REGIONAL STRATEGY
TABLE OF CONTENTS

REGIONAL STRATEGY
LIST OF APPENDICES

CHAPTER 1: GENERAL

1.1 BACKGROUND

At the time the 1990 FCAA Amendments were enacted, the focus on controlling ozone pollution was centered on local controls. However, for many years an increasing number of air quality professionals have asserted that ozone is a regional problem requiring regional strategies in addition to local control programs. As nonattainment areas across the United States prepared attainment demonstration SIP revisions in response to the 1990 FCAA Amendments, several areas found that modeling attainment was made much more difficult, if not impossible, because of high ozone and ozone precursor levels entering from the boundaries of their respective modeling domains (i.e., high background levels of ozone).

The commission has conducted air quality modeling and upper air monitoring that found that regional air pollution should be considered when addressing air quality in Texas' ozone nonattainment areas. This work is supported by research conducted by OTAG, the most comprehensive attempt ever undertaken to understand and quantify the transport of ozone. Both the commission and OTAG study results point to the need to take a regional approach to controlling air pollutants.

As part of the COAST project, the commission and its contractor (Environ, Inc.), conducted regional-scale modeling to develop future year boundary conditions for the COAST modeling domain. The emissions inventory used in this modeling was based on the OTAG emission inventory. The modeling was conducted for a domain covering most of Texas as well as several southern states.

During the OTAG process, the commission modeling staff ran several sensitivity analyses using this regional modeling setup to assess the impact of potential OTAG reductions on Texas. Applying the OTAG 5c reductions across the domain (60% reduction of point source NO_x, 30% reduction of low-level NO_x, 30% reduction of VOC), compared to the case of no reductions, indicates that modeled reductions would significantly reduce ozone throughout most of the eastern half of Texas. Overall, the modeling indicates that a regional reduction strategy would be beneficial across a wide area of the state.

During modeling for the HGA attainment demonstration SIP revision, the commission's modeling staff conducted sensitivity analyses to determine the benefits regional reductions might have on the HGA area when applied simultaneously with local reductions. Unlike the commission's regional modeling exercises discussed previously, these model runs offer an opportunity to assess separately the benefits of reductions made within and outside a region, since model runs with and without the regional reductions scenarios in HGA were run. Modeling runs were completed to evaluate the 8-hour average ozone concentrations in the COAST modeling domain for September 8, 1993 with 2007 projected emissions and assuming a reduction of 70% NO_x and 15% VOC in the 8-county HGA area. Even with the large reductions in HGA, much of the upper Texas Coast is projected to be well above the 8-hour standard. Also, Austin, Victoria, and Corpus Christi showed modeled 8-hour average concentrations above 80 ppb. The benefit of applying OTAG 5c reductions outside the HGA 8-county area clearly showed that the reductions are beneficial to HGA and provided additional ozone benefits of between 5 and 10 ppb in HGA. This modeling provides part of the evidence of the benefit of regional reductions on Texas' nonattainment areas.

In addition, the University of Texas has performed regional scale photochemical modeling with the 1993, 1995, and 1996 ozone episodes. The 1993 episode was used for the HGA nonattainment area SIP and the 1995 and 1996 episodes were used for modeling in the DFW nonattainment area SIP. All results are

based on a future base 2007 emissions inventory. A series of model sensitivity evaluations were made with elevated NO_x emissions reduced across-the -board by 20%, 30% , 40% and 50% applied to the sources located in the area of Texas generally east of I-35. The maximum 1-hour ozone reductions range from 14 ppb to 27 ppb. Depending on the day simulated, reductions in excess of 12 ppb are found from 10 to 37 counties. The reductions occur where high ozone is predicted. Maximum 8-hour ozone reductions ranged from 12 ppb to 22 ppb.

Conclusions from the commission's work are supported by OTAG studies that also illustrate the importance of implementing a regional air quality control strategy. Overall, the conclusions and recommendations of OTAG are very consistent with the commission's approach, leading to the determination that regional control strategies are needed to achieve the NAAQS for ozone.

The commission has completed modeling runs incorporating the overall regional strategy. The first run was modeled with NLEV, cleaner gasoline, Stage I, and 50% point source NO_x reductions and showed upwards of a 12 ppb decrease in ozone. A modeling run was also made using only the mobile source controls (the NLEV program, cleaner gasoline, and Stage I vapor recovery). This second modeling run showed an overall ozone reduction of about 4 ppb. Reductions in the regional levels of ozone and ozone precursors will help to reduce the maximum ozone concentration and the duration of ozone events in the nonattainment areas.

