MOBILITY 2040

Killeen-Temple Metropolitan Planning Organization

Appendix H: Air Quality

Killeen-Temple KTMPO METROPOLITAN PLANNING ORGANIZATION

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Appendix H-1: Air Quality Next Steps Guide

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KTMPO
Killeen-Temple
METROPOLITAN PLANNING ORGANIZATION

Air Quality

Next Steps Guide

July 2012

Kimley-Horn
and Associates, Inc.

KTMPO Air Quality Next Steps Guide

A number of factors have contributed to the need for the Killeen-Temple MPO (KTMPO) to proceed with proactive air quality planning within the region. These factors include the region's proximity to one of the country's busiest Interstate Highway corridors, a recently introduced air quality monitoring station at Skylark Field, and potential changes in EPA ozone standards that may affect the KTMPO.

Kimley-Horn and Associates (KHA) was retained to assist them in an information gathering effort relating to their regional air quality. Through this effort, KHA met with local and regional stakeholders on May 16th, 2012 to discuss the current and future air quality conditions in the area. As a follow up to that effort, we have prepared this Next Steps Guide. The Guide's purpose is to document the steps KTMPO will have to take and potential issues that may be encountered as air quality becomes a high priority for the region.

This guide is composed of the following sections:

- **Introduction to air quality** – summary of overarching topics and terminology
- **Impacts for KTMPO** – potential actions and timelines involved with air quality nonattainment
- **Preparing for air quality nonattainment** – summary of Ozone Advance program and next steps for MTP, TIP, and travel demand model
- **Transportation conformity** – overview of conformity process for KTMPO
- **The MOVES model** – summary of data needs and integration of the travel demand model
- **Potential staffing needs** – description of options for staffing to facilitate air quality modeling
- **Interagency consultation** – discussion of participants in air quality consultation process

This guide is meant to serve as a companion to the Air Quality Work Session presentation, now available on the KTMPO website. For more information on these topics, please reference that document.

Introduction to Air Quality

KTMPO has been very proactive in seeking ways to prepare

for future air quality issues. As stated above, the Air Quality Work Session presentation along with KTMPO's previously prepared air quality presentation provide much of the background information on this topic.

To help with the ease of use of this document, applicable terms and standards are defined here. Other terms may be introduced and described in detail elsewhere in the document.

- **National Ambient Air Quality Standards (NAAQS)** – Standards implemented by EPA to assign limits to the amount of pollution that can be present in the atmosphere. The NAAQS seek to regulate carbon monoxide, lead, nitrogen dioxide, ozone, particle pollution, and sulfur dioxide.
- **Nonattainment** – Based on monitoring data, the EPA will determine if a region has air quality pollution levels that are under the NAAQS thresholds. If the region exceeds any of these thresholds, it is considered to be in nonattainment. For ozone, there have been different levels of nonattainment designations created based on the severity of the violation.
- **Transportation Conformity** – Transportation conformity is a process required by EPA for any nonattainment area. Conformity requires the analysis of proposed projects for air quality impacts within the MTP and TIP.
- **MOVES** – MOVES is the EPA's adopted air quality modeling software.
- **Travel Demand Model** – The travel demand model monitors the region's transportation network. This tool is relied upon during the MTP and TIP development, as well as the transportation conformity process.

Impacts for KTMPO

KTMPO is currently in attainment for all criteria air pollutants. The recent implementation of ozone monitoring in the Killeen area means that this region will become more highly scrutinized for its conformance to that standard. To determine if KTMPO is still attaining the standard, the EPA will look at the three-year average of monitoring data for this location. While it is unlikely that KTMPO will be designated nonattainment for the 2008 ozone standard, they may face this issue when the ozone standard is revised. The EPA is currently in progress with updating this standard. The current schedule for this is as follows:

- Standard proposed by end of 2013
- Finalized by end of 2014
- State recommendations for nonattainment areas by end of 2015
- EPA's final nonattainment designations by end of 2016

Once the final nonattainment designations are made, KTMPO would have one year to adopt a conforming MTP and TIP.

Preparing for Air Quality Nonattainment

This section details action KTMPO can take to make air quality a higher priority within its planning and projects.

Ozone Advance

KTMPO's future of being an air quality nonattainment area is far from a foregone conclusion. There are steps that the region can take now to avoid or minimize their air quality problems in the future. To assist interested states, local governments, MPOs, and COGs work towards this goal, the EPA created the Ozone Advance program. This program was created to accompany the 2008 ozone standards that are currently being implemented. The goals of the Ozone Advance program are as follows:

1. Help attainment areas take action in order to keep ozone levels below the level of the standard to ensure continued health protection
2. Better position areas to remain in attainment
3. Efficiently direct available resources toward actions to address ozone problems quickly

During the KTMPO Air Quality meeting on May 16, 2012 and subsequent discussions with staff, there was strong interest expressed in participating in this program. The actions needed to initiate participation in this program are as follows:

- Notify agency partners such as TxDOT, EPA, TCEQ, and FHWA of interest in participating. Agency support through this process will be critical, so they need to be on board from the beginning.
- Coordinate with Fort Hood. KTMPO's proximity to and close relationship with Fort Hood makes the installation an invaluable partner. Representatives from Fort Hood should be invited to participate in the development of KTMPO's strategies.
- Identify types of measures that can be considered. In order to achieve maximum impact with minimal expense, KTMPO should place initial emphasis on transportation demand management programs. Examples of TDM programs include ridesharing and carpooling, telecommuting, and increased bicycle and pedestrian travel.
- Within a year, develop a plan framework. This can consist of general descriptions of the measures being considered, and does not have to include quantitative analysis.
- Annual follow-up meetings with EPA. These meetings are required, but ideally coordination should be more frequent.

