at a minimum, any submission to the TCEQ would need to document that the base case, baseline, and future case modeling scenarios were fully replicated. As the tables and explanation above demonstrate, the modeling scenarios, although close, have not been accurately replicated. No changes were made in response to these comments.

The Sierra Club and Downwinders commented that a UNT modeling scenario was performed where the DFW area cement kiln NO_X was reduced by 90% in 2018, and that this resulted in ozone reductions ranging from 1.9 to 4.5 ppb at the 20 DFW area monitoring locations. As evidence to support this claim, the Sierra Club and Downwinders present a table showing the maximum absolute difference of eight-hour average ozone predicted in a 3x3 array of cells surrounding each monitor.

The TCEQ disagrees with this interpretation of the UNT modeling results. As stated in response to a previous comment about UNT modeling scenarios for EGUs, the air quality impact of a potential emissions change is more appropriately evaluated by looking at changes in the future design value rather than the maximum absolute difference in modeled eight-hour ozone concentrations. In fact, the impact on future design values for this scenario is reported on slide 26 of a UNT presentation entitled *North Texas Ozone Attainment Initiative Project: Preliminary Project Results*, presented on November 6, 2015 at the NCTCOG offices (http://www.nctcog.org/trans/committees/aqtc/110615/Item_8.pdf). The 90% NO_X reduction to the cement kilns is shown to reduce the 2018 future design value at the Denton Airport South monitor by 0.4 ppb.

The results presented by UNT in slide 26 show that reducing the cement kiln NO_X by 90% (roughly 15.8 NO_X tpd) would increase ozone by 0.4 ppb at the Kaufman monitor and by 0.5 ppb at the Greenville monitor, yet decrease ozone by 0.2 ppb at the nearby Rockwall Heath monitor, all of which are located east of Dallas. Such ozone increases at Kaufman and Greenville in response to NO_X decreases are atypical in a NO_X-limited environment such as DFW. These unusual modeling results were noted to UNT staff during the November 6, 2015 meeting at NCTCOG, but an explanation was not provided. No changes were made in response to these comments.

The Sierra Club and Downwinders referenced three UNT modeling scenarios where reductions were applied to oil and gas emissions: 50% NO_X reduction from electrifying half of 647 point source compressors; 100% NO_X reduction from electrifying all 647 point source compressors; and 100% NO_X and VOC reduction from all oil and gas sources (area and point) within the Barnett Shale, along with all Haynesville oil and gas area sources. The Sierra Club and Downwinders provided various tables showing that the modeled reductions from these scenarios range from 1-3.6 ppb at the Denton Airport South monitor and from 2.2-5.4 ppb at the Eagle Mountain Lake monitor. The tables included reflect the maximum absolute difference of eight-hour average ozone predicted in a 3x3 array of cells surrounding each monitor.

The TCEQ disagrees with this interpretation of the UNT modeling results. As stated in response to a previous comment about UNT modeling scenarios for EGUs, the air quality impact of a potential emissions change is more appropriately evaluated by looking at changes in the future design value rather than the maximum absolute difference in modeled eight-hour ozone concentrations. In fact, the impact on future design values for these three scenarios is reported by UNT in a presentation entitled *North Texas Ozone Attainment Initiative Project: Preliminary Project Results*, presented on November 6, 2015 at the NCTCOG offices (http://www.nctcog.org/trans/committees/aqtc/110615/Item_8.pdf). The 2018 future design value changes for Scenario D (50% electrification) are presented on slide 29 and show that the reductions would only be 0.1 ppb at Denton Airport South and no change at Eagle Mountain Lake, which contrasts sharply with the 1 ppb and 2.2 ppb reductions at these monitors, respectively, that are stated by the commenters. The 2018 future design value changes for Scenario E (100% electrification) are presented on slide 32 and show the same impacts of 0.1 ppb and 0 ppb at Denton Airport South and Eagle Mountain Lake, respectively, as Scenario D (50% electrification).

The 2018 future design value changes for Scenario F are provided in slide 35 for 100% NO_X and VOC reductions for all oil and gas sources (point and area), along with a 100% NO_X and VOC reduction to Haynesville oil and gas sources (area only). These results show a 0.4 ppb reduction at Denton Airport South and a 0.1 ppb reduction at Eagle Mountain Lake, which contrasts sharply with the 3.6 ppb and 5.4 ppb reductions at these monitors, respectively, that are stated by the commenters.

The relatively low reductions in future design value changes from these scenarios are not surprising because compressor engine NO_X has already been reduced by 93% as a result of TCEQ rules that were promulgated in 2007 for the DFW area. For each of these scenarios, UNT only reduced emissions from the various oil and gas sources assuming full or partial electrification of the compressors but did not account for the net increase in emissions that would result from additional generation of electricity to power the compressors. No changes were made in response to these comments.

The Sierra Club and Downwinders stated that the UNT modeling demonstrates approximately 38% of the pollution contributing to DFW ozone levels come from point sources outside the 10-county DFW ozone nonattainment area but within Texas. To substantiate this claim, the Sierra Club and Downwinders provided a pie chart entitled "*Example Contributions for Eastern Receptors*" with a subtitle of "*2018 Contributions to Denton County, TX Site 034,*" which is the Denton Airport South monitor.

The TCEQ disagrees with this interpretation of the ozone contributions for Denton County. The values referenced by the commenter reflect an aggregate contribution of 38% from all anthropogenic sources for all 254 Texas counties. Thus, it is incorrect to state that this 38% contribution is for Texas point sources outside of the 10-county DFW ozone nonattainment area.