1.2 PUBLIC HEARING INFORMATION

The commission will hold public hearings at the following times and locations:

CITY	DATE	TIME	LOCATION
El Paso	January 24, 2000	2:00 p.m.	City of El Paso Council Chambers 2 Civic Center Plaza, 2nd floor
Austin	January 25, 2000	10:00 a.m.	TNRCC 12100 N. I-35, Building E, Room 201S
Longview	January 26, 2000	10:00 a.m.	Longview City Hall Council Chambers 300 West Cotton Street
Irving	January 26, 2000	7:00 p.m.	City of Irving Central Library Auditorium 801 West Irving Blvd.
Dallas	January 27, 2000	10:00 a.m.	Dallas Public Library Auditorium 1515 Young Street
Lewisville	January 27, 2000	7:00 p.m.	Lewisville City Council Chambers Municipal Center
Fort Worth	January 28, 2000	10:00 a.m.	Council Chambers, 2nd Floor Fort Worth City Hall 1000 Throckmorton
Beaumont	January 31, 2000	1:30 p.m.	John Gray Institute 855 Florida Avenue
Houston	January 31, 2000	7:00 p.m.	Houston-Galveston Area Council 3555 Timmons Lane

The hearings are structured for the receipt of oral or written comments by interested persons. Individuals may present oral statements when called upon in order of registration. Open discussion will not be permitted during the hearings; however, agency staff members will be available to discuss the proposal 30 minutes prior to each hearing and will answer questions before and after the hearings.

Written comments will also be accepted via mail or fax. All comments should be submitted to Lola Brown, Office of Environmental Policy, Analysis, and Assessment, P.O. Box 13087, MC 205, Austin, Texas 78711-3087 or fax number (512) 239-4808. The public comment period will close on February 1, 2000.

1.3 SOCIAL AND ECONOMIC CONSIDERATIONS

For a detailed explanation of the social and economic issues involved with any proposed strategies please refer to the preambles that precede each rule package accompanying this SIP.

1.4 FISCAL AND MANPOWER RESOURCES

The state has determined that its fiscal and manpower resources are adequate and will not be adversely affected through implementation of this plan.

CHAPTER 2: REGIONAL OZONE STRATEGY

Due to the significant air quality concerns under the 1-hour ozone NAAQS, and the potential challenges imposed by the proposed new 8-hour NAAQS, Texas has developed a regional strategy to provide improved control of ozone air pollution. This strategy has five elements: 1) support of the NLEV program which will bring cleaner cars to Texas by model year 2001; 2) Stage I vapor recovery for larger gas stations; 3) cleaner gasoline; 4) the CARE program; and 5) reduction in NO_x emissions from larger point sources.

2.1 NATIONAL LOW EMISSION VEHICLE PROGRAM

Through the NLEV program, automobile manufacturers have made a commitment to introduce cleaner cars to the nation earlier than what would have been required by the FCAA. The reductions from this action, although significant, will not be enough to get Texas where it needs to be in relation to overall air quality. Improvements in gasoline quality alone also may not be enough. An improvement in gasoline quality, combined with the advanced vehicle technology, will move Texas closer to achieving its overall air quality goals than either step alone could possibly achieve.

2.2 STAGE I VAPOR RECOVERY

The commission adopted the Stage I vapor recovery rules on June 30, 1999. These rules already applied to approximately 7,000 gasoline stations in the Beaumont/Port Arthur, El Paso, Houston/Galveston, and Dallas/Fort Worth ozone nonattainment areas. These rules now also apply in 95 counties in the eastern and central parts of Texas. These rules regulate the filling of gasoline storage tanks at gasoline stations by tank-trucks. To comply with Stage I requirements, a vapor balance system is typically used to capture the vapors from the gasoline storage tanks which would otherwise be displaced to the atmosphere as these tanks are filled with gasoline. The captured vapors are routed to the gasoline tank-truck, and the vapors are processed by a vapor control system when the tank-truck is subsequently refilled at a gasoline terminal or gasoline bulk plant. The adopted rules will reduce VOC emissions which are precursors to ground-level ozone formation, resulting in ground-level ozone reductions.

The effectiveness of Stage I vapor recovery rules depends on the captured vapors being: (1) effectively contained within the gasoline tank-truck during transit; and (2) controlled when the transport vessel is refilled at a gasoline terminal or gasoline bulk plant. Otherwise, the emissions captured at the gasoline station will simply be emitted at a location other than the gasoline station, resulting in no reduction in VOC emissions despite the Stage I requirements.

2.3 CLEANER GASOLINE

The commission has evaluated a cleaner gasoline for the eastern and central parts of Texas. After much research, industry consultation, and communication with local, state, and federal agencies, the commission has proposed a fuel it believes will move Texas much closer to achieving its overall air quality goals. The fuel is a low RVP gasoline. Results of the commission's evaluation efforts to date are summarized below along with more detail on the fuel.

Starting in late 1997, the commission began to evaluate different types of cleaner burning fuels (gasoline, diesel, etc.) as part of an overall regional strategy. The commission eventually settled its focus on a cleaner gasoline. Of the cleaner gasolines under consideration, four were evaluated thoroughly: 1) federal RFG; 2) a gasoline with equal emissions performance to federal Phase II RFG; 3) a formula-based fuel with low RVP, low sulfur fuel; and 4) California reformulated gasoline.