Carrie Paige serves as the Ozone Advance coordinator for EPA Region 6. During the preparation of this material, Carrie expressed her interest in helping KTMPO to move this along. Carrie's contact information is included at the end of this document.

Incorporating Air Quality into Planning Tools

Air quality needs can be a consideration in the long-range planning process even if an area is in attainment for all standards. There are actions that can be taken with the MTP, TIP, and travel demand model (TDM) to help streamline future air quality considerations.

- **MTP** – The biggest change that can be made to consider air quality in the MTP comes through the project prioritization criteria. As the evaluation process for ranking or grouping projects is established, air quality should be included as one of the criteria. Air quality benefits can be reasonably expected through most bicycle, pedestrian, and transit projects (reducing vehicle miles traveled), intersection improvement projects focused on congestion relief (reducing idling vehicles), ITS projects (reducing delay), and even some major congestion relief projects. However, some new location projects or widening projects will increase demand or VMT such that air quality impacts increase. As a result, these types of projects would not receive ranking points in this category. Consideration of air quality's importance may also influence the type of projects and programs that are recommended.
- **TIP** – Most of the changes to the TIP will come as a result of the modifications to the project ranking criteria done in the MTP.
- **TDM** – The full range of data needs for air quality modeling that can be obtained from the TDM are detailed in a subsequent section. Addressing these potential data needs in a timely fashion will allow for new data to be collected or analyzed (if needed) prior to the region moving into air quality nonattainment.

Transportation Conformity

If the KTMPO area is designated as an air quality nonattainment area, the transportation conformity process will have to be introduced into MTP and TIP development. Any time an update or modification is made to either of these documents, a conformity analysis will be performed. The financially constrained project list must be subjected to a conformity test to ensure those projects will not result in excessive negative air quality impacts for the region. Air quality conformity will be documented in its own chapter of the MTP, and also in the TIP documentation.

The concepts of regional significance and transportation control measures are important to this process.

Regional Significance

The transportation conformity process is geared towards addressing air quality issues associated with regionally significant projects. Regional significance is a concept that has been introduced at the federal level. However, it has been left to the regional and state level to define regional significance for their areas.

KTMPO can begin this process by coordinating with TxDOT. Since TxDOT oversees all the MPOs in the state, they have an active role in vetting the regionally significant project definitions. To help this process move forward, KTMPO should reference the regional significance definitions being used by other MPOs. It would be advisable to reference nearby MPOs as well as MPOs of similar size or makeup as KTMPO. KTMPO may begin the process of defining regional significance at any time

Skylark Field Air Quality Monitoring Station

Transportation Control Measures

If during the conformity process the region has difficulty staying under their budget, KTMPO may want to consider implementing transportation control measures (TCMs). TCMs provide additional enhancement to the area's air quality by promoting activities or projects that reduce vehicle miles traveled or vehicle delay. Many of these measures are similar to those that could be considered in the Ozone Advance program. TCMs can be implemented directly into the region's conformity analysis at any time. However, if TCMs are incorporated as a part of the demonstration of conformity, KTMPO will have to quantify the benefits that can be received from each of them. Proactively implementing some of these solutions is usually the preferred course of action, rather than having to rely on them to reach conformity.

The MOVES Model

The EPA introduced the MOVES model in 2009. MOVES serves as a new way to look at mobile source emissions, replacing EPA's old MOBILE6 software. In the years following its release, MOVES has been gradually rolling out for both regional and project-level air quality modeling. The most recent federal guidance indicates that all regional conformity air quality modeling must use the MOVES software after March 2013.

MOVES is a data-hungry software, relying on database iterations as the backbone of its analysis process. If KTMPO becomes an air quality non-attainment area, they will have to collect the appropriate data for this analysis as a part of the air quality modeling process. Data can be pulled from many sources. The major data needs for this program are listed below, along with potential sources of this information. The source used for this data can vary based on the capabilities of the travel demand model and the availability of local, regional, or state information.

Integrating the Travel Demand Model

The KTMPO travel demand model is in the process of being revised. This model is based upon the standard TxDOT modeling structure. The MPO has contracted with CDM Smith to update the base year data. However, the updating and maintenance of this model is typically done at the state level through the TxDOT Transportation Planning and Programming Division (TPP).

The travel demand model and its capabilities are an integral part of the MOVES air quality analysis process. If KTMPO does become a nonattainment area for air quality, significant coordination will be needed between the MPO and TxDOT. During this coordination process, TxDOT will be able to provide guidance about what types of air quality modeling information can be obtained from the model. If the model does not have the capability to provide all the potential data sources, they will have to be obtained from existing state or federal data. While this is often an acceptable alternative, having the information in the regional travel demand model helps to ensure the air quality modeling information being used is reflective of the local conditions. We encourage TxDOT to discuss the options for air quality modeling integration within the travel demand model with KTMPO and other potentially affected MPOs in advance of any air quality rulings. Advance preparation will help ensure desired model data is available in time for future air quality analyses.