Further, it appears these modeling results are incorrectly attributed to UNT modeling efforts. Instead, they were extracted from Appendix C of a January 2015 EPA report entitled *Air Quality Modeling Technical Support Document for the 2008 Ozone NAAQS Transport Assessment*. For various ozone monitors throughout the continental U.S., the 2018 ozone source apportionment results are provided by the EPA. The percentage contribution figures reported match the allocations for the Denton Airport South monitor with the listed receptor site identification code of 481210034.

For the 2018 DFW AD SIP revision, the TCEQ provided 2018 ozone source apportionment results in Section 3.7.3, *Ozone Source Apportionment Tool and Anthropogenic Precursor Culpability Analysis*. To be consistent with the monitor and future year referenced in the comment, these 2018 results are presented in Table 14: *2018 Ozone Source Apportionment for Denton Airport South*.

Table 14: 2018 Ozone Source Apportionment for Denton Airport South

Geographic Area and Source Type	Ozone Contribution (ppb)	Relative Contribution
DFW On-Road	8.66	11.29%
DFW Non-Road	3.39	4.42%
DFW Off-Road - Airports and Locomotives	2.96	3.86%
DFW Area Sources	2.77	3.61%
DFW Oil/Gas Drilling and Production	0.40	0.52%
DFW Point - Electric Utilities	0.41	0.53%
DFW Point - Cement Kilns	0.21	0.27%
DFW Point - Oil/Gas and Other	1.47	1.92%
Non-DFW TX On-Road	2.56	3.34%
Non-DFW TX Non-Road, Off-Road, and Area Sources	2.82	3.68%
Non-DFW TX Oil/Gas Drilling and Production	1.67	2.18%
Non-DFW TX Point - Electric Utilities	2.64	3.44%
Non-DFW TX Point - Cement Kilns, Oil/Gas, and Other	1.97	2.57%
Non-TX Anthropogenic - All Source Types	18.59	24.23%
Biogenic - All Geographic Areas	4.40	5.74%
Boundary Conditions	21.02	27.40%
Initial Conditions	0.78	1.02%

As shown, the non-DFW Texas electric utilities contribute 3.44% of the Denton Airport South ozone. When combined with the aggregated non-DFW Texas point source category at 2.57%, the non-DFW Texas point source total is 6%, which is much smaller than the 38% contribution claimed by the commenter. Similar 2017 future-year ozone source apportionment results are provided in Section 3.7.3, *Ozone Source Apportionment Tool and Anthropogenic Precursor Culpability Analysis*, of the 2017 DFW AD SIP revision. No changes were made in response to these comments.

Congresswoman Johnson and the Fort Worth League of Neighborhood Associations commented that this 2017 DFW AD SIP revision does not meet the scientific peer-reviewed modeling methods developed by experts at UNT and the UT Southwestern Medical School. The Denton Drilling Awareness Group and Frack Free Denton commented that UNT reviewed the TCEQ ozone modeling and found it to be lacking.

The TCEQ disagrees with these comments. As documented in Chapter 3 and Appendices A, *Meteorological Modeling for the DFW Attainment Demonstration SIP Revision for the 2008 Eight-Hour Ozone*, B, C, D, and E, *Protocol for the Eight-Hour Ozone Modeling of the DFW Area*, the photochemical modeling included with this 2017 DFW AD SIP revision meets EPA requirements for ozone ADs. The TCEQ is not aware of any peer-reviewed ozone modeling methods developed by UNT or the UT Southwestern Medical School that either agree with or exceed EPA requirements. Slide 5 of the *North Texas Ozone Attainment Initiative Project: Preliminary Project Results* presentation given by UNT in November 2015 (http://www.nctcog.org/trans/committees/aqtc/110615/Item_8.pdf) states that their ozone simulations were run using the files made available by the TCEQ on its Texas Air Quality Modeling - Files and Information (2006 Episodes) Web page, (http://www.tceq.state.tx.us/airquality/airmod/data/tx2006). The UNT reported results of scenarios where specific emission categories within the TCEQ files were reduced, but they did not provide any recommendations for improving the inputs and methodologies that the TCEQ employed in developing the 2017 DFW AD SIP revision. No changes were made in response to this comment.

Point Sources

An individual commented on air emissions of benzene, toluene, and xylenes from the Arlington General Motors assembly plant (GM) as reported to the EPA's Toxic Release Inventory. Specifically, the individual commented that GM released 1,351 pounds of benzene in 2014, and over a 27-year period, the average annual emissions rate of toluene was 21,000 pounds (approximately 10.5 tons) and the average annual emissions rate of xylene was 252,000 pounds (approximately 126 tons).

The TCEQ air emissions inventory (EI) data shows an overall decline in emissions from 1990 through 2014. The commenter's numbers appear to be correct; however, air emissions cannot be solely evaluated by looking at an average of 27 years of data. In its 2014 EI, GM reported 1.38 tpy of toluene emissions and 11.8 tpy of xylene emissions, which represents a decrease of 94% and 93%, respectively, from 1990 when GM first submitted an EI. These reductions are due in part to federal and state VOC and hazardous air pollutant regulations. No changes were made in response to this comment.

An individual commented that GM is expanding but cannot reduce its air releases.

The TCEQ's EI data indicates GM's total VOC emissions have declined approximately 67% from 1990 through 2014, although each individual species of VOC may not have declined at the same rate during this time period. Regarding the possibility of future expansions, GM is required to comply with all federal and state regulations and if any expansion results in a major modification the project

must demonstrate a net air quality benefit. No changes were made in response to this comment.

The Sierra Club and Downwinders commented that five East Texas coal-fired power plants (Martin Lake, Monticello, Big Brown, Limestone, and Welsh power plants) are among the largest emitters of NO_X pollution. The Sierra Club and Downwinders also commented that coal-fired power plants account for 22% of the state's annual point source NO_X pollution and approximately 9% of the state's overall NO_X pollution.