After further discussions the commission completed its analysis on the top two fuels of choice, a performance-based fuel with emissions limits equal to federal phase II RFG, and the formula-based fuel with controls on RVP and sulfur. The low RVP/low sulfur fuel was settled upon for the following reasons: 1) emissions performance; 2) effect on advanced technology cars; 3) impacts on off-road emissions; and 4) low production costs. However, EPA is not likely to act on the state's waiver request for lower sulfur. Therefore, the fuel will likely be a lower RVP only fuel.

The cleaner gasoline will have a lower RVP outside the DFW and HGA areas. The RVP required is 7.8 psia starting May 1, 2000. The RVP limit would be in effect every summer from May 1st through October 1st. A 7.8 psia RVP fuel is expected to reduce evaporative emissions from automobiles, off-highway gasoline powered equipment, and all gasoline storage and transfer operations. Evaporative VOC emissions from automobiles will be reduced by at least 14%. The rules would further provide for counties or large cities to opt into these regulations earlier than proposed here provided certain conditions are met.

Texas and other states have used low RVP fuels for a number of years as an effective program for reducing ozone levels. While EPA is not looking at RVP, it is considering lowering the sulfur content of all U.S. gasoline concurrent with its evaluation of new motor vehicles standards (Tier II). The Tier II regulations should be finalized in late 1999 with a new fuel starting in 2004. EPA's proposed sulfur limit would be 30 ppm on average. By this SIP amendment and concurrent rulemaking, Texas would get cleaner gasoline sooner than what may be required federally. Texas has watched and has been a part of the national debate on cleaner gasoline. Texas will continue these efforts and if the national situation continues in a timely and positive direction, Texas may not need to proceed on its own with the lower sulfur aspect of cleaner gasoline.

Section 211(c)(4)(A) of the FCAA prohibits states from prescribing or attempting to enforce any "control or prohibition" of a "characteristic or component of a fuel or fuel additive" if EPA has promulgated a control or prohibition applicable to such characteristic or component under §211(c)(1). Section 211(c)(4)(C) provides an exception to this prohibition for a nonidentical state standard contained in a SIP where the standard is "necessary to achieve" the primary or secondary NAAQS that the SIP implements. EPA can approve a SIP provision as necessary if the Administrator finds that "no other measures that would bring about timely attainment exist," or that "other measures exist and are technically possible to implement, but are unreasonable or impracticable." Therefore, Texas has requested a waiver from §211(c)(4)(A) of the FCAA and is working with EPA to make it approveable.

2.4 CLEAN AIR RESPONSIBILITY ENTERPRISE

During the 75th legislative session in 1997, HB 3019 directed the commission to develop a voluntary emissions reduction plan for the permitting of existing significant sources. These existing significant sources are commonly known as grandfathered facilities. A grandfathered facility is one that existed at the time the legislature amended the TCAA in 1971. These facilities were not required to comply with the then new requirement to obtain permits for construction or modifications of facilities that emit air contaminants. If grandfathered facilities have not been modified, they continue to be authorized to operate without a permit. Beginning in the early 1990s, efforts were made to develop concepts and provide incentives to bring grandfathered facilities into the permit program. The intent of HB 3019 was to create a program that would encourage the remaining grandfathered facilities to voluntarily obtain permits that would reduce the emissions from those facilities. In response to the legislative directive in HB 3019, the commission appointed an eleven-member advisory panel to provide recommendations regarding the criteria for a voluntary emission reduction plan for grandfathered facilities. This committee, the CARE Committee,

consisted of representatives from local governments, the environmental community, and industry groups, and met several times in the fall of 1997 to provide the commission with recommendations. Those recommendations were presented to the commission at the December 18, 1997, Commissioner's Work Session. The commission held several hearings to obtain comments on the recommendations made by the CARE committee and received comments from the public and industry groups.

In order to implement the recommendations of the CARE committee and the requirements of HB 3019, the 76th Legislature passed SB 766 in 1999. In general, SB 766 recategorizes the new source review authorizations under the TCAA and creates the new program for the voluntary permitting of grandfathered facilities. Prior to the revisions by SB 766, the TCAA authorized the commission to issue permits for the construction or modification of facilities that will emit air contaminants; standard permits adopted by rule; and exemptions from permitting, also adopted by rule. SB 766 modified this structure by authorizing the commission to issue standard permits using a process that does not require each standard permit to be in a rule. A new authorization—permits by rule—was created for the construction of certain types of insignificant facilities. Exemptions from permitting now authorize only changes at insignificant facilities. Finally, the commission is now authorized to develop criteria for facilities that emit a *de minimis* amount of air contaminants that do not need preconstruction authorization. Within the category of permits, SB 766 created two new permitting options: the VERP program for permitting of grandfathered facilities, and the multiple plant permit. As a part of the VERP program, the commission is required to create an emission reduction credit program for use by grandfathered facilities that are unable to meet the control method requirements of the VERP program.