Data Need	Travel Demand Model	TxDOT	TCEQ	FHWA/ EPA	Regional Transit Agencies	Notes
Vehicle Source Type		x	x			Likely references DMV records
Vehicle Age Distribution		x	x			Likely references DMV records
Alternative Vehicle Fuel Types					x	If applicable
I/M Program Data			x			If applicable
Meteorology			x			May reference NOAA data for Skylark Field
Fuel Supply/Fuel Formulation		x	x			
Road Type Distribution	x	x	x			May use HPMS data
Vehicle Type VMT	x					
Monthly/Daily VMT Fractions		x		x		State or national averages
Hourly VMT Fractions	x	x				
Ramp Fraction	x					
Speed Distribution	x	x		x		

Potential Staffing Needs

If the KTMPO becomes a nonattainment area it will introduce a new element of transportation planning and modeling to the region. To prepare for this, it is important to consider the options available for addressing these concerns at an agency level.

Two primary staffing options present themselves for consideration. The first option would involve all air quality modeling being conducted in-house by KTMPO. Alternately, KTMPO could consider having their air quality modeling done elsewhere and then being applied into the MTP and TIP processes. Both options are discussed below, along with the skill sets and efforts involved.

To ensure smooth startup for KTMPO's air quality involvement, coordination with other involved agencies (TxDOT, TCEQ, FHWA, EPA) will be needed to clearly outline the staff member's responsibilities. Other ways to speed KTMPO's integration into the air quality modeling process would be to enlist an outside entity (e.g. public/private agency such as TTI, or private consulting firm) that could assist with the first air quality model development, analysis, and coordination and conduct supplemental training for staff.

Option 1 – AQ modeling done locally

In order for a KTMPO staff member to perform the needed air quality analysis and documentation, several issues should be considered. The staff member identified should be required to attend the FHWA/EPA MOVES Regional Conformity training. If possible, the staff member should also be involved with the development of other elements of the MTP. If KTMPO is performing portions of its travel demand modeling in-house, it is recommended that the same person manipulating the TDM also performs the air quality modeling. This staff member would also be responsible for leading the air quality interagency consultation process.

The staff member's time will be needed whenever an update is made to the region's TIP or MTP, with additional coordination on projects requiring NEPA analysis and updates to the TDM. Continuing education initiatives like air quality webinars, training courses, and conferences/workshops would also be beneficial to maintain proficiency. With all of this in mind, a full-time staff member is not needed.

Option 2 – AQ modeling done elsewhere, applied into MTP and TIP

If KTMPO determines that a fully in-house air quality modeling presence is not desired or practical, they can look to an outside entity for assistance. There are three potential ways the air quality effort could be completed:

- **State-led effort** – If resources exist and are available for use, KTMPO could rely on TxDOT to perform air quality analyses for MTP and TIP updates.
- **Public/private entity** – An entity such as TTI that works with TxDOT while also having the freedom to work for other clients could be hired to assist, depending on their available resources and skill sets.
- **Consulting firm** – A private consultant could be retained to perform AQ analysis. Consultant could be retained using a master agreement, thereby allowing flexibility for their involvement when AQ analysis is needed. Consultant could also be hired on an as-needed basis during MTP and TIP updates.

It is recommended that a KTMPO staff member be identified as the primary coordination point for these efforts. This staff member would still benefit from having background knowledge about the air quality modeling process. As such, the staff member may want to attend the FHWA/EPA MOVES

Regional Conformity training. Other FHWA/EPA webinars or presentations could potentially serve this purpose as well. This staff member will also head up ongoing coordination with involved agencies (TxDOT, TCEQ, FHWA, and EPA) to track timelines and needed deliverables.

Interagency Consultation

The interagency consultation process is at the heart of any air quality conformity determination. Interagency consultation is needed to establish air quality modeling parameters, to provide review and oversight on the analysis and documentation, and to ensure the regional air quality conformity process will satisfy federal and state requirements.

During the preparation of this material, we relied on the input from representatives at agencies such as FHWA, EPA, TxDOT, and TCEQ. These representatives, along with representatives from KTMPO and FTA, would form the backbone of the interagency consultation process. Depending on the interest level of local jurisdictions, counties and municipalities may also be invited to participate in the interagency coordination process. Similarly, a contact from Fort Hood could also be invited to participate in this process.

The table below shows the recommended agencies and contact points within those agencies that could serve as the core interagency consultation group.

Name	Agency	Email	Phone
Margie McAllister	TCEQ	Margie.mcallister@tceq.texas.gov	(512) 239-1967
Shelley Naik	TCEQ	Shelley.naik@tceq.texas.gov	(512) 239-1536
Barbara Maley	FHWA	Barbara.maley@dot.gov	(214) 224-2175
Jose Campos	FHWA	Jose.campos@dot.gov	(512) 536-5932
FTA Region 6	FTA		(817)978-0550
Tim Juarez	TxDOT	Tim.juarez@txdot.gov	(254) 745-2136
Tim Wood	TxDOT	Tim.wood@txdot.gov	(512) 416-2659
Greg Lancaster	TxDOT	Greg.lancaster@txdot.gov	(512) 486-5126
Carrie Paige	EPA	Paige.carrie@epamail.epa.gov	(214) 665-6521
Guy Donaldson	EPA	Donaldson.guy@epamail.epa.gov	(214) 665-7242

Transportation Control Measures

According to the U.S. Federal Highway Administration (FHWA), Transportation Contol Measures (TCMs) are strategies that:

1. are specifically identified and committed to in State Implementation Plans (SIPs); and
2. are either listed in Section 108 of the Clean Air Act (CAA) or will reduce transportation-related emissions by reducing vehicle use or improving traffic flow. (http://www.gpo.gov/fdsys/pkg/USCODE-2010-title42/html/USCODE-2010-title42-chap85-subchapI-partA-sec7408.htm)

Section 108 of the CAA provides examples of transportation control measures including, but not limited to:

- improved public transit,
- traffic flow improvements and high-occupancy vehicle lanes,
- shared ride services,
- pedestrian/bicycle facilities, and
- flexible work schedules.