The commission agrees that coal-fired power plants are large sources of emissions and account for a significant amount of the state's point source NO_X emissions. However, these emissions have to be evaluated in context of their geographical location, temporal distribution, and with other emissions sources within the photochemical model. Section 3.7.3, *Ozone Source Apportionment Tool and Anthropogenic Precursor Culpability Analysis*, of the 2017 DFW AD SIP revision provides ozone source apportionment results by 17 combinations of source category and geographic area. The non-DFW Texas EGUs are shown to account for 2.3-2.4 ppb of ozone, while the largest local ozone contributor is DFW on-road at 9.8-11.8 ppb and the largest anthropogenic contributor outside of DFW is non-Texas at 17.4-18.6 ppb. The five East Texas coal-fired power plants referenced by the commenter are included within the 118 facilities that are grouped under the non-DFW Texas EGUs category. These 118 facilities are located throughout Texas, but outside of the 10-county DFW ozone nonattainment area, and were modeled at their 2017 CSAPR emission caps of 463.50 NOx tpd. No changes were made in response to these comments.

Water Quality

An individual expressed concerns about drilling activities impacting Lake Arlington water quality.

Water quality is outside the scope of this SIP revision. No changes were made in response to this comment.

Upstream Oil and Gas Emissions Sources

The EPA requested information on the percentage of wells in the DFW nonattainment counties that have implemented green completions. The EPA also asked if the TCEQ plans on conducting outreach to encourage more green completions to facilitate attainment.

NSPS 40 CFR Part 60, Subpart OOOO (NSPS OOOO) rules require green completions for all hydraulically fractured gas wells beginning in 2015. Based on the most recent available drilling information (calendar year 2014) used to estimate well completion emissions for the DFW ozone nonattainment counties for the 2017 DFW AD SIP revision, 99% of the wells completed in 2014 were hydraulically fractured gas wells (314 out of 327 total wells) that would have required green completions. Only 1% of the wells (two gas wells that were not hydraulically fractured, plus 12 oil wells) would not have required green completions based on the NSPS OOOO requirements, although some of them may have used green completions voluntarily. Although 2014 was the most recent available data for this determination, the TCEQ believes it is representative of

general drilling trends in the DFW ozone nonattainment area and therefore applicable to subsequent years through 2017.

The TCEQ has conducted outreach about NSPS OOOO requirements at its Environmental Trade Fair and Conference, Advanced Air Permitting Seminar, and external conferences, workshops, and trainings, and will continue those efforts as necessary. Based on required NSPS OOOO notifications submitted to the TCEQ in 2014, 330 well completions were made in the DFW ozone nonattainment area, which almost exactly matches the external drilling information cited above. The high percentage of notifications submitted in 2014 for hydraulically fractured gas wells indicates TCEQ outreach about NSPS OOOO requirements have been successful and the TCEQ will continue to provide these types of outreach efforts. No changes were made in response to these comments.

The Sierra Club and Downwinders indicated that the TCEQ's projected NO_X emissions from oil and gas compressor engines has increased by over 50% from last year's AD SIP revision, and that controlling compressor engine NO_X emissions is important.

The commission has adopted rules to reduce emissions from natural-gas fired compressor engines. For the nine-county DFW 1997 eight-hour ozone nonattainment area, the 30 TAC Chapter 117 NO_X rules impose emission limits on all compressor engines rated at 50 or more horsepower. The compressor engine controls required to meet the Chapter 117 emission limits result in compressor engine NO_X emissions that are about 93% lower than those from uncontrolled compressor engines.

Although NO_X emissions estimates from area source oil and gas compressor engines increased between the two DFW AD SIP revisions, the commission disagrees that the emissions estimates increased by over 50%. It is important to note that the attainment year changed between the two SIP revisions (the previous AD SIP revision used a 2018 attainment date, and the current AD SIP revision uses a 2017 attainment date). Additionally, the current AD SIP revision uses updated oil and gas emission estimates based on more recent oil and gas production data. The previous AD SIP revision used 2013 oil and gas production data reported to the RRC, which resulted in projected 2018 NO_X emissions of 7.24 tpd. The current AD SIP revision used 2014 RRC oil and gas production data, which resulted in projected 2017 NO_X emissions of 9.37 tpd. This is an increase of 29% in area source compressor engine NO_X emissions estimates between the two AD SIP revisions. No changes were made in response to this comment.

The Sierra Club and Downwinders asked whether the TCEQ's area source emissions inventory improvement study to quantify current use of electric-powered compressor engines had been completed. The Sierra Club and Downwinders also asked if the results of this study were reflected in this DFW AD SIP revision.

The study referenced in the comments, *Control Measures for Upstream Oil and Gas Sources*, was completed by Eastern Research Group, Inc. (ERG), in July 2015. As part of the study, ERG performed research to estimate the amount of electric-powered compressor motor use in populated urban areas, including the ten-

county DFW 2008 eight-hour ozone nonattainment area. The study found only a handful of electric compressor motors used at wellhead sites across the state. As a result, no reductions were used when estimating area source compressor engine emissions for the 2017 AD SIP revision. The study did find a small amount of electric compressor motors used at larger midstream compressor stations (possibly up to 10 % of the compressors found at these sites). Emissions from these compressor stations would be included in the AD SIP revision as point sources, and these emissions estimates would already include the effects of any electric compressor motor use. No changes were made in response to these comments.

An individual commented that the true volumes of oil and gas pollution were hidden in the DFW AD SIP revision.