SB 766 also provided several incentives for grandfathered facilities to apply for a permit under the VERP program. Section 11 of the bill provides that not later than January 15, 2001, the commission shall prepare a report on the number of companies that have obtained or applied for a VERP and the reductions in emissions anticipated. The report shall be submitted to the governor, the lieutenant governor, the speaker of the House of Representatives, the chair of the Senate Committee on Natural Resources, and the chair of the House Committee on Environmental Regulation. Section 12 of the bill states that the commission may not initiate an enforcement action against a person for the failure to obtain a preconstruction permit under Texas Health and Safety Code, §382.0518, concerning Preconstruction Permit, or a rule adopted or order issued by the commission under that section, that is related to the modification of a facility that may emit air contaminants if, on or before August 31, 2001, the person files an application for a VERP. Section 12 does not apply to an act related to the modification of a facility that occurs after March 1, 1999. The bill also amended TCAA, §382.0621(d) to require increasing emission fees for the largest grandfathered facilities which do not participate in the VERP program by the dates established. The fee increases have been scheduled for proposal in February 2000.

The adoption, scheduled for December 15, 1999, implements two of the new requirements of SB 766, the VERP program and the new process for issuing standard permits. This will provide a significant amount of flexibility to owners and operators of grandfathered facilities to voluntarily make cost-effective emissions reductions. Applications for a VERP are voluntary and applicants must demonstrate the ability to meet flexible control options not available to new permitted facilities. For a grandfathered facility to be eligible for a VERP, an application must be submitted before September 1, 2001.

The remaining elements of SB 766, including emissions fees, multiple plant permits, permits by rule, and *de minimis* criteria, will be addressed in rulemaking scheduled for proposal in February 2000. SB 766 and the VERP program will not be submitted as revisions to the SIP. As a means of substantiating the

reductions assumed from the implementation of SB 766, the commission is working with various companies as they make their plans in order to secure the agreement that the reductions will be available for SIP credit. To date negotiations have commenced with two companies (See Section 2.5.3).

For modeling purposes, the commission made a reasonable assumption that ultimately the following reductions would occur. Sources identified as grandfathered were reduced by 30%, while sources identified as permitted were not reduced. Sources whose status could not be determined were reduced by the average (weighted) value of 13%.

2.5 REGIONAL NO_x POINT SOURCE REDUCTIONS

The commission is proposing rules which would require NO_x emission reductions from all cement kilns and electric utility power boilers and gas turbines located in east and central Texas. Because of regional transport, the commission believes that this proposal will reduce ozone in ozone near-nonattainment areas and, in combination with other emission reduction rules, ozone nonattainment areas.

2.5.1 Electric Generating Facilities

For EGFs, the proposed rule sets the NO_x emission limit at 0.165 lb of NO_x /MMBtu. Many permitted EGFs are authorized to operate at an emission rate in excess of 0.165 lb of NO_x/MMBtu. Specifically, current average emission rates for permitted EGFs in attainment counties in east Texas are estimated at approximately 0.3 lb NO_x/MMBtu. A reduction to 0.165 lb NO_x/MMBtu would accomplish the goal of a 50% reduction generally considered necessary to achieve regional reductions in ambient ozone. Based upon the significant technical evidence, the commission believes that this level of reduction is a necessary and essential component of the control strategies needed to attain the 1-hour ozone NAAQS. The purpose of the strategy is to reduce overall background levels of ozone in order to assist in keeping ozone attainment areas and near-nonattainment areas in compliance with federal ozone standards. The strategy is also necessary to help the BPA, DFW, and HGA ozone nonattainment areas move closer to reaching attainment with the 1-hour NAAQS. The strategy takes into account recent science that shows that regional approaches may provide improved control of air pollution. In particular, staff has conducted photochemical grid modeling which indicates that elevated point source NO_x controls in east and central Texas will reduce peak 1-hour ozone between 14 and 27 ppb in much of the region.

2.5.2 Cement Kilns

For cement kilns, the proposed rule establishes emission limits on the basis of pounds of NO_x per ton of clinker produced. These emission limits are based on the NO_x emissions averaged over each 30 consecutive day period, and vary depending on the type of cement kiln (long wet; long dry; preheater; preheater-precalciner; or precalciner). The proposed emission limits are identical to those specified in EPA notice of proposed rulemaking concerning Federal Implementation Plans to Reduce the Regional Transport of Ozone which was published in the October 21, 1998 issue of the *Federal Register* (63 FR 56394). EPA stated that these limits are designed to achieve a 30% decrease in NO_x emissions from uncontrolled levels.