Timely implementation of TCMs criterion must be satisfied before conformity determinations can be made. Consequently, TCMs receive the highest priority for funding under the Congestion Mitigation and Air Quality Improvement (CMAQ) Program.

Many other measures, similar to the TCMs listed in the CAA, are being used throughout the country to manage traffic congestion on streets and highways and to reduce vehicle emissions. Increasingly they are being recognized for their benefits toward improving an area's livability. These TCM type activities may be eligible for CMAQ funding, whether or not they are in approved SIPs, if they are documented to have emission reduction benefits in nonattainment and maintenance areas. These activities have been employed throughout the country for many years and include many travel demand management and transportation system management applications.

Examples that have been, or will be, implemented in the **Dallas–Fort Worth area** include: intersection improvements, grade seperations, signal improvements, high-occupancy-vehicle lanes, freeway-corridor management, park and ride lots, travel-demand management, ped-bike facilities, rail, and vanpool.

Currently in the State of Texas, only H-GAC and NCTCOG utilized Transportation Control Measures and CMAQ funding.

Process for Determining Regionally Significant Facilities for Purposes of Regional Emissions Analysis (Mountainland Association of Governments)

http://www.ampo.org/assets/590_regionallysignificant5106.doc

Background: 40 FR 93.101 defines "regionally significant project" and associated facilities for the purpose of transportation conformity. The federal definition does not specifically include minor arterials. The following definitions and processes will be used by the MPOs in consultation with DAQ, UDOT, UTA, FHWA, FTA, and EPA to determine which facilities shall be considered regionally significant for purposes of regional emissions analysis. It is the practice of the MPO to include minor arterials and collectors in the travel model for the purpose of accurately modeling regional VMT and associated vehicle emissions. The inclusion of minor arterials and collectors in the travel model, however, does not identify these facilities as regionally significant.

1. Any new or existing facility with a functional classification of principal arterial or higher on the latest UDOT Functional Classification Map shall be considered regionally significant.
2. Any fixed guideway transit service including light rail, commuter rail, or portions of bus rapid transit that involve exclusive right-of-way shall be considered regionally significant.
3. As traffic conditions change in the future, the MPO's - in consultation with DAQ, UDOT, FHWA, and EPA (and UTA and FTA in cases involving transit facilities) - will consider 1) the relative importance of minor arterials serving major activity centers, and 2) the absence of principal arterials in the vicinity to determine if any minor arterials in addition to those listed in Exhibit A should be considered as regionally significant for purposes of regional emissions analysis.

Appendix H-2: Killeen Skylark Monitoring Ozone Readings

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Jan-10	39	39	28	30	28	28	32	35	32	35	38	38	37	31	35	39	34	35	31	29	39	39	40	37	34	44	41	37	29	29	28
Feb-10	23	22	26	23	21	34	21	26	37	34	27	33	35	33	41	42	43	49	35	39	43	33	38	41	45	38	44	54			
Mar-10	38	44	47	50	51	52	46	36	47	47	49	48	50	62	42	29	47	54	52	38	41	50	50	34	44	54	49	44	49	57	53
Apr-10	45	41	55	28	35	40	57	51	57	53	41	71	58	44	36	33	32	27	48	61	62	39	40	51	53	59	51	70	50	46	
May-10	56	53	56	69	72	64	49	51	47	29	42	42	36	36	54	49	53	57	44	NV	35	28	28	41	38	47	53	61	67	63	58
Jun-10	52	45	31	60	59	47	35	44	34	34	27	23	21	32	33	34	31	32	31	30	35	38	40	NV	37	34	37	40	40	32	
Jul-10	21	18	18	26	30	48	43	21	22	32	29	36	34	37	40	32	35	41	45	34	39	38	28	32	40	50	33	24	27	37	44
Aug-10	42	45	48	45	44	47	41	34	34	31	51	62	53	35	34	40	58	52	46	38	37	34	49	46	65	63	75	72	53	31	30
Sep-10	33	42	54	63	63	44	24	22	28	31	35	37	44	60	52	51	41	50	48	40	34	33	33	30	34	34	50	57	57	65	
Oct-10	50	61	44	49	56	64	63	75	54	44	36	51	56	50	54	72	62	48	44	45	38	37	38	34	44	48	46	44	44	58	5
Nov-10	57	36	31	38	39	43	56	47	40	38	33	32	36	37	31	41	45	32	41	45	39	38	32	30	35	38	42	47	41	36	
Dec-10	41	45	43	45	29	25	30	35	41	NV	38	38	33	44	44	36	26	32	48	50	40	26	23	19	22	30	37	27	33	33	42