The commission disagrees that oil and gas emissions are hidden in the 2017 DFW AD SIP revision. In the *Executive Summary* of the 2017 DFW AD SIP revision, Table ES-1: *Summary of 2006 Baseline and 2017 Future Year Anthropogenic Modeling Emissions for DFW*, includes three line item estimates of oil and gas emissions: Oil and Gas – Production, Oil and Gas – Drill Rigs, and Point – Oil and Gas. Chapter 3 of the 2017 DFW AD SIP revision includes more detailed information about the oil and gas emissions, including a breakdown of 2017 area source oil and gas emissions by Source Classification Code in Table 3-31: *2017 Oil and Gas Production Emissions for 10-County DFW Area*, and a breakdown of 2017 point source oil and gas emissions by Standard Industrial Classification in Table 3-32: *2017 Point Source Oil and Gas Emissions for 10-County DFW Area*. The 2017 DFW AD SIP revision included this level of detail so that the oil and gas emissions would be transparent.

As noted above, the 2017 DFW AD SIP revision used 2014 RRC oil and gas production data to develop its emissions inventory. Specifically, Chapter 3 of the 2017 DFW AD SIP revision detailed not only the RRC production data but the studies, emissions forecasting methods, and other relevant data used to develop the oil and gas emissions inventory. No changes were made in response to this comment.

WEIGHT OF EVIDENCE (WOE)

The RTC requested that the TCEQ remove references to transportation control measures (TCM) from Table 4-1: *Existing Ozone Control and Voluntary Measures Applicable to the DFW 10-County Nonattainment Area* because the photochemical modeling included in the proposed SIP revision does not account for emissions reductions from the TCMs and because TCMs are not required for areas that are classified as moderate nonattainment.

The TCEQ appreciates the RTC's concerns regarding TCMs. The purpose of Table 4-1: *Existing Ozone Control and Voluntary Measures Applicable to the DFW 10-County Nonattainment Area* is simply to provide a list of ozone control measures that have been implemented in the 10-county DFW ozone nonattainment area; the table is not intended to assign requirements upon the nonattainment area or to provide a list of control measures included in the photochemical model. However, additional language has been added to the description of TCMs in Table 4-1 to

make clear that TCMs were implemented for previous ozone NAAQS and are not required to be considered for a moderate nonattainment area.

The Sierra Club and Downwinders commented that the TCEQ relied on emissions reductions from numerous small, incremental, and qualitative measures to support its WoE analysis while neglecting similar emissions increases and asserted that this was arbitrary government action. The commenters provided the decommissioning of Stage II vapor control equipment as an example of such a measure.

The qualitative WoE included in Chapter 5: _Weight of Evidence_ includes measures that are not directly accounted for in the photochemical model inputs for SIP creditability. While some of these measures may result in small emissions reductions, others, such as TERP, have a significant impact on emissions in the DFW area. See the response to how decommissioning of Stage II vapor control equipment was accounted for in this Response to Comments on page 62, which explains why decommissioning does not result in significant emissions increases in the DFW area. The commenter provided no other specific examples of measures that could lead to increased emissions of ozone precursors and the TCEQ is unaware of any such measures. No changes were made in response to this comment.

Energy Efficiency / Renewable Energy

The EPA requested that the TCEQ provide data data specific to the DFW area from the annual Statewide Air Emissions Calculations for Energy Efficiency, Wind, and Renewables to support the use of energy efficiency and renewable energy measures as (WoE). The EPA also asked whether the TCEQ is planning to support the DFW area in completing more energy efficiency and renewable energy projects than would be expected by March 1, 2017.

The document referenced by the EPA, *Statewide Air Emissions Calculations for Energy Efficiency, Wind, and Renewables*, is not an annual report to the TCEQ but actually a 2008 presentation by Dr. Jeff Haberl, Ph.D., P.E., of Energy Systems Laboratory (ESL). The TCEQ does receive two annual reports from the ESL: *Statewide Air Emissions Calculations from Wind and Other Renewables*, performed under contract with the TCEQ; and *Energy Efficiency/Renewable Energy Impact in the Texas Emissions Reduction Plan (TERP)*. While these reports might be used to provide county specific estimated emission reductions from energy efficiency and renewable energy measures, the commission stopped specifically citing emission reductions estimates from energy efficiency and renewable energy measures in SIP revisions after the 2005 DFW Increment of Progress SIP Revision, even in the WoE discussion. The commission acknowledges that such measures can result in emission reductions and are beneficial for the state's air quality goals. The discussion of energy efficiency and renewable energy measures in the WoE portion of the SIP revision is included to provide additional information for the EPA's consideration of the SIP revision in light of the benefits of such measures, which the EPA itself acknowledges. However, the commission has technical and legal concerns with quantifying the emission reduction benefits from energy efficiency and renewable energy measures, particularly with doing so for narrow geographic areas such as a specific nonattainment area. While ESL is generally conservative in estimating emission reduction benefits, the amount of

future emission reductions actually resulting from energy efficiency and renewable energy measures is dependent on a number of variables that can change in the future, such as unit dispatch. Furthermore, providing a specific estimate of emission reductions from such measures in the WoE may lead to confusion by the public or even the EPA regarding which emission reductions are considered enforceable under the SIP. Therefore, the commission declines to provide estimates of specific emission reductions in the DFW area from energy efficiency or renewable energy measures. However, the commission has revised the energy efficiency and renewable energy discussion in the WoE portion of this SIP revision to provide a link (http://esl.tamu.edu/) to ESL's website where the EPA and other interested parties may access the most recent reports with ESL's estimates of energy savings and potential emission reductions from energy efficiency and renewable energy in Texas.