2.5.3 Alcoa/Texas Eastman Agreed Orders

The Aluminum Company of America's Rockdale (Milam County) plant has applied for a standard permit for control of NO_x emissions under 30 TAC §116.717. This permit application will ultimately result in emission reductions of approximately 900 tpy of NO_x. These new emission reductions will be enforceable through commission order and ultimately creditable to the SIP. This initial commitment is a result of trying new technology on one of their boilers. As the technology proves successful and is then applied to the

remaining boilers, the commission expects significantly more NO_x reductions from those boilers to be similarly credited to the SIP.

The commission is currently in negotiations with Texas Eastman (Harrison County) for reductions in emissions of NO_x. Through an agreed order, Texas Eastman will reduce their emissions of NO_x by a substantial amount as well. Reductions through agreed orders are enforceable.

CHAPTER 3: PHOTOCHEMICAL MODELING

The University of Texas has performed regional scale photochemical modeling with the 1993, 1995, and 1996 ozone episodes. The 1993 episode was used for the HGA nonattainment area SIP and the 1995 and 1996 episodes were used for modeling in the DFW nonattainment area SIP. All results are based on a future base 2007 emissions inventory. For the 1993 episode the emissions were projected to 2007 directly from the base 1993 emissions inventory. For the 1995 and 1996 episodes, the future base 2007 emissions inventory was projected to 2007 using emissions from the projections to 2007 used with the 1993 episode and day specific temperatures and day of the week information.

This modeling was designed to evaluate the impact of various levels of reductions on areas for which detailed urban scale modeling has not been performed. Due to the large area covered, the grid size has been larger than that used for detailed urban scale modeling used for SIP development in the nonattainment areas. For the nonattainment area evaluations of emission reductions from sources outside of nonattainment areas, refer to the modeling chapter (Chapter 3) for each of those areas.

A series of model sensitivity evaluations were made with elevated NO_x emissions reduced across-the -board by 20%, 30% , 40%, and 50% applied to the sources located in the area of Texas generally east of I-35. These reductions were applied to all nonattainment areas. This report includes specific values for reductions of 20%, 30%, 40% and 50% over each near- nonattainment area. The maximum 1-hour ozone reductions range from 14 ppb to 27 ppb. In general, these maximum reductions are located in northeast Texas. Depending on the day simulated, reductions in excess of 12 ppb are found from 10 to 37 counties. The reductions occur where high ozone is predicted.

Maximum 8-hour ozone reductions ranged from 12 ppb to 22 ppb. In general these maximum reductions are located in northeast Texas, range over a number of counties and are located where high 8-hour ozone concentrations are predicted.

Details for 1-hour and 8-hour averages for each area are included in the attached table. In each case, the base case values are those modeled after clean gasoline controls have been applied over the state. In a number of cases the modeled base case concentration was near monitored background levels. In these cases the model is rather “stiff” and ozone concentrations do not show much response to reductions of NO_x. In a few cases when the base case concentrations are low, there are small increases in ozone concentrations.

1-HOUR CONCENTRATIONS - AUSTIN					
		Maximum difference (in ppb) when elevated point sources are reduced by 20%, 30%, 40% and 50%			
Day	**Base Case Value (in ppb)**	**20%**	**30%**	**40%**	**50%**
09/07/93	104	4	6	7	8
09/08/93	131	<1	1	2	3
09/09/93	104	1	1	2	2
09/10/93	108	3	3	4	4
09/11/93	103	3	5	7	10
06/20/95	62	1	1	2	3
06/21/95	77	3	4	5	6
06/22/95	93	1	1	2	3
07/02/96	77	1	1	2	2
07/03/96	92	1	2	3	3
07/04/96	80	1	1	2	2

1-HOUR CONCENTRATIONS - SAN ANTONIO					
		Maximum difference (in ppb) when elevated point sources are reduced by 20%, 30%, 40% and 50%			
Day	**Base Case Value (in ppb)**	**20%**	**30%**	**40%**	**50%**
09/07/93	118	2	3	4	5
09/08/93	131	1	2	2	3
09/09/93	115	1	1	2	2
09/10/93	119	2	2	3	4
09/11/93	79	<1	1	1	2
06/20/95	57	1	1	1	2
06/21/95	64	1	1	1	2
06/22/95	81	1	1	1	2
07/02/96	79	<1	1	1	2
07/03/96	82	<1	<1	<1	1

07/04/96	65	<1	1	1	1

1-HOUR CONCENTRATIONS - CORPUS CHRISTI					
		Maximum difference (in ppb) when elevated point sources are reduced by 20%, 30%, 40% and 50%			
Day	**Base Case Value (in ppb)**	**20%**	**30%**	**40%**	**50%**
09/07/93	71	1	2	3	4
09/08/93	85	1	1	2	3
09/09/93	79	1	2	3	4
09/10/93	64	<1	<1	1	1
09/11/93	53	<1	<1	1	1
06/20/95	45	<1	<1	<1	<1
06/21/95	51	<1	<1	<+1*	<+1*
06/22/95	59	<1	<1	<1	<1
07/02/96	56	<1	<1	1	1
07/03/96	61	<+1*	<+1*	<+1*	<+1*
07/04/96	50	<1	<1	<1	<1