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Feb-11	35	38	36	41	43	46	34	45	39	42	40	47	51	42	42	40	NV	NV	32	33	41	27	21	42	33	24	44	46			
Mar-11	51	67	60	44	43	49	53	44	44	49	63	56	38	45	50	37	44	44	37	37	45	43	58	59	47	52	26	34	29	46	55
Apr-11	52	44	38	48	59	61	47	42	36	37	54	63	73	47	59	61	67	51	51	39	43	44	42	38	49	54	57	58	64	53	
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Jul-11	35	40	48	55	57	63	59	52	42	33	33	34	41	48	45	41	37	46	51	46	38	41	35	36	41	46	47	45	42	32	37
Aug-11	52	61	57	52	51	42	38	46	49	45	45	40	34	36	52	43	46	56	60	62	45	46	50	56	61	60	71	81	75	67	63
Sep-11	48	54	65	69	51	60	77	70	71	70	71	70	68	67	68	54	44	45	63	75	68	63	53	68	67	64	43	58	57	51	
Oct-11	NV	68	73	61	50	48	39	37	35	34	54	42	47	63	75	65	54	43	47	54	59	50	44	51	55	52	27	40	48	56	57
Nov-11	63	46	38	42	52	37	35	39	40	41	46	47	46	40	20	37	35	39	36	25	5	20	34	52	44	31	37	35	38	32	
Dec-11	43	28	29	19	26	22	35	36	35	22	37	28	23	28	28	25	32	30	30	25	23	NV	14	16	24	37	33	41	36	33	50

Source: TCEQ Air Quality: Daily Maximum Eight-Hour Ozone Averages

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Jul-12	35	34	34	32	39	37	49	31	41	58	56	58	57	54	47	38	34	38	38	38	46	37	34	42	42	40	41	33	52	58	49
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Jan-13	18	24	32	34	30	38	38	24	23	25	42	21	34	33	31	36	NA	NV	48	51	41	48	52	38	28	18	34	32	39	39	NV
Feb-13	49	44	49	43	45	38	41	43	25	42	32	37	42	50	38	43	55	48	44	34	50	34	47	56	47	48	48	45			
Mar-13	50	45	55	53	48	47	53	45	37	42	51	62	66	64	57	51	42	53	54	55	54	38	37	44	55	56	66	51	52	44	51
Apr-13	50	29	24	33	56	60	46	41	43	30	51	60	59	50	49	45	33	39	53	58	54	61	34	50	49	34	44	56	47	44	
May-13	49	40	49	55	44	51	65	51	33	53	61	55	70	65	43	48	50	64	46	47	42	62	35	33	23	28	32	38	26	31	34
Jun-13	38	49	60	60	49	58	61	63	52	58	48	38	34	40	35	35	48	47	42	37	38	32	28	38	35	44	43	46	64	61	
Jul-13	59	66	68	71	74	64	45	34	43	43	46	51	61	45	42	34	31	41	44	45	30	37	41	47	45	41	46	41	40	43	39
Aug-13	51	48	42	34	44	44	48	52	41	50	42	51	41	37	46	60	63	64	65	58	36	41	42	54	40	37	20	42	59	64	61
Sep-13	57	60	65	66	60	59	39	41	43	47	51	51	58	64	49	28	41	47	34	32	56	56	62	66	75	71	28	26	35	67	
Oct-13	46	30	41	40	30	45	49	70	67	50	38	29	32	25	25	26	40	36	39	51	40	42	45	57	56	51	30	35	34	21	42
Nov-13	45	41	43	30	37	25	39	40	42	45	43	31	30	37	38	34	36	41	43	33	18	12	18	20	22	34	35	34	40	36	
Dec-13	35	37	39	28	20	27	25	17	19	27	31	NV	22	28	39	42	48	47	37	27	29	29	34	35	34	36	37	43	28	28	29

Source: TCEQ Air Quality: Daily Maximum Eight-Hour Ozone Averages

Skylark Field Annual Highest Values 2010-2013

1st			2nd			3rd			4th		
Date	Time	Value	Date	Time	Value	Date	Time	Value	Date	Time	Value
10/8/2010	1000	**75**	8/27/2010	1100	**75**	10/16/2010	1000	**72**	8/28/2010	1000	**72**
8/28/2011	1000	**81**	9/7/2011	1600	**77**	10/15/2011	1000	**75**	9/20/2011	1100	**75**
8/10/2012	1200	**87**	8/11/2012	1100	**78**	6/27/2012	1100	**78**	6/26/2012	900	**78**
9/25/2013	1100	**75**	7/5/2013	1100	**74**	9/26/2013	1000	**71**	7/4/2013	1200	**71**

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Appendix H-3: Waco Ozone Conceptual Model Report

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3.0 Ozone Trends

This section presents an overview of ozone concentrations measured at CAMS 1037 during 2007-2012 and CAMS 1047 during 2009-2012. Annual, seasonal, day-of-week, and time-of-day trends of high ozone concentrations are investigated.

3.1 Sensitivity to Monitoring Locations

Throughout the analyses presented in this report, the reader should recognize that data interpretations are inherently biased by the locations of the individual monitors within the Waco monitoring network. For example, CAMS 1037 is located several miles northeast of downtown Waco. As shown in subsequent data analyses, high ozone concentrations occur on days when ground-level winds are northerly clockwise through southerly. During these wind flow patterns, CAMS 1037 is not well-positioned to sample a portion of the Waco urban ozone plume. As such, the overall maximum ozone concentrations in the Waco area may not be captured and the maximum ozone concentrations at downwind locations may have been different than the CAMS 1037 data indicate.