While the commission is not providing estimates of emission reductions for energy efficiency and renewable energy, according the EPA's own guidance, it is not necessary to quantify the specific emission reduction benefits from energy efficiency or renewable energy for consideration in the WoE portion of an AD SIP revision. The EPA's Roadmap for Incorporating Energy Efficiency/Renewable Energy Policies and Programs into State and Tribal Implementation Plans (EPA-456/D-12-001a, July 2012) provides multiple pathways for states to include energy efficiency and renewable energy measures in a SIP even if the measures do not necessarily meet all of the EPA's four criteria for SIP creditable reductions. The Weight of Evidence Pathway (EPA's Roadmap for Incorporating Energy Efficiency/Renewable Energy Policies and Programs into State and Tribal Implementation Plans, Section 7.0, page 39) is just one of the four pathways described by the EPA for states to account for energy efficiency and renewable energy in SIP revisions. The Baseline Emissions Projection Pathway (EPA's Roadmap for Incorporating Energy Efficiency/Renewable Energy Policies and Programs into State and Tribal Implementation Plans, Section 4.0, page 33) and the Emerging/Voluntary Measures Pathway (EPA's Roadmap for Incorporating Energy Efficiency/Renewable Energy Policies and Programs into State and Tribal Implementation Plans, Section 6.0, page 37) also provide flexibility for including energy efficiency and renewable energy measures that do not necessarily meet the EPA's criteria for fully creditable SIP reductions, including the requirement to be quantifiable.

As discussed in Chapter 5: *Weight of Evidence* of this SIP revision, Texas leads the nation in wind generation capacity. As of December 2014, Texas had more than 14,000 megawatts (MW) of installed wind generation capacity. The 2014 installed wind capacity was approximately a 37% increase just since 2011. U.S. Department of Energy National Renewable Energy Laboratory estimates indicate that Texas' total installed wind capacity by the end of 2015 was 17,713 MW, an approximate 25% increase in just one year. Even though the commission is not including specific emission reductions as SIP creditable reductions associated with the wind generation, if Texas' wind generation was not present additional generation sources, including fossil fuel-fired generation, would be needed to meet the electricity demands of the state, resulting in additional emissions that would have otherwise occurred.

Finally, while the TCEQ generally supports implementation of energy efficiency and renewable energy measures, the agency does not play a direct role in tracking or providing support for such measures. The Public Utility Commission of Texas and the Texas State Energy Conservation Office (SECO) oversee and provide support on energy efficiency and renewable energy programs in Texas. SECO provides direct support to local governments, residential consumers, businesses and industry, school districts and other public institutions on energy efficiency measures through programs such as the Texas LoanSTAR Program.

Texas Emissions Reduction Plan (TERP)

The EPA applauded the TERP and the reductions achieved by the program and noted that it was pleased that the TERP continues to be funded through 2017. The EPA also noted that several years ago, it teamed with the TCEQ to get the word out on the TERP to as many potential participants in the DFW area as possible and encourage them to apply for TERP funds. The EPA asked if the TCEQ was planning a similar event to encourage more TERP participation in the DFW area in time to help facilitate attainment by the attainment date.

The commission appreciates the EPA's ongoing support of the TERP. The previous collaborative effort to encourage participation in the TERP by potential participants in the DFW area was an excellent example of how federal, state, regional, and local government agencies and interested organizations can work together to contribute to the success of voluntary programs like the TERP. The commission has no current plans for organizing such a comprehensive effort again for the DFW area. However, participation in the TERP by entities in the DFW area has remained strong. The TCEQ has also continued offering TERP workshops and presentations across the state including the DFW area. The TERP staff is working on ideas and plans for enhancing TERP outreach and marketing activities and would be pleased to consider any ideas the EPA may have for making those efforts as effective as possible. No changes were made in response to these comments.

Local Initiatives

The RTC staff reviewed the proposed SIP and concurs with the on-road mobile source emission inventories, 2017 MVEB, and local initiatives as referenced in Appendix H: Local Initiatives submitted by the North Central Texas Council of Governments, which are an integral part of the region coming into compliance with the eight-hour ozone NAAQS and will continue to play a significant role in decreasing ozone-forming pollutants in the DFW region.

The TCEQ appreciates the support and is committed to working with local entities and interested parties to keep them updated on SIP developments and informed about technical issues related to air quality. No changes were made in response to these comments.

FIELD INVESTIGATIONS

An individual commented that people have called the TCEQ with complaints and were forced indoors and made sick by fumes where fracking and blowback was occurring on half a dozen gas pumps nearby. TCEQ reports came back to them and said they found nothing, no violations. Further, the individual noted that when they filed an open records request, a separate concurrent report was found that said there was a violation of the operator venting raw emissions, not using green completions. The individual commented that the TCEQ filmed it, and that the report was not given to the people. The commenter's child's daycare was 900 feet downwind. There was no heads up given to the school about a massive amount of smog-forming methane laced with a cocktail of chemicals floating in that direction.

When complaints are received and investigated by the TCEQ, the complainants are notified in writing about the results of the investigation of their complaint only. Copies of reports for investigations that are not directly related to a complaint investigation can be obtained through a public information request or are available for review at the TCEQ's Central File Room or regional office. Additionally, information about violations for a specific facility is available online through the TCEQ's Central Registry Query Web page (http://www15.tceq.texas.gov/crpub/). No changes were made in response to these comments.

Further, the individual was concerned that the TCEQ is still using landline type air testing equipment rather than state-of-the-art real-time testing equipment, that is the equivalent to smart phones, used by the Houston Advanced Research Center. The commenter stated that they were informed by the TCEQ that the TCEQ is lacking in what it needs to test for frack chemicals listed on the frack chemical disclosure registry. The commenter further stated that the TCEQ checks for explosive conditions and organics but nobody is testing for the inorganics.