1-HOUR CONCENTRATIONS - TYLER/LONGVIEW					
		Maximum difference (in ppb) when elevated point sources are reduced by 20%, 30%, 40% and 50%			
Day	**Base Case Value (in ppb)**	**20%**	**30%**	**40%**	**50%**
09/07/93	104	2	4	7	10
09/08/93	136	6	9	12	14
09/09/93	119	3	5	6	8
09/10/93	102	3	5	8	10
09/11/93	108	4	6	8	11
06/20/95	105	5	8	11	13
06/21/95	98	3	5	7	10
06/22/95	142	4	6	8	12
07/02/96	133	6	10	14	18
07/03/96	145	9	14	19	20

07/04/96	112	5	7	10	13

1-HOUR CONCENTRATIONS - VICTORIA					
		Maximum difference (in ppb) when elevated point sources are reduced by 20%, 30%, 40% and 50%			
Day	**Base Case Value (in ppb)**	**20%**	**30%**	**40%**	**50%**
09/07/93	98	3	5	7	9
09/08/93	121	5	7	10	14
09/09/93	109	5	8	11	14
09/10/93	83	4	6	8	10
09/11/93	56	<1	1	1	3
06/20/95	48	1	2	2	3
06/21/95	57	1	2	3	3
06/22/95	66	2	3	4	5
07/02/96	62	2	3	4	5
07/03/96	71	2	3	4	5
07/04/96	57	1	2	3	4

8-HOUR CONCENTRATIONS - AUSTIN					
		Maximum difference (in ppb) when elevated point sources are reduced by 20%, 30%, 40% and 50%			
Day	**Base Case Value (in ppb)**	**20%**	**30%**	**40%**	**50%**
09/07/93	96	2	3	4	6
09/08/93	115	2	3	4	4
09/09/93	98	<1	1	1	1
09/10/93	99	1	2	2	3
09/11/93	83	2	3	5	7
06/20/95	60	1	2	2	3
06/21/95	73	2	3	4	5
06/22/95	83	1	2	3	3
07/02/96	70	<1	1	1	2
07/03/96	83	1	1	2	2

07/04/96	72	1	1	2	3

8-HOUR CONCENTRATIONS - SAN ANTONIO					
		Maximum difference (in ppb) when elevated point sources are reduced by 20%, 30%, 40% and 50%			
Day	**Base Case Value (in ppb)**	**20%**	**30%**	**40%**	**50%**
09/07/93	106	2	3	4	5
09/08/93	118	1	2	3	4
09/09/93	108	1	1	1	2
09/10/93	104	2	2	3	4
09/11/93	68	1	1	2	2
06/20/95	52	<1	<1	1	1
06/21/95	59	1	1	1	2
06/22/95	73	1	1	1	2
07/02/96	71	1	1	1	2
07/03/96	69	<1	<1	1	1
07/04/96	60	1	1	1	1

8-HOUR CONCENTRATIONS - CORPUS CHRISTI					
		Maximum difference (in ppb) when elevated point sources are reduced by 20%, 30%, 40% and 50%			
Day	**Base Case Value (in ppb)**	**20%**	**30%**	**40%**	**50%**
09/07/93	63	2	2	2	3
09/08/93	74	1	1	1	2
09/09/93	71	2	2	3	3
09/10/93	55	<1	<1	1	1
09/11/93	45	<1	<1	<1	<1
06/20/95	42	<1	<1	<1	<1
06/21/95	46	1	1	1	1
06/22/95	49	<1	<1	<1	<1
07/02/96	49	1	1	1	1
07/03/96	51	<1	<1	<1	<1

07/04/96	44	<1	<1	<1	<1

8-HOUR CONCENTRATIONS - TYLER/LONGVIEW					
		Maximum difference (in ppb) when elevated point sources are reduced by 20%, 30%, 40% and 50%			
Day	**Base Case Value (in ppb)**	**20%**	**30%**	**40%**	**50%**
09/07/93	99	4	6	9	11
09/08/93	124	3	4	6	8
09/09/93	110	2	3	4	6
09/10/93	94	3	4	6	8
09/11/93	96	2	4	5	7
06/20/95	96	4	6	8	9
06/21/95	97	5	8	11	14
06/22/95	124	4	7	11	15
07/02/96	117	5	8	11	12
07/03/96	131	8	12	15	16
07/04/96	106	4	6	8	11

8-HOUR CONCENTRATIONS - VICTORIA					
		Maximum difference (in ppb) when elevated point sources are reduced by 20%, 30%, 40% and 50%			
Day	**Base Case Value (in ppb)**	**20%**	**30%**	**40%**	**50%**
09/07/93	94	3	4	6	8
09/08/93	113	3	5	8	10
09/09/93	104	4	6	8	10
09/10/93	74	1	2	3	4
09/11/93	51	1	2	3	3
06/20/95	46	1	2	2	3
06/21/95	53	2	3	3	4
06/22/95	60	2	3	3	4
07/02/96	58	2	3	4	5
07/03/96	64	1	2	3	3