Ozone trends are presented using measurement data collected at both CAMS 1037 (Waco) and CAMS 1047 (Killeen). Monitoring data are available at CAMS 1047 beginning on June 12, 2009 and are included to complement the CAMS 1037 results through an analysis of regional trends. It should be mentioned that three years of data may not provide a sufficiently large dataset for a robust investigation of ozone annual and seasonal trends in Killeen and that Killeen is influenced by different local emissions sources than the Waco area.

3.2 Frequency of Occurrence by Year

During 2007-2012, 17 days had maximum ozone concentrations ≥ 75 ppb at CAMS 1037. The annual numbers of high ozone days are shown in Figure 3-1 for both CAMS 1037 and CAMS 1047. At CAMS 1037, the annual number of high ozone days ranged from 1 day in 2008 and 2010 to 7 days in 2011. Both 2011 and 2012 each had 5 high ozone days at CAMS 1047.

3.3 Frequency of Occurrence by Month

The monthly numbers of high ozone days at CAMS 1037 and CAMS 1047 are shown in Figure 3-2. At CAMS 1037, the number of high ozone days ranged from 2 days during July to 7 days during August. CAMS 1047 had 0 days during July and 6 days during August. No high ozone days were measured at either monitor during April-May. Based on the frequency of occurrence of days with local meteorological conditions conducive to high ozone concentrations at CAMS 1037 (refer to Section 4.5 of this report), April-May (and October) are relatively unfavorable for high ozone concentrations.

To investigate the inter-annual variation in the seasonal occurrence of high ozone days, the ozone season was divided into early (June–July) and late (August–October) components. Figure 3-3 shows the numbers of early and late season high ozone days for each year at CAMS 1037 and CAMS 1047. At both monitors, each year had at least one high ozone day during the late ozone season. At CAMS 1037, the year 2011 had an atypically high number of late ozone season days at 6 days; otherwise, the years 2009 and 2012 each had higher number of early season days (2 days) compared to the late season (1 day). At CAMS 1047, high ozone days occurred predominantly during the late season.

Figure 3-1. Annual numbers of high ozone days at CAMS 1037 (left) during 2007-2012 and CAMS 1047 (right) during 2009-2012.

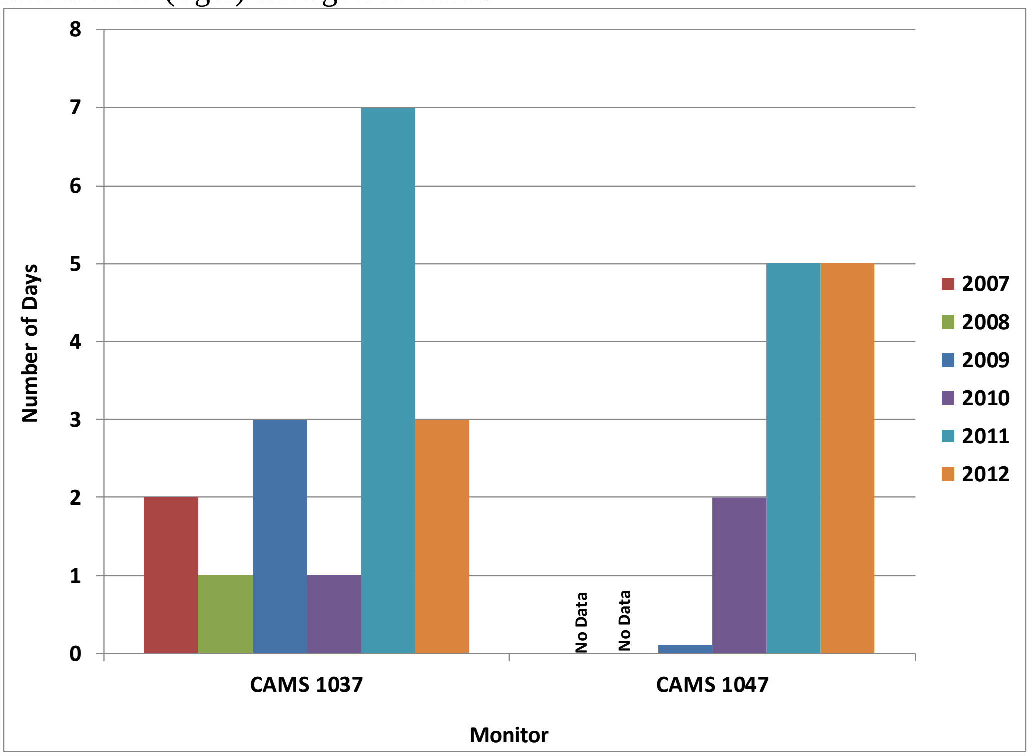


Figure 3-2. Monthly numbers of high ozone days at CAMS 1037 (left) and CAMS 1047 (right) during 2007-2012.