The TCEQ monitors ambient air quality in the DFW area for a variety of objectives, including evaluation of population exposure, background concentrations, upwind and downwind concentrations, and concentrations in areas that are expected to have the highest concentrations. These ambient monitoring sites include monitors that measure ozone, NO_2, particulate matter, sulfur dioxide, lead, carbon monoxide, and/or several species of VOC emissions. Many of these monitors operate continuously, providing ambient air quality data online and available to the public every hour. The location of these monitoring sites is selected based on the specific monitoring objective of the site and following the siting criteria specified in EPA regulations located in 40 CFR Part 58.

When conducting investigations, TCEQ staff utilize hand-held monitors to detect the presence of various compounds, including hydrocarbons, hydrogen sulfide, and particulate matter to determine if additional sampling is necessary. Evacuated air canisters can be collected to speciate specific VOCs if appropriate. No changes were made in response to these comments.

PERMITTING

An individual expressed concern about individual urban drilling sites operating under permits by rule in the Barnett Shale.

TCEQ permits by rule are specifically provided for minor sources of air pollutants to authorize specific emissions. Individual sources that use a permit by rule must meet the requirements of the appropriate permit. No changes were made in response to this comment.

An individual states that he is concerned about the City of Denton and Denton Municipal Electric's plans to build natural gas-powered EGUs in the city of Denton. The individual also states that under current rules, the TCEQ does not need to review these plans before issuing emission permits, and that he understands that lower levels are required on the size of the pollution source before a review and offsetting emission reductions are required. The individual states that this defies common sense given Denton's nonattainment status.

These comments are beyond the scope of this SIP revision. Generally, before any permit would be issued by the commission for any new electric generating facility, an application would have to be submitted and reviewed by the TCEQ. Additionally, before such a permit could be issued, it would have to go through the public notice procedures required by commission rules. It is true that if the electric generating facility's potential emissions did not exceed the major source threshold for the nonattainment area, then the electric generating facility would not be required to obtain a major source new source review (preconstruction) permit or a Title V operating permit. Instead, it would be required to obtain a minor source new source review (preconstruction) permit. It is true that only facilities above a certain level of emissions must offset those emissions with emission reduction credits. Those levels are set by the FCAA and are not discretionary. The levels are set by the FCAA for major sources of emissions of NO_X and VOC in an ozone nonattainment area, as these are the precursor emissions that lead to the formation of ozone. Additional information regarding air permitting requirements is available at the TCEQ's Air Permits and Registrations Web page (https://www.tceq.texas.gov/permitting/air). No changes were made in response to these comments.

An individual commented that West Dallas has the highest concentration of cement batch plants in the area. The individual states that this is a problem, another request for a cement batch plant in the area has just come in, and that his concerns about cement batch plants are not being heard. The individual also states that there was a request in October for a cement plant to be put in 200 yards downwind from a middle school, and that the school district, city council, and local community were not informed nor was a meeting held regarding the plant. An individual commented that there is a lack of information available, and that the EPA has taken victory laps for areas that are not really clean, in addition to unspecified concerns regarding property development in West Dallas.

These comments are beyond the scope of this action. Cement batch plants may be authorized under different types of permits that are issued by the TCEQ. All of these permit authorizations require notice and public comment opportunities. For some types of cement batch plants, a public hearing will be held to solicit public comments. For other types, a public meeting must be requested. No changes were made in response to these comments.

TRANSPORT

The North Texas Renewable Energy Group stated that Wise County is only part of the nonattainment area because of transported emissions from the south, not because of industry in the county itself.

The EPA included Wise County over the State of Texas's objection. The State of Texas and the TCEQ sued the EPA over the inclusion of Wise County in the DFW nonattainment area, but this challenge was denied by the U.S. D.C. Circuit Court of

Appeals in an opinion issued on June 2, 2015. The purpose of the 2017 proposed AD is to show how the DFW ozone nonattainment area will reach attainment of the 2008 ozone NAAQS. No changes were made in response to this comment.

SUPERFUND

An individual commented that the EPA cleaned up a Superfund site recently and stated that the area was really safe. However, the city council denied a request for a dog park inside the levies near Trinity Groves because of high concentrations of lead and acid in the area.

These comments are beyond the scope of this action. No changes were made in response to these comments.

REFERENCES

Abinkami LJ; AE Simon; LM Rossen. 2016. Changing trends in asthma prevalence among children. *Pediatrics* 137(1):e20152354.

Adams, WC. 2006. "Comparison of chamber 6.6-h exposures to 0.04-0.08 ppm ozone via square-wave and triangular profiles on pulmonary responses." *Inhal Toxicol* 18(2):127-136.

American Thoracic Society (ATS). 2000. "What Constitutes an Adverse Health Effect of Air Pollution?" *American Journal of Respiratory and Critical Care Medicine* 161(2): 665-673. doi: 10.1164/ajrccm.161.2.ats4-00

Atkinson, RW; BK Butland; C Dimitroulopoulou; MR Heal; JR Stedman; N Carslaw; D Jarvis; C Heaviside; S Vardoulakis; H Walton; and HR Anderson. 2016. Long-term exposure to ambient ozone and mortality: a quantitative systematic review and meta-analysis of evidence from cohort studies. *BMJ Open* 6:e009493. doi: 10.1136/bmjopen-2015-009493.

Centers for Disease Control and Prevention (CDC). 2014. Summary health statistics: National Health Interview Survey, 2014, Table C-1b.
http://ftp.cdc.gov/pub/Health_Statistics/NCHS/NHIS/SHS/2014_SHS_Table_C-1.pdf

CDC.2013a. Behavioral Risk Factor Surveillance System (BRFSS) Adult Self-Reported Lifetime Asthma Prevalence Rate (Percent) by State.
http://www.cdc.gov/asthma/brfss/2013/mapL1.htm

CDC. 2013b. Behavioral Risk Factor Surveillance System (BRFSS) Child Lifetime Asthma Prevalence Rate by State or Territory. http://www.cdc.gov/asthma/brfss/2013/default.htm (rates)

Gauderman, WJ; R Urman, E Avol, K Berhane, R McConnell, E Rappaport, R Chang, F Lurmann, and F Gilliland. 2015. Association of improved air quality with lung development in children. *N Engl J of Med* 372(10): 905-913.