07/04/96	52	1	1	2	3

CHAPTER 4: DATA ANALYSIS

4.1 REGIONAL BACKGROUND LEVELS OF OZONE IN TEXAS

Monitoring data over the last several years has shown that regional background levels of ozone vary considerably during the high ozone season from March through October. Data from both fixed surface monitoring sites and from aircraft monitoring show a range in ozone background patterns that are associated with different wind flow patterns. Air from major point sources and urban areas usually merges into the plumes from these sources. As a result of the night-time shearing, most urban plumes do not have significant direct impacts beyond about 40 to 60 miles downwind with worst-case light winds. Large rural elevated point sources may have direct impacts out to greater distances, possibly likely to affect the night-time emissions from these sources. These influences cause some of the small-scale variability in the ozone background levels.

One of the more common ozone background patterns occurs with persistent south to southeast winds bringing maritime air into Texas. With this flow pattern, the levels of ozone coming into the Texas coast are often as low as 10 to 30 ppb for daily maximum 1-hour averages. As the air moves inland, the upwind ozone levels in the San Antonio area are usually about 10 to 20 ppb higher than the coastal measurements and the upwind levels in the DFW area are commonly about 20 to 30 ppb higher than the coastal measurements. With lighter winds speeds, this gradient in the background levels is generally stronger than with higher winds.

The most extreme case occurs when stagnant continental air comes into Texas, usually from the east or northeast, but occasionally from the southeast. The upwind ozone levels are typically in the 60 to 80 ppb with continental air, and sometimes as high as about 100 to 110 ppb for 1-hour maximums.

Combinations of the two patterns described above can occur when a weak frontal boundary stalls in the center of the state. In this situation, part of the state can be under the influence of continental air and part under the influence of the maritime regime. Regardless of the wind patterns, the worst case background levels almost always occur away from areas of dense clouds and precipitation. Shower activity usually causes local decreases in the background levels and may cause regional decreases if the clouds cover a large enough area.

4.2 BAYLOR AIRCRAFT FLIGHT BRIEFINGS

In 1996, the commission asked Baylor University to undertake a series of air quality measurement flights in and around Texas. The purpose for these flights was to better understand background levels of pollutants like ozone and sulfur dioxide and the impact of large point sources on air quality in rural Texas. Instrumentation aboard the aircraft captures pollution concentration data for ozone, SO_2, NO_x, nitric oxide, reaction products of nitrogen dioxide (NO_y), and measures light back scattering (for studying visibility and particulate matter). To this date, approximately 108 missions have been completed by Baylor aircraft. Data for eighteen of these missions has been validated and analyzed.

Regional Haze – Texas/Mexico Border Region
Baylor Flight #83 – October 5, 1998

On this flight along the border, the Baylor aircraft encountered a large plume possibly attributable to the Carbon I/II power facility in Mexico (based on southerly and southeasterly winds present throughout the

day). Instrument readings indicated a well dispersed plume of Ozone and Sulfur dioxide coming across the border near Del Rio and Langtry. Even more telling were Nephelometer readings which show back scattering increase from approximately 50 to 100 inverse Megameters. *This flight documents the potential for regional/international transport in west Texas.*

Urban Ozone Plumes – DFW
Baylor Flight #73 -- August 31, 1998

On Flight #73, the Baylor aircraft first flew south, east, and north of the DFW area to measure background pollutant levels and then flew a series of westward arcs to document the size and magnitude of an urban ozone plume present on this day (August 31, 1998). In the first part of the flight, it encountered background ozone levels of 60 to 80 ppb. These high background levels of ozone were been brought into the DFW area by winds coming from an easterly direction. The afternoon portion of the mission documented a large urban plume encompassing much of the Fort Worth area and a region to the northwest of the city. Ozone in this plume reached a maximum concentration of approximately 123 ppb over central Fort Worth. *This flight demonstrated the potential for significant ozone levels when high background levels of ozone are transported into the Dallas/Fort Worth area.*

Industrial (Power Plant) Plumes – Northeast Texas (Longview and Tyler)
Baylor Flight #42 – August 28, 1997
Baylor Flight #61 – July 17, 1998