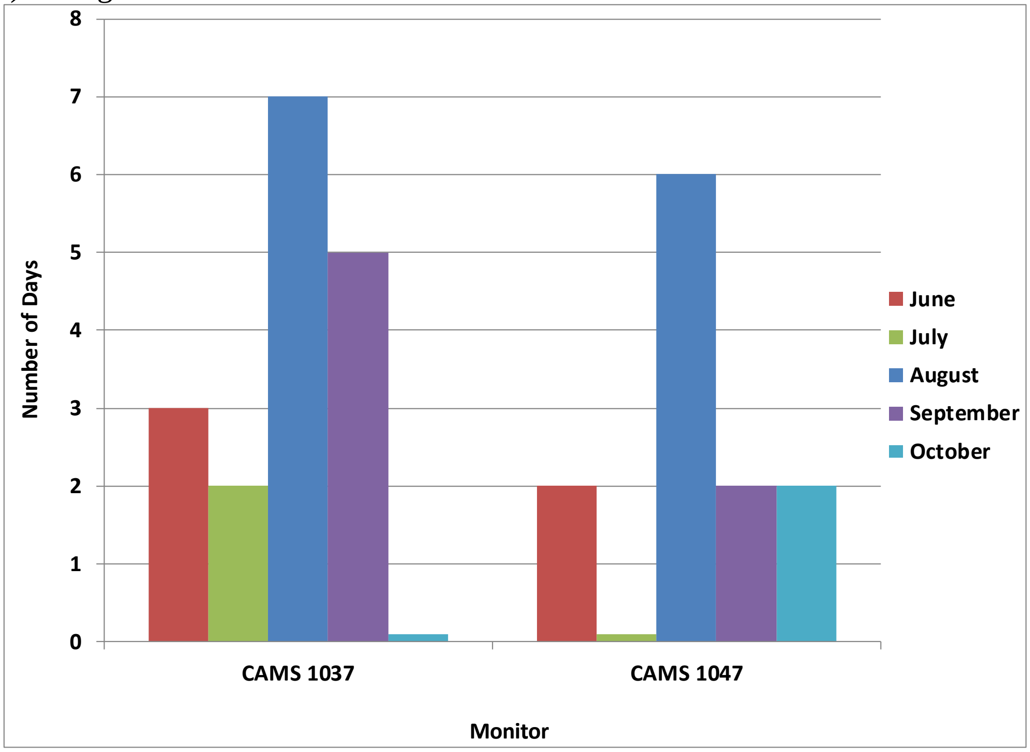
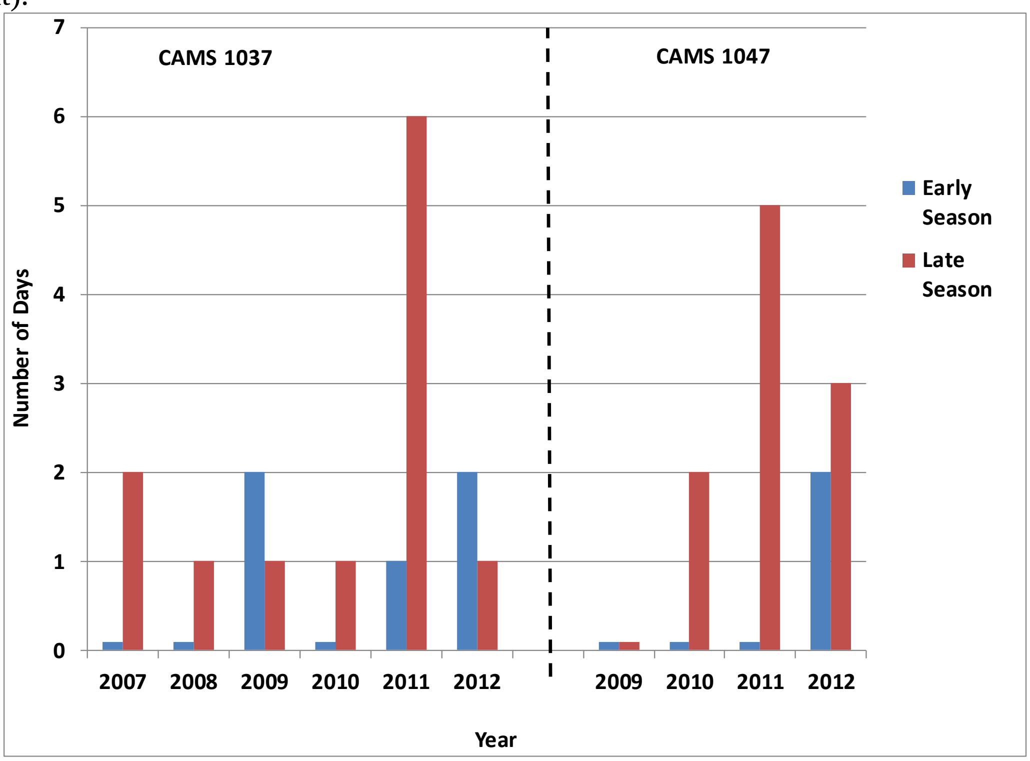


Figure 3-3. Annual numbers of early season (June–July) and late season (August–October) high ozone days during 2007-2012 at CAMS 1037 (left) and CAMS 1047 (right).



3.4 Frequency of Occurrence by Day-of-Week

The numbers of high ozone days grouped by day-of-week (Figure 3-4) show large variability that suggests the day-to-day differences are associated with weather variability due to the small sample size. For example, it is not obvious what emissions sources might be associated with relatively highest numbers of high ozone days on Wednesday at CAMS 1037 or no high ozone days on Thursday at CAMS 1047.

3.5 Frequency of Occurrence by Time of Day

The numbers of high ozone days, grouped by the starting hour of the daily maximum 8-hour average ozone concentration, is shown in Figure 3-5 for CAMS 1037 and CAMS 1047. At CAMS 1037, the starting hour across the 17 high ozone days ranged between 1000 CST and 1300 CST; the majority of days (9 days) had a starting hour of 1100 CST. Most high ozone days at CAMS 1047 had a starting hour of 1000-1100 CST.