Goodman, JE; Prueitt, RL; Sax, SN; Lynch, HN; Zu, Ke; Lemay, JC; King, JM; Venditti, FJ. 2014. "Weight-of-evidence evaluation of short-term ozone exposure and cardiovascular effects." *Crit. Rev. Toxicol.* 44(9):725-790. doi: 10.3109/10408444.2014.937854.

Hackney, JD; WS Linn; JG Mohler; and CR Collier. 1977. Adaptation to short-term respiratory effects of ozone in men exposed repeatedly. *J Appl Physiol* 43(1): 82-85.

Holz, O; Jorres, RA; Timm, P; Mucke, M; Richter, K; Koschyk, S; Magnussen, H.1999. “Ozone-induced airway inflammatory changes differ between individuals and are reproducible.” *Am J Respir Crit Care Med*. 159(3): 776-784.

Jerrett, M.; Burnett, R.T.; Ma, R.; Pope, C.A.; Krewski, D.; Newbold, K.B.; Thurston, G.; Shi, Y.; Finkelstein, N.; Calle, E.E.; Thun, M.J. Spatial analysis of air pollution and mortality in Los Angeles. *Epidemiology* 2005, *16(6)*, 727-736.

Jerrett, M; Burnett, RT; Pope, CA; Ito, K; Thurston, G; Krewski, D; Shi, Y; Calle, E; Thun, M. 2009. "Long-term ozone exposure and mortality." *N Engl J Med* 360(11):1085-1095.

Keet, CA; McCormack, MC; Pollack, CE; Peng, RD; McGowan, E; Matsui, EC. 2015. “Neighborhood poverty, urban residence, race/ethnicity, and asthma: Rethinking the inner-city asthma epidemic.” *J Allergy Clin Immunol.* doi: 10.1016/j.jaci.2014.11.022.

Kerrigan, K. 2015, Sep. EPA Official Disavows American Lung Association Air-Quality Claims. http://centerforregulatorysolutions.org/epa-official-disavows-american-lung-association-air-quality-claims.

Kim, CS; Alexis, NE; Rappold, AG; Kehrl, H; Hazucha, MJ; Lay, JC; Schmitt, MT; Case, M; Devlin, RB; Peden, DB; Diaz-Sanchez, D. 2011. "Lung function and inflammatory responses in healthy young adults exposed to 0.06 ppm ozone for 6.6 hours." *Am J Respir Crit Care Med.* 183:1215-1221.

Koenig, JQ; Covert, DS; Marshall, SG; Van Belle, G; Pierson, WE. 1987. “The effects of ozone and nitrogen dioxide on pulmonary function in healthy and asthmatic adolescents.” *Am Rev Respir Dis*. 136(5): 1152-1157.

Lagorio, S; F Forastiere; R Pistelli; I Iavarone; P Michelozzi; V Fano; A Marconi; G Ziemacki; BD Ostro. 2006. Air pollution and lung function among susceptible adult subjects: A panel study. *Environ Health* 5:11. http://dx.doi.org/10.1186/1476-069X-5-11

Lee, K.; Parkhurst, W.J.; Xue, J.; Ozkaynak, A.H.; Neuberg, D.; Spengler, J.D. 2004. “Outdoor/indoor/personal ozone exposures of children in Nashville, Tennessee.” *J Air Waste Manag Assoc*, *54(3)*, 352-9.

McDonnell, WF; Chapman, RS; Leigh, MW; Strope, GL; Collier, AM. 1985. "Respiratory responses of vigorously exercising children to 0.12 ppm ozone exposure." *Am Rev Respir Dis* 132:875-879.

NIOSH Pocket Guide to Chemical Hazards (NPG). 2005. Pub No. 2005-149. September. Accessed at: http://www.cdc.gov/niosh/npg/

O'Connor, GT; Neas, L; Vaughn, B; Kattan, M; Mitchell, H; Crain, EF; Evans, R III; Gruchalla, R; Morgan, W; Stout, J; Adams, GK; Lippman, M. 2008. "Acute respiratory health effects of air pollution on children with asthma in US inner cities." *J Allergy Clin Immunol* 121(5):1133-1139.

Peacock, JL; HR Anderson; SA Bremner; L Marston; TA Seemungal; DP Strachan; JA Wedzicha. 2011. Outdoor air pollution and respiratory health in patients with COPD. *Thorax* 66: 591-596. doi: 10.1136/thx.2010.155358

Pope, CA 3rd; Burnett, RT; Thun, MJ; Calle, EE; Krewski, D; Ito, K; Thurston, GD. 2002. “Lung cancer, cardiopulmonary mortality, and long-term exposure to fine particulate air pollution.” *JAMA*. 287(9): 1132-41.

Prueitt, RL; Lynch, HN; Zu, K; Sax, SN; Venditti, FJ; Goodman, JE. 2014. “Weight-of-evidence evaluation of long-term ozone exposure and cardiovascular effects.” *Crit Rev Toxicol*. 44(9): 791-822.

Sarnat, JA; Schwartz, J; Catalano, PJ; Suh, HH. 2001. "Gaseous pollutants in particulate matter epidemiology: Confounders or surrogates?" *Environ Health Perspect* 109(10):1053-1061.

