Summary of 2009 NETAC Air Quality Planning Activities

March 2, 2010

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Introduction

The Northeast Texas Near Non-Attainment Area (NNA) has seen large reductions in ozone during the last two decades, achieving the 1996 1-hour National Ambient Air Quality Standard (NAAQS) for ozone and successfully concluding its Early Action Compact (EAC) in 2007 with attainment of the 0.08 ppm 8-hour ozone standard. In March, 2008, the U.S. Environmental Protection Agency (EPA) promulgated a new, more stringent 8-hour ozone standard of 0.075 ppm. On January 6, 2010, EPA proposed reducing the ozone standard even further to a level within the range of 0.060-0.070 ppm. EPA will issue a final standard by August 31, 2010.

As of November, 2009, the ozone design values for all Northeast Texas monitors met the 2008 standard of 0.075 ppm. The Northeast Texas NNA is committed to continuing its progress in decreasing ozone levels while maintaining the economic vitality of the regional area. The Texas Legislature has provided rider funding to NNAs to enable ozone air quality planning activities. The Northeast Texas NNA has used this funding to:

- Conduct the technical studies needed to understand the ozone problem in Northeast Texas and develop effective control strategies.
- Implement local emission reduction strategies needed to attain the 1-hour ozone standard resulting in the 1-hour ozone SIP revision submitted to EPA in 2002.
- Join EPA's ozone "Early Action Compact" (EAC) program and submit a Clean Air Action Plan (CAAP) demonstrating attainment of the 8-hour ozone standard in 2007 and maintenance of the standard through 2012. The CAAP was incorporated into a SIP revision submitted to EPA by the State in 2004.
- Implement local emission reduction strategies needed to attain the 0.08 ppm 8-hour ozone standard.
- Perform public outreach and awareness programs to ensure local participation in, and commitment to, ozone air quality planning activities for the region.

These activities have been funded through the East Texas Council of Governments (ETCOG) under the technical direction of Northeast Texas Air Care (NETAC), a local stakeholder group comprised of representatives of local government, business and industry, the general public, and environmental interest groups. In this report, a brief summary of the NETAC's air quality improvement efforts during 2009 is provided.

Ozone Attainment Status

The Northeast Texas ozone monitoring data determine whether the area is in compliance with the National Ambient Air Quality Standards for ozone. The Texas Commission on Environmental Quality (TCEQ) operates three ozone monitors (Continuous Air Monitoring Stations, CAMS) in

Northeast Texas at Longview, Tyler, and Karnack. NETAC has operated a research ozone monitor that was located at Waskom in 2002-2003 and in Panola County in 2004-2006. The Panola research monitor helped to characterize the concentrations of background ozone in air entering the Northeast Texas region on high-ozone days. EPA designated all five NETAC counties as being in attainment of the 0.80 ppm 8-hour ozone standard on April 15, 2004 (69 FR 23858).

The annual 4th highest 8-hour ozone values and the resulting design values at monitors in Northeast Texas for recent years are shown in graphical form in Figures 1 and 2, respectively, and are listed in Tables 1 and 2. Note that all ozone data through December 31, 2009 have been validated by the TCEQ and that the research monitor at Panola was not active after 2006, so a design value cannot be calculated for 2007-2009 for this monitor. Figures 1 and 2 show dramatic declines in 4th high ozone levels and design values at all three monitors over the last decade. The ozone data indicate that 2005 was a relatively high ozone year in Northeast Texas; the 2005 data increased the three year averages used to calculate the 2004-2006 design values to the point where the Longview monitor was out of compliance with the 8-hour standard at the end of 2006. The 2007-2008 period, on the other hand, saw the lowest 4th high ozone values in the last decade at the Northeast Texas monitors. The 2005-2007 design values were all 84 ppb or less, which means that all Northeast Texas monitors were in attainment of the 0.08 ppm 8-hour ozone standard at the end of the Early Action Compact in December, 2007. The 2006-2008 design values show a further reduction in ozone levels such that Northeast Texas design values were at their lowest levels in ten years at all three monitors. The 2009 annual 8th high ozone value at Karnack was at its lowest value since the monitor became operational in 2002, while the Longview and Tyler monitors recorded slight increases over 2008. The 2007-2009 design values continued to decline at all three monitors and all three monitors currently attain the 2008 ozone standard of 75 ppb.

Table 1. Annual 4th highest 8-hour ozone values (ppb) for Northeast Texas

Year	Longview	Tyler	Karnack	Panola
2004	83	81	77	75
2005	88	83	84	79
2006	84	82	78	79
2007	81	77	69	N/A
2008	71	72	68	N/A
2009	73	75	67	N/A

Table 2. Recent trends in 8-hour ozone design values (ppb) for Northeast Texas

Design Value for Years	Longview	Tyler	Karnack	Panola
2002-2004	83	81	81	N/A
2003-2005	84	81	80	77
2004-2006	85	82	79	77
2005-2007	84	80	77	N/A
2006-2008	78	77	71	N/A
2007-2009	75	74	68	N/A

Since the 2004-2006 period, design values for all three monitors have declined, although TCEQ data show that NOx levels in the Tyler-Longview-Marshall area have been either flat (Tyler and Karnack monitors) or increasing slightly (Longview) in recent years ("2008 in Review", presentation by Jonathan Steets, TCEQ Air Quality Division, December 16, 2008). NETAC's conceptual model of ozone formation indicates that ozone levels in Northeast Texas are critically dependent on the amount of NOx available. Decreases in local NOx emissions are unlikely to explain the declining ozone design values. One possible explanation is that weather conditions since 2005 have been less conducive to ozone formation than in previous years; another possible explanation is that regional emissions decreases have reduced the amounts of transported ozone and precursors coming into Northeast Texas.

Ozone formation in Northeast Texas peaks on hot, sunny days with winds ranging from northerly to southeasterly. Figure 2 shows the relationship between weather conditions favorable for producing high ozone in Northeast Texas and ozone values over the last eight years. At CAMS 19, there was a fairly close correspondence between weather and number of high ozone days from 2002-2006. During 2007-2009, there were fewer high ozone days than days with weather suitable for ozone formation. CAMS 85 also shows a close correspondence between weather and number of high ozone days from 2002-2006 except during 2005, when there were far more days with weather favorable to ozone formation than high ozone days. There were no high ozone days during the 2007-2009, despite the existence of favorable conditions on multiple days. CAMS 82 does not show the same relationship between weather and high ozone days as the CAMS 19 and CAMS 85 monitors during 2002-2006. At the CAMS 82 monitor, there were more high ozone days than days with favorable weather during 2003-2006. This may indicate that CAMS 82 has a different set of weather conditions during its high ozone periods than the other two monitors. During 2007-2009, however, the CAMS 82 monitor shows the same trend as the other two monitors, with a larger number of days favorable to ozone formation than high ozone days.

Considering the flat or increasing NOx levels in Northeast Texas, the data in Figure 2 suggest it is possible that declining design values at the Northeast Texas monitors are due in part to weather conditions during the last four years that were less conducive to ozone formation than in previous years (e.g. 2005) and also to decreases in background ozone transported into Northeast Texas resulting from regional NOx emissions reductions measures such as the NOx SIP Call and Federal mobile source controls.

In March of 2009, the State of Texas recommended attainment designations to the EPA in reference to the new 2008 ozone standard. The TCEQ used 2006-2008 ozone data to make recommendations to Governor Perry regarding the attainment status of all Texas counties. As of the end of 2008, the Karnack monitor had a 2006-2008 design value of 71 ppb, which is in attainment of the 0.075 ppm (75 ppb) ozone standard promulgated in 2008. The Tyler and Longview monitors had design values of 78 ppb and 77 ppb, respectively, and did not attain the 75 ppb standard. Accordingly, the TCEQ recommended that Gregg, Rusk, and Smith counties be designated as nonattainment (letter from TCEQ Chairman Buddy Garcia to Governor Perry, December 11, 2008). In their recommendation letter, TCEQ noted that 2009 data could be considered by EPA in making attainment designations. As noted above, in 2009 all three

Northeast Texas monitors met the 75 ppb ozone standard by achieving a 2007-2009 design value of 75 ppb or less.

In May 2008, states, environmental groups and industry groups filed petitions with the D.C. Circuit Court of Appeals for review of the 2008 ozone standard. In March 2009, the Court granted EPA's request to stay the litigation so the new administration could review the standard and determine whether it should be reconsidered. On September 16, 2009, the EPA announced it would reconsider the 2008 standard and notified the Court that was hearing the appeal of the 75 ppb ozone standard that it would like a stay of proceedings. EPA has laid out a fairly aggressive timeline for its review of the standard. A new standard was proposed on January 6, 2010 and EPA will make a final ruling on the new standard by August 31, 2010. EPA has asked that the current standard be stayed during its review and that no designations be made based on the 75 ppb standard. Therefore, no attainment designation would be made for Northeast Texas even though attainment is currently being monitored. EPA plans to compress the usual two-year process for designations into one year. Recommendations on designations from the states to EPA would be due by January, 2011 with EPA making final designations by July, 2011. State Implementation Plans would then be due in December, 2013.

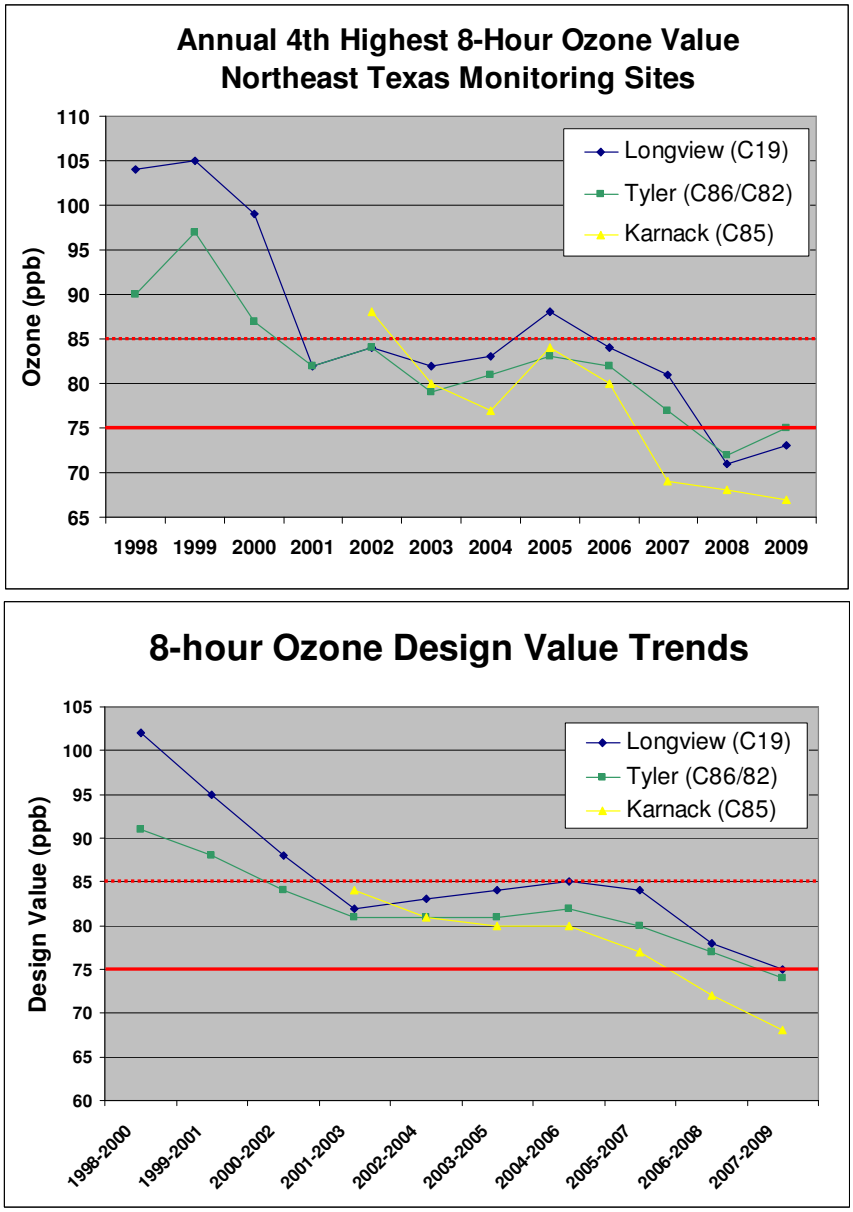

Figure 1. Trends in annual 4th highest 8-hour ozone values (upper panel) and design values (lower panel) at the Longview, Tyler, and Karnack monitors in Northeast Texas. The solid red line indicates the 2008 75 ppb ozone standard and the dotted red line shows the 1996 85 ppb standard.

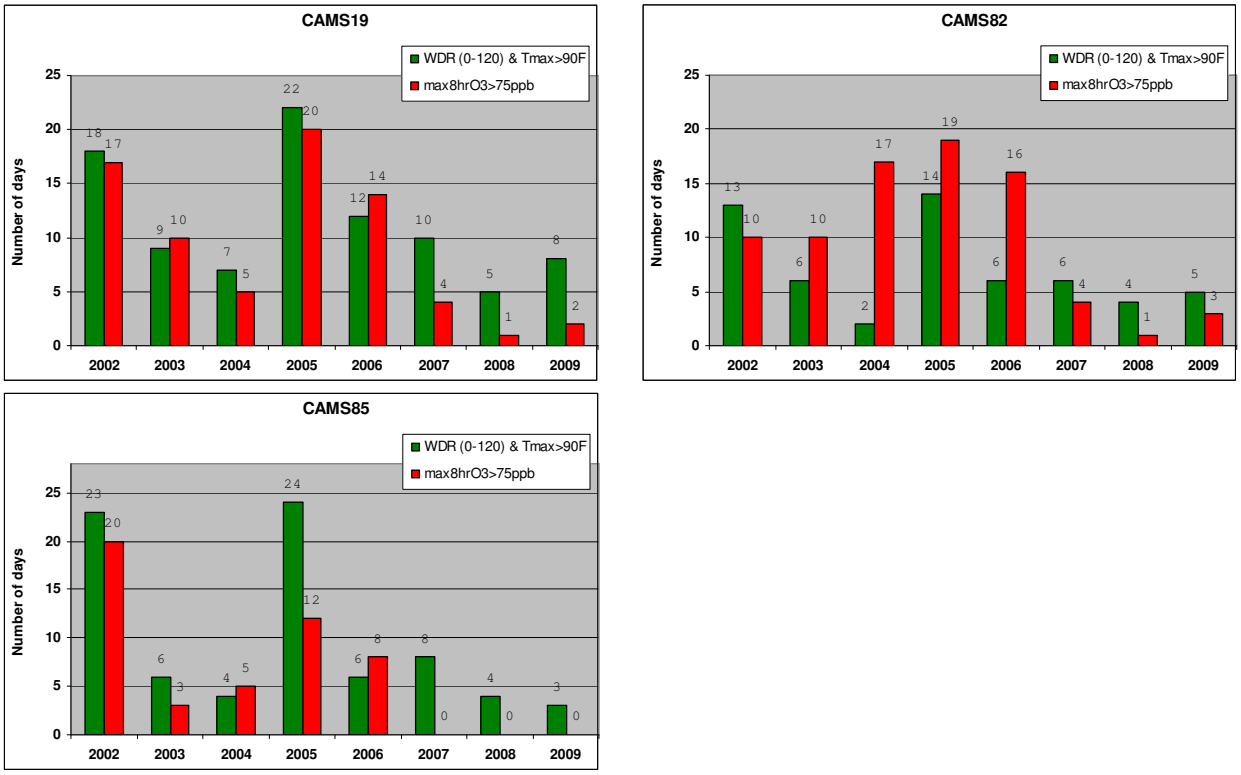

Figure 2. Relationship between weather conditions and high ozone in Northeast Texas. Green bars indicate the number of days that had weather conditions typically associated with high ozone in Northeast Texas: daily maximum temperature greater than 90ºF and 10 am-3 pm average wind direction between 0º and 120º (North to Southeast). Red bars in each panel indicate the number of days during each year that the monitor recorded daily maximum 8-hour ozone concentrations greater than 75 ppb. Top left panel: Longview CAMS 19. Top right panel: Tyler CAMS 82. Lower left panel: Karnack CAMS 85.

Analysis of 2009 Ozone Data

NETAC has reviewed 2009 ozone concentrations recorded at the Longview, Karnack, and Tyler ozone monitors. For the purposes of the analysis presented below, we define a high ozone day to be one on which the daily maximum 8-hour average ozone concentration was greater than 75 ppb or the daily maximum 1-hour average ozone concentration was greater than 85 ppb at one or more of the three Northeast Texas monitors. There were nine such days in 2009.

Each high ozone day was analyzed using data for ozone, sulfur dioxide (SO_2), NOx, and winds from the TCEQ CAMS ground-level monitors at Longview, Tyler and Karnack. Back trajectories were prepared for air arriving at each monitor that measured high ozone. The back trajectories were calculated using NOAA's HYSPLIT (Hybrid Single-Particle Lagrangian Integrated Trajectory) model and TCEQ's AQplot model. Back trajectories are a qualitative tool subject to theoretical and data limitations and were used only to investigate possible source regions for pollutants transported to the monitor.

Here follows an analysis of the high ozone days in Northeast Texas in 2009 based on the available data described in the previous paragraph:

- On two high ozone days at Longview, elevated SO_2 was observed at the same time as the ozone peak, indicative of plume impacts from nearby coal-fired power plants. On both of these days, winds were northerly or northeasterly, consistent with possible plume impacts from the Pirkey Power Plant or power plants in Titus County.
- There was a high ozone event in March at the Longview monitor that was unusual in that it came so early in the year on a day when the peak temperature was 71ºF; this is ~20ºF lower than the typical temperature for a high ozone event in Northeast Texas. The Longview peak was about 40 ppb higher than the regional background of ~45 ppb. On this day, local winds were light and variable at Longview. There was some SO_2 present at the monitor, but there was no peak coincident with ozone peak. There is no clear explanation for this atypical event.
- One high ozone day at Longview occurred with northerly winds and a rapid early morning rise in ozone. This sharp ozone increase during a period of northerly winds and is consistent with the impact of a plume containing highly reactive volatile organic compounds (HRVOCs) from the chemical plant complex owned by Eastman, Westlake, and Flint Hills. The Longview ozone peak was ~50 ppb higher than the regional background of ~50 ppb. There were two additional high ozone days when back trajectories indicated that emissions from the Eastman Complex may have played a role in elevated ozone at the Longview monitor.
- Three high days at Tyler occurred on days with high regional background, easterly winds and late afternoon impacts from the Tyler urban area. It is possible that power plant impacts also played a role in these Tyler events, but no definitive statement can be made because there is no SO_2 monitor at the Tyler CAMS site.
- The only high ozone day at the Karnack monitor showed a peak ~20 ppb higher than background of ~65 ppb, and was unusual in that ozone at Karnack on this day was higher than at Tyler or Longview. The south/southeasterly winds suggest that this could have been a power plant plume impact.

The surface monitoring data from the 2009 ozone season are consistent with the conceptual understanding of the factors leading to ozone levels exceeding the 8-hour ozone standard in Northeast Texas. In 2009, high ozone in Northeast Texas was often caused by emissions from sources within Northeast Texas superimposed on a high regional ozone background.

Status of Emission Reduction Measures at the End of 2009

NETAC has played a key role in identifying and facilitating important local emission reductions. NETAC has carried out emission inventory development supplemented by local surveys as well as aircraft- and surface-based ambient air quality monitoring which indicated that Northeast Texas ozone levels can be most effectively lowered by reducing emissions of nitrogen oxides (NOx). This finding was confirmed through ozone modeling of the area. NETAC then secured agreements for local NOx reductions from key major sources such as the Eastman Chemical

Complex in Longview and several facilities operated by American Electric Power (AEP) and Luminant (formerly TXU) in Northeast Texas. For example, NETAC has worked with Luminant to make installation of NOx-reducing selective catalytic reduction (SCR) technology at the Martin Lake Power Plant a priority.

Luminant has made a commitment to reduce NOx emissions from coal-fired power plants in Eastern Texas by 20% below 2005 annual emissions. To implement this commitment, Luminant has filed with TCEQ applications for the installation of selective catalytic reduction (SCR) technology on the three electric generating units at the Martin Lake station. During TCEQ's June 13, 2007, consideration of a Luminant permit application for a new generating unit, TCEQ commissioner Larry Soward asked for clarification concerning the Luminant commitment. Luminant's legal counsel advised Commissioner Soward and the commission that the commitment was evidenced by the applications to install SCR controls on the Martin Lake units and the Sandow-4 unit. Luminant's legal counsel reaffirmed that these emission reductions will occur.

On July 17, 2007, the NETAC Policy Committee adopted a resolution urging TXU (now Luminant), Kohlberg Kravis Roberts, and Texas Pacific Group to cooperate with NETAC and TCEQ in making its proposed emission reductions legally enforceable. NETAC's co-chairs met with Luminant in 2007 to discuss plans for additional controls at the Martin Lake units. At the NETAC Technical Committee meeting held on November 7, 2008, David Duncan of Luminant reported that Luminant had applied to TCEQ for SCR permits for the Martin Lake plant, but that approval of the SCR permits was being contested. In November, 2009, David Duncan reported that the date when the permit may be granted is still unclear, and so Luminant does not have an estimate for when the SCR will be installed at Martin Lake.

Another focus of NETAC's emission reduction efforts has been gas compressor engines associated with natural gas production. Emission inventory and survey data compiled by NETAC showed that total NOx emissions from these compressor engines in the five NETAC counties are comparable to NOx emissions from a large power plant. In 2005, NETAC implemented a pilot project to demonstrate the effectiveness of retrofitting small (< 500 hp), spark-ignited, rich-burn compressor engines used in natural gas production with exhaust catalysts and electronic air/fuel ratio controllers. At the end of a year-long test period, these controls were achieving an estimated emission reduction efficiency of greater than 90%, or 0.1 ton/day NOx per engine. NETAC then vigorously pursued funding for a catalyst retrofit program for compressor engines. In 2010, emissions from larger (>240 hp) gas compressor engines will be regulated by the East Texas Combustion Rule.

In June 2007, the TCEQ adopted an East Texas Combustion Rule as part of the Dallas-Fort Worth 8-Hour Ozone SIP Revision. The rulemaking will subject owners or operators of stationary sources of NOx in the Dallas-Fort Worth eight-hour ozone nonattainment area, as well as in specified counties in the northeast Texas area, to more stringent emission control, monitoring, testing, recordkeeping, and reporting requirements. The Rule applies to rich-burn engines with horsepower greater than 240 hp. The preamble to the proposed rule published in December 2006 noted that catalyst technology is expected to be the primary control technology for rich-burn, gas-fired engines. The rule applies in 33 East Texas Counties, and the compliance

deadline is March 1, 2010. An analysis performed by the TCEQ suggests that NOx reductions from the East Texas Combustion Rule for the 5-county Tyler-Longview area would be approximately 7 tons per day. A separate assessment by NETAC predicts a reduction of approximately 17 tons of NOx per day for the 5-county area in the year 2012.

Other emissions reductions supported by NETAC include energy efficiency programs adopted by the cities of Longview, Marshall, and Tyler. Voluntary on-road vehicle emission reductions were made through funding for clean-fueled propane vans for local transit agencies under the DOE "Clean Cities Program". The East Texas Council of Governments runs public awareness programs that are funded by the State of Texas through Rider funding for near-nonattainment areas (NNAs). These programs include:

- ozone watch and warning communications network between local government and industries to communicate ozone action day forecasts issued by TCEQ;
- NETAC website;
- public service announcements; school programs and teacher training workshops; distribution of public information and educational materials;
- Annual Ozone Season kick-off meeting for the NETAC area.

NETAC's Stakeholder Process and Committee Activities During 2009

In 1995, local elected officials and other leaders in local government, business and industry created Northeast Texas Air Care (NETAC) in order to provide leadership and guidance in addressing ozone air quality issues in a five county area consisting of Gregg, Harrison, Rusk, Smith, and Upshur counties. A policy committee consisting of representatives of local government, business and industry, the general public and environmental interest groups governs NETAC. (Attachment 1)

From its inception, NETAC has emphasized the need to ensure that air quality planning activities are developed using scientifically sound techniques. In order to achieve this objective NETAC created a Technical Advisory Committee to undertake, supervise, and guide technical studies such as emission inventory development, air quality modeling and control strategy development, and specialized monitoring studies. The Technical Advisory Committee reports to the policy committee. The Technical Advisory Committee consists of representatives from local government, local business and industry, EPA technical staff, TCEQ technical staff, Texas Department of Transportation planning staff, and the general public and environmental interest groups (Attachment 1).

NETAC is actively involved in public education and outreach programs concerning ozone air quality issues. This work is guided by NETAC's Public Education/Outreach Committee, which consists of representatives from local government, local business and industry, TCEQ staff, and environmental interest groups (Attachment 1). The Public Education/Outreach Committee reports to the NETAC Policy Committee.

NETAC receives staff support for its activities from the East Texas Council of Governments (ETCOG), which receives and administers grant funds provided by the Texas Legislature for air

quality planning activities. NETAC and its subcommittees meet on an as-needed basis. All meetings are open to the public and are posted at the East Texas Council of Governments and advertised through the distribution of information packets to local media outlets. During 2009, the NETAC Technical and Policy Advisory Committees held meetings on April 28 and October 16.

During the April 28 and October 16 meetings, the Technical Committee discussed: (a) analysis and modeling of HRVOC data collected at CAMS 19 in 2008; (b) recent improvements to NETAC's 2005 ozone model; (c) 2012 emission inventories for future year ozone modeling including an emission inventory for natural gas development in the Haynesville Shale; (d) two proposed ambient monitoring projects at CAMS 19; (e) Near-Nonattainment Area funding; (f) the attainment status of Northeast Texas and the designation process; (g) a review of 2009 high ozone days; (h) ozone planning activities during FY 2008-2009 and 2009-2010; and (i) the EPA decision to review the 2008 75 ppb ozone standard.

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Public Outreach Activities During 2009

NETAC is actively engaged in public education and outreach activities concerning ozone air quality issues. The public outreach committee organized an ozone season awareness kickoff event held on April 28, 2009. The purpose of the kickoff event was to raise public awareness of ozone air quality issues and encourage public support for programs designed to minimize ozone formation.

NETAC Public Education/Outreach activities for 2009 included the following:

- Hosting the NETAC website (www.netac.org). The website is regularly updated with meeting dates, associated agendas and enclosures for Committee meetings. The public can also find minutes of past meetings, various air quality reports, and a directory of all participants in NETAC.

- In cooperation with the Texas Commission on Environmental Quality, NETAC and local governments in the area provide "ozone action alerts" for the public on days when TCEQ predicts meteorological conditions are favorable for high ozone formation. Notification

is provided through the NETAC website, local government public access channels, and the display of ozone alert flags.

- The Annual Ozone Season Awareness Event was held in Longview at the Maude Cobb Convention Center on April 28, 2009. Speakers at the event included Eric Potter of the Texas Bureau of Economic Geology, who discussed enhanced oil recovery in Texas and how Northeast Texas might benefit from CO_2 capture and sequestration, and Jim Mathews, NETAC's Legal Counsel, who gave the NETAC Progress Report for 2009.

- NETAC sponsored a series of public service announcements (PSAs) that ran on several local radio stations from May through September 2009. These PSAs sought to educate the public about what they can do at both work and home during the ozone season to reduce their impact on air quality readings.

- The NETAC Public Education/Outreach Committee approved the purchase of book covers for school districts in the five county area for the 2009-2010 school year. The book covers have an informational theme as well as including information on where to learn more about air quality. This is one of the most well-received activities as ETCOG receives numerous thank you letters from students and school administrations.

Technical Activities

NETAC technical activities during 2005 and 2006 emphasized ambient air monitoring. During 2007-2009, there was a shift in emphasis towards emission inventory development and ozone modeling with the goal of understanding the causes of episodes of elevated ozone concentrations at the Longview monitor and developing a plan for maintaining attainment through 2012 and supporting possible SIP development. Below is a description of technical activities NETAC carried out in 2009:

Air Monitoring

Surface Mobile Monitoring at CAMS 19

During October-November, 2009 mobile surface sampling was conducted to evaluate regional concentrations of ozone precursors in Northeast Texas. Surface mobile monitoring is an effective method for collecting air quality data over large geographic regions between fixed surface monitoring stations (e.g., TCEQ's CAMS locations). The sampling effort was carried out by researchers from the University of Texas (UT) and focused on rural areas with oil and gas production activities to investigate the spatial distribution and magnitude of VOC and NOx emissions from oil and gas production activities. Preplanned sampling routes were developed by UT in conjunction with NETAC. The routes were designed to provide good spatial sampling of oil- and gas-producing regions in the 5-county area and Panola county and, wherever possible, to use paved roads with little traffic to minimize interference by emissions from other vehicles. Continuous measurements were made for ozone, sulfur dioxide (SO_2), carbon monoxide (CO), nitrogen oxides (NO_y), methane, and total non-methane hydrocarbons (TNMHC). VOC canister

samples were collected at locations close to oil and gas production activities where the continuous hydrocarbon monitor detected high TNMHC concentrations and were analyzed for concentrations of 75 specific VOCs. Data from the mobile monitoring study are currently being quality-assured and analyzed. Once analysis is completed, the results of the study will be presented in a report and will be integrated into NETAC's conceptual model of ozone formation in Northeast Texas.

Enhanced VOC Monitoring at CAMS 19

Between June, 2005 and October, 2007, NETAC maintained a total non-methane hydrocarbon monitor at CAMS 19 in Longview. The monitor was deactivated and removed in 2008. During 2009, the TNMHC monitor was repaired and reinstalled at CAMS 19 and was configured to report TNMHC data to the TCEQ website. The purpose of the TNMHC monitoring is to track the effects of oil and gas production activity, which appears to be a large source of hydrocarbon emissions in Northeast Texas. TNMHC measurements will also be used to inform the development of emission inventory estimates as well as to provide observational constraints on CAMx ozone modeling and inform the conceptual model of ozone formation. This monitoring program will continue during 2010.

Conceptual Model Update

During 2008, NETAC updated its conceptual model of ozone formation. Between the previous conceptual model update in 2004 and the 2008 conceptual model update, NETAC carried out surface-based and aircraft measurements in Northeast Texas, revised and refined the local and regional emission inventories, and developed ozone models for the years 2002 and 2005. This wealth of new information lent additional detail to the 2008 conceptual model, but did not change the overall picture of the factors leading to high ozone in Northeast Texas.

High ozone days in Northeast Texas are usually the result of a local point source plume impact at a Northeast Texas monitor on a day when regional background ozone levels are high. High ozone days occur most often between June and September when the area is under the influence of a semi-permanent subtropical high-pressure system, when vertical mixing of pollutants in the atmosphere is restricted, when skies are clear to partly cloudy, when temperatures are high, and winds are light. Most episodes are associated with near-surface winds from either the east/northeast or south/southwest with the latter direction appearing less consistently on the highest days and with greater variability in direction.

On a regional scale, emissions of ozone precursors in Northeast Texas are dominated by highly reactive biogenic VOCs such as isoprene and pinenes; anthropogenic sources account for a much smaller fraction of total daily VOC emissions in the NETAC area. The overall VOC/NOx emission ratio in the five county area is well within the regime associated with NOx-limited ozone formation. As a result, reductions in NOx will be generally more effective in controlling ozone on a regional basis than reductions in anthropogenic VOC. Sensitivity tests using NETAC's 2005 ozone model confirm that NOx reductions are more effective than VOC reductions in controlling ozone in Northeast Texas.

NETAC will revise the conceptual model in early 2010 to reflect findings from monitoring and modeling carried out since the 2008 conceptual model update.

Local Emission Inventory Development

During November of 2007, TCEQ made available a revised emission inventory for 2005. The incorporation of this inventory into NETAC's May-June 2005 ozone model was initiated during the second half of 2007 and completed in 2008. Emission inventory development during 2009 was focused on enhancing the 2005 local Northeast Texas emission inventory. In 2009, a series of emission inventory updates were integrated into NETAC's 2005 model, and their impacts were assessed.

During 2009, NETAC developed an emission inventory for the year 2012 for the purpose of 2012 ozone modeling. The 2012 inventory was based on TCEQ's 2018 inventory developed for Houston SIP modeling with revisions to the amount of emissions growth and the implementation of future emission controls. NETAC made other local enhancements to the 2012 emission inventory that are specific to Northeast Texas.

Gas Compressor Engine Inventory

Emissions from gas compressor engines used in natural gas gathering systems are an important component of the Northeast Texas emission inventory. Discussions between NETAC and TCEQ identified engine load factor as an uncertain parameter in NETAC's existing emission inventory for gas compressor engines. Engine load factor is the ratio of the engine's operating horsepower to the engine's rated horsepower. During 2008, NETAC carried out a field study to determine the appropriate load factor for compressor engines used in natural gas production in the five NETAC counties and Panola County. Previous studies had assumed a load factor of 100% consistent with normal emission inventory techniques. Applying the load factors determined in the NETAC study reduced the estimated 2005 emissions of compressor engine NOx by 34%. Similar reductions are seen for engine exhaust emissions of VOC and CO. The 2005 gas compressor engine emission inventory was added into NETAC's 2005 model during 2008, and during 2009, the revised load factor data was also integrated into the model.

TCEQ Drill Rig Emission Inventory

Drilling rigs are a major source of NOx emissions from oil and gas exploration and production (E&P) activity. Previous inventories of oil and gas related emissions from all E&P activities in the western regional U.S. have concluded that in most major oil and gas development areas, drilling rigs are the highest or second highest NOx source category from these activities. TCEQ developed an emission inventory for drill rigs for the year 2005 and this inventory was integrated into NETAC's 2005 ozone model. Use of this inventory increases the NOx emissions in the 5-county area by ~30 tons/day which is comparable to NOx emissions from a large power plant.

Analysis of Local Power Plant Emissions

During 2009, NETAC performed an analysis of 2006-2008 local power plant NOx emissions and heat input to provide emission trend analyses for the conceptual model update. Continuous emissions monitoring data were obtained from EPA's Acid Rain database and 2006-2008 heat input and NOx emission trends for local power plants were examined.

Haynesville Shale Emission Inventory Development

The Haynesville Shale is a rock formation that lies at depths of 10,000 to 13,000 feet below the surface and straddles the border between Northeast Texas and Northwest Louisiana near Shreveport. This formation is estimated to contain very large recoverable reserves of natural gas, and during the two years since the drilling of the first highly productive wells, has been the focus of intensive exploration and leasing activity. The development of natural gas resources within the Haynesville Shale is likely to be an important driver of local economic growth, but may also generate significant emissions of ozone precursors in a region that is often immediately upwind of the 5-county area of Northeast Texas on high ozone days. During 2009, NETAC carried out a study to investigate how development in the Haynesville Shale may impact future ozone air quality in Northeast Texas.

A survey asking about current and projected activity and equipment use was sent to producers identified by company web pages and stockholder and venture capital reports as being major leaseholders in the Haynesville Shale. These companies were: XTO, Chesapeake, Petrohawk, EOG, EnCana, Shell, BP, Devon and El Paso. All of the companies declined to participate in the study. Based on well production data from state regulatory agencies and a review of the available literature, projections of future year Haynesville Shale natural gas production were derived for 2009-2020 for three scenarios corresponding to limited, moderate, and aggressive development. These production estimates were then used to develop an inventory of potential emissions from future natural gas exploration and production in the Haynesville Shale for all three scenarios. Estimates of 2012 NOx emissions in Northeast Texas and Northwest Louisiana due to development in the Haynesville Shale ranged from 61 tons/day in the limited development scenario to 82 tons/day in the moderate scenario to 140 tons/day in the aggressive scenario. Results for the moderate scenario indicate that by 2020, development in the Haynesville Shale results in more than 120 tons/day of additional NOx emitted in Northeast Texas and Northwest Louisiana. There is significant uncertainty associated with these emissions estimates since development in the Haynesville Shale is still in its initial stages. The assumptions used in the development of the inventories – particularly the minimal need for wellhead compressors – indicate that these inventories represent a lower bound of the potential emissions from these scenarios. Analysis of the emission inventories suggests that if the development of the Haynesville Shale proceeds at even a relatively slow pace, emissions from exploration and production activities will be sufficiently large that their potential impacts on ozone levels in Northeast Texas should be evaluated. NETAC has performed ozone modeling that uses the emission inventory described above to assess the potential ozone impacts of the Haynesville Shale. This is discussed under the Ozone Modeling section below. The results of the Haynesville Shale emissions and ozone analysis are presented in the 2012 ozone modeling report.

<u>Ozone Modeling</u>

NETAC has developed a SIP-quality seasonal ozone model for the period May-June, 2005 with a future year scenario for 2012. This model is being used to understand conditions leading to 8-hour ozone problems in Northeast Texas (at the Longview monitor in particular) through an examination of the influences of regional transport, local sources and meteorological variability on Northeast Texas ozone levels. Modeling efforts undertaken during 2009 extend previous NETAC Northeast Texas modeling work by updating the emissions inventories and meteorological database. The model is being used to evaluate the likelihood of future exceedances of the ozone NAAQS and develop emissions reduction strategies to ensure that the area does not exceed the ozone NAAQS in the future.

Meteorological Model Updates

At the close of 2008, NETAC's 2005 ozone model performed well on most days during the May-June 2005 period, achieving performance statistics that compare favorably with those of similar regional ozone modeling applications, but underestimated peak ozone at Longview on 3 of 5 8-hour ozone exceedance days. Detailed analysis for the three ozone exceedance days on which the peak ozone values at CAMS 19 were underestimated by the model showed that the most likely reason that the peak ozone values were not accurately simulated at CAMS 19 is errors in wind speed and direction modeled by the meteorological model MM5. During 2009, a new treatment of clouds was applied to the entire May-June episode and additional wind profiler data was used in nudging the MM5 meteorological model toward observed winds. These changes to the meteorological fields improved CAMx ozone performance markedly on the only remaining June high ozone day with a significant underestimate of peak ozone.

Updated CAMx Dry Deposition Algorithm

Dry deposition refers to the direct removal of air contaminants through contact with various terrestrial surfaces and uptake into biota. Dry deposition is an important process that removes ozone from the atmosphere and limits buildup of ozone concentrations. The treatment of dry deposition in a regional air quality model can therefore have a significant effect on model performance

During 2009, a state-of-the-science dry deposition algorithm used in Environment Canada's AURAMS air quality model was implemented in CAMx. The capabilities of the scheme were extended by adding the option to use episode-specific satellite leaf area index (LAI) data to characterize the surface. The Environment Canada scheme was tested in CAMx using episode-specific satellite LAI data, and model performance was evaluated at rural sites to emphasize the effects of deposition. The change from the original CAMx scheme to the Environment Canada scheme increased peak ozone and improved model performance across Texas and the surrounding regions; the Environment Canada scheme was therefore integrated into the NETAC ozone model, replacing the previous dry deposition scheme.

CAMx Sensitivity Tests

Comparison of observed and modeled ozone time series at the Northeast Texas monitors showed that the model had a tendency to overestimate nighttime ozone. The CAMx sensitivity testing showed that reducing the overall vertical mixing calculated within CAMx and setting an upper bound on the mixing via adjustment of the vertical diffusion profile improved the model's simulation of the nighttime ozone minima without significantly affecting daytime ozone performance. Therefore, the modified vertical mixing was incorporated into the ozone model.

New episode-specific lateral boundary conditions on the outer (36 km) grid that incorporated the effects of satellite-derived fire emissions data for all of the continental U.S. were tested. The new boundary conditions resulted in improved ozone performance in Northeast Texas, and were integrated into the model.

2005 Emission Inventory Updates

During 2009, the gas compressor engine emission inventory with updated load factor data was