Figure 3-4. By day-of-week numbers of high ozone days during 2007-2012 at CAMS 1037 (left) and CAMS 1047 (right).

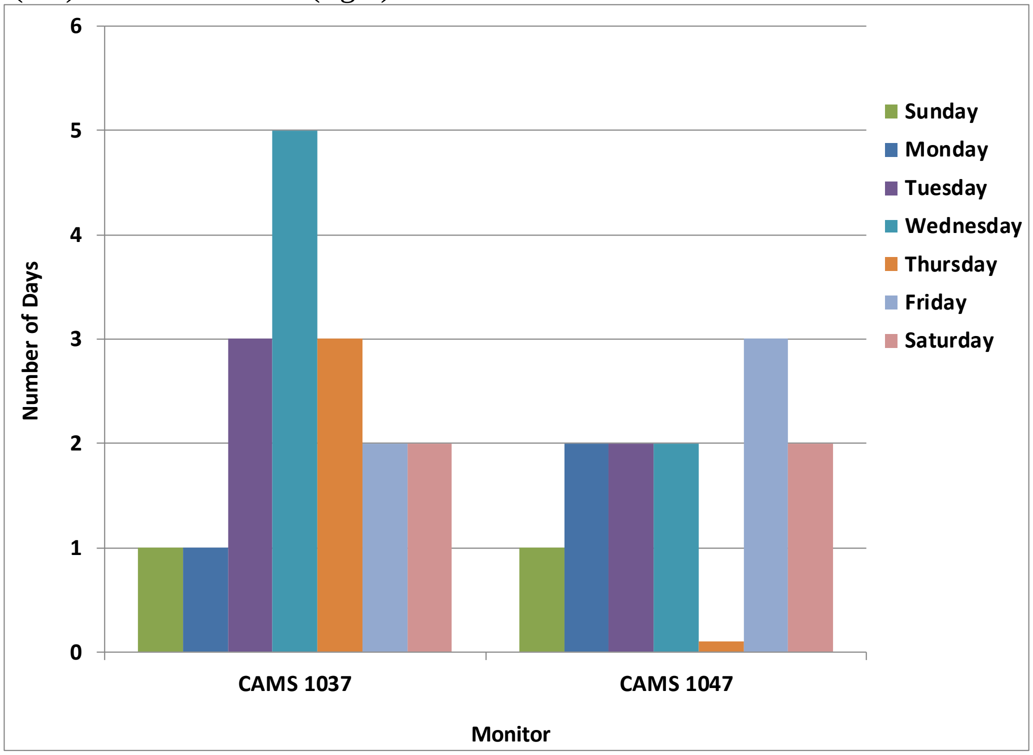
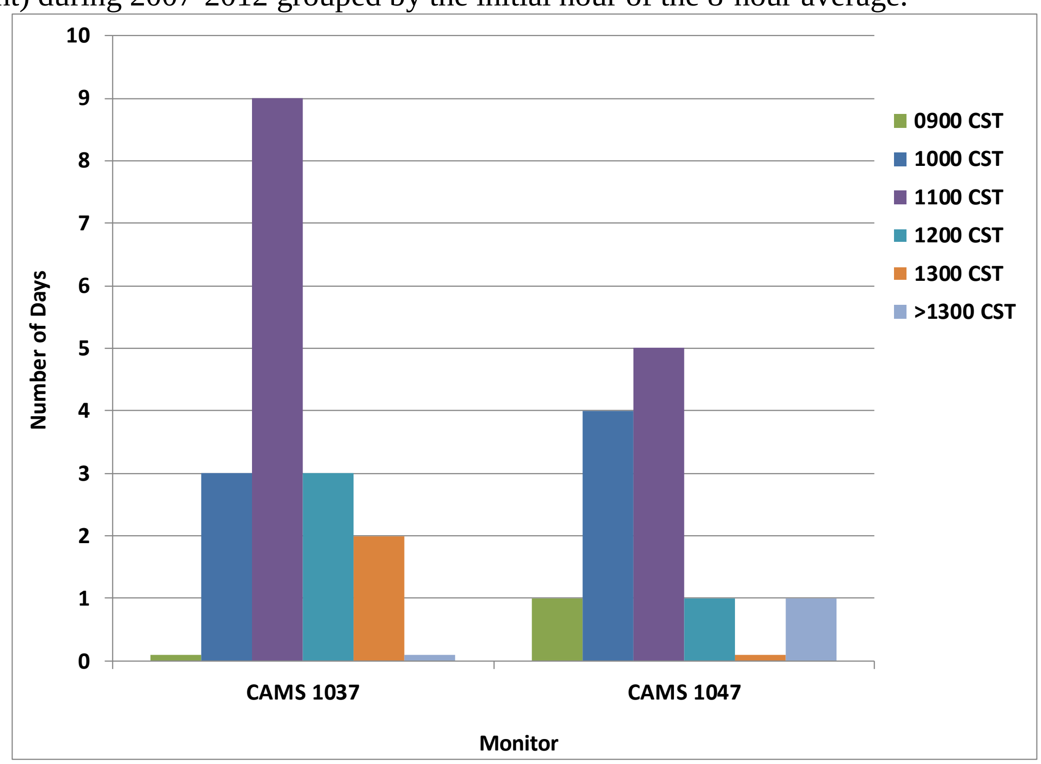


Figure 3-5. The numbers of high ozone days at CAMS 1037 (left) and CAMS 1047 (right) during 2007-2012 grouped by the initial hour of the 8-hour average.



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