Flight 42 investigated background ozone levels south and east of the DFW area and then traveled to the Longview/Tyler area to study power plant plumes. Background ozone levels south of Dallas generally ranged from 40 ppb to 80 ppb. As the aircraft approached Tyler, there was an indication of higher ozone associated with a sulfur plume. When the aircraft reached Longview, it flew a spiral pattern around Texas Eastman and identified an ozone plume north of the plant. The plume is quite distinct, so we may conclude that the winds at mission altitude during this portion of the flight are coming from the south. Ozone readings on the south side of the Texas Eastman indicated ozone between 40 and 80 ppb and no identifiable plumes, again reflecting transport of relatively high levels of background ozone. Sulfur levels north of Texas Eastman ranged from 0 to 6 ppb indicating low background concentrations. However, on the eastern edge of the spiral pattern, a sulfur plume with levels ranging from 60 to 80 ppb appeared to be coming from the Martin Lake power plant. Additional evidence linking this plume to Martin Lake was the high levels of NO_y and reduced levels of ozone indicating substantial scavenging. A second set of spirals was flown around the Martin Lake and HW Pirkey powerplants. These ozone and sulfur patterns both indicated wind at altitude blowing from the south. It also appeared that there was substantial ozone scavenging near Martin Lake with ozone levels recovering to higher levels further downstream of the plant. Later, the aircraft flew NNE of the Pirkey power plant and measured high levels of ozone in that area. If we assume that the winds at altitude are still from the south, the most likely upstream sources for the ozone plume appear to be the Pirkey power plant, the Carthage Compressor Station and the East Texas Gas plant. The Pirkey plume was associated with elevated sulfur readings, whereas the Carthage and East Texas Gas ozone plumes were associated with background levels of sulfur. *This mission demonstrates that significant ozone plumes are generated by rural industrial facilities in northeast Texas.*

Flight 61 investigated background levels of ozone in northeast Texas. Surface winds over this time seemed to come generally from the south to east. In the early parts of the flight just east of Dallas, high ozone measurements are most probably attributed to numerous overlapping power plant plumes coming from well

east of the flight path (Monticello, Welsh, Wilkes, Hawkins, Pirkey, and Martin Lake). Later parts of the flight showed evidence of plumes coming from facilities in the near vicinity of Longview; however, the surface wind directions changed rapidly from south to east during this portion of the flight. At the end of the flight – as the plane returned to Waco – there was an indication of wind flow and plumes coming from the southeast, implicating Big Brown, Limestone, and TNP One. *Flight 61 demonstrates the regional transport of ozone plumes from industrial sources in northeast Texas towards the Dallas/Fort Worth metropolitan area.*

Urban Ozone Plumes – San Antonio Metropolitan Area
Baylor Flight #72 – August 28, 1998

Flight #72 investigated urban ozone plumes in the San Antonio area. The morning portion of the flight was characterized by low levels of atmospheric mixing. Arriving in the far northern part of the San Antonio area early in the morning, the aircraft encountered a temperature inversion at approximately 1,500 feet above sea level. Low ozone concentrations (as low as 10 ppb) below the inversion compared to higher ozone levels (70 ppb) above the inversion suggest that ozone above the inversion was transported into the San Antonio area by southeasterly winds. As the aircraft flew further south over the San Antonio area, it detected the remnants of several ozone and sulfur dioxide plumes. Ozone concentrations in one plume on the south side of San Antonio reach 105 ppb. During the afternoon portion of the flight, the atmosphere was more uniformly mixed. Background ozone levels ranged from 90 ppb at ground level to 67 ppb at 2,000 feet above sea level. The aircraft encountered an urban plume on the west side of San Antonio with ozone concentrations as high as 108 ppb (along with low levels of sulfur dioxide). Later while flying south of San Antonio, the aircraft detected a plume from the Summers-Deeley power plant, with elevated levels of sulfur dioxide (30 ppb), NO (45 ppb), and NO_y (97 ppb), along with decreased levels of ozone (from 80 ppb to 65 ppb). On its way back to Waco, the aircraft experienced steady background levels of ozone (45 ppb to 60 ppb) until it descended into Waco where it encountered ozone levels up to 100 ppb. *This flight found evidence of ozone transport into the San Antonio area, industrial plumes being generated in the San Antonio area, and significant urban plumes being generated in the San Antonio area.*

Results of Data Analysis
Baylor University has an extensive compilation of flight data (108 missions), most of which has yet to be validated and analyzed. Commission staff has analyzed and interpreted some (18 missions) valid flight data as it became available. The analysis conducted so far has furthered the commission's understanding of air pollution in Texas several ways:

- The aircraft has extended the state's existing network of ground-based monitors – not only by covering large areas of the state where no monitors exist, but by providing data on air pollution at different altitudes.
- Important data have been provided regarding urban and industrial pollution plumes.
- The aircraft has measured high regional ozone levels coming into Texas and moving between urban areas in Texas.
- Nephelometer data indicates that fine particulate matter increases along with ozone in the urban plumes of all the larger Texas cities.
- The aircraft has also helped show that high ozone levels have been associated with smoke layers aloft during the 1998 smoke events in Mexico.

Aircraft data, in conjunction with data from upwind ground-based monitors, should generate a reasonably accurate picture of regional transport levels for ozone within the state of Texas.

Graphics which show the aircraft's flight path along with ozone levels and other information can be found in Appendix A to this SIP narrative.