Sarnat, JA; Brown, KW; Schwartz, J; Coull, BA; Koutrakis, P. 2005. "Ambient gas concentrations and personal particulate matter exposures: Implications for studying the health effects of particles." *Epidemiology* 16(3):385-395.

Schelegle, ES; Morales, CA; Walby, WF; Marion, S; Allen, RP. 2009. "6.6-Hour inhalation of ozone concentrations from 60 to 87 parts per billion in healthy humans." *Am J Respir Crit Care Med* 180(3):265-272.

Schildcrout, J. S., Sheppard, L., Lumley, T., Slaughter, J. C., Koenig, J. Q., & Shapiro, G. G. 2006. “Ambient air pollution and asthma exacerbations in children: an eight-city analysis.” *Am J Epidemiol* 164(6), 505-517.

Stenfors, N; Pourazar, J; Blomberg, A; Krishna, MT; Mudway, I; Helleday, R; Kelly, FJ; Frew, AJ; Sandstrom, T. 2002. “Effect of ozone on bronchial mucosal inflammation in asthmatic and healthy subjects.” *Respir Med* 96(5): 352-8.

Stokinger, HE. 1957. Evaluation of the hazards of ozone and oxides of nitrogen. *Arch Ind Health* 15:181-190.

Texas Commission on Environmental Quality (TCEQ). 2015. Development Support Document – Benzene. https://www.tceq.texas.gov/assets/public/implementation/tox/dsd/final/benzene.pdf

Texas Department of State Health Services (TDSHS). 2010. 2010 Texas Asthma Burden Report. December 2010. 74 p.

TDSHS. 2012. Frequently Asked Questions-Indoor Air Quality Program. http://dshs.state.tx.us/iaq/faqs.shtm.

TDSHS. 2014. 2014 Texas Asthma Burden Report. December 2014. 47 p.

USEPA. 2003. “Integrated Risk Information System (IRIS) Chemical Assessment Summary – Benzene.” https://cfpub.epa.gov/ncea/iris/iris_documents/documents/subst/0276_summary.pdf#nameddest=cancerinhal

USEPA. 2014. "National ambient air quality standards for ozone (Proposed rule)." 40 Code of Federal Regulation Parts 50, 51, 52, 53 and 58.

USEPA. 2015. Regulatory Impact Analysis of the Final Revisions to the National Ambient Air Quality Standards for Ground-Level Ozone. Vol. EPA-452/R-15-007, September. 480 p.

Zanobetti A and J Schwartz. 2008. Is there adaptation in the ozone mortality relationship: A multi-city case-crossover analysis. *Environmental Health* 7:22. doi: 10.1186/1476-069X-7-22

ORDER ADOPTING
REVISION TO THE STATE IMPLEMENTATION PLAN

Docket No. 2015-1380-SIP
Project No. 2015-014-SIP-NR

On July 6, 2016, the Texas Commission on Environmental Quality (Commission), during a public meeting, considered adoption of a revision to the state implementation pan (SIP). The Commission adopts the revision to the Dallas-Fort Worth (DFW) 2008 Eight-Hour Ozone Nonattainment Area Attainment Demonstration to fulfill its commitment to address the United States Court of Appeals for the District of Columbia Circuit decision that changed the attainment deadlines for the 2008 Eight-Hour ozone NAAQS to a July 20, 2018 attainment date and a 2017 attainment year. Under Tex. Health & Safety Code Ann. §§ 382.011, 382.012, and 382.023 (West 2010), the Commission has the authority to control the quality of the state's air and to issue orders consistent with the policies and purposes of the Texas Clean Air Act, Chapter 382 of the Tex. Health & Safety Code. Notice of the proposed revision to the SIP was published for comment in the December 25, 2015, issue of the *Texas Register* (40 TexReg 9801).

Pursuant to 40 Code of Federal Regulations § 51.102 and after proper notice, the Commission conducted a public hearing to consider the revision to the SIP. Proper notice included prominent advertisement in the areas affected at least 30 days prior to the date of the hearing. Public hearings were held in Arlington, Texas, on January 21, 2016 and in Austin, Texas, on January 26, 2016.

The Commission circulated hearing notices of its intended action to the public, including interested persons, the Regional Administrator of the EPA, and all applicable local air pollution control agencies. The public was invited to submit data, views, and recommendations on the proposed SIP revision, either orally or in writing, at the hearings or during the comment period. Prior to the scheduled hearings, copies of the proposed SIP revision were available for public inspection at the Commission's central office and on the Commission's website.

Data, views, and recommendations of interested persons regarding the proposed SIP revision were submitted to the Commission during the comment period, and were considered by the Commission as reflected in the analysis of testimony incorporated by reference to this Order. The Commission finds that the analysis of testimony includes the names of all interested groups or associations offering comment on the proposed SIP revision and their position concerning the same.

IT IS THEREFORE ORDERED BY THE COMMISSION that the revision to the SIP incorporated by reference to this Order is hereby adopted. The adopted revision to the SIP is incorporated by reference in this Order as if set forth at length verbatim in this Order.

IT IS FURTHER ORDERED BY THE COMMISSION that on behalf of the Commission, the Chairman should transmit a copy of this Order, together with the adopted revision to the

SIP, to the Regional Administrator of EPA as a proposed revision to the Texas SIP pursuant to the Federal Clean Air Act, codified at 42 U.S. Code Ann. §§ 7401 - 7671q, as amended.

If any portion of this Order is for any reason held to be invalid by a court of competent jurisdiction, the invalidity of any portion shall not affect the validity of the remaining portions.

TEXAS COMMISSION ON
ENVIRONMENTAL QUALITY

____
Bryan W. Shaw, Ph.D., P.E., Chairman

____
Date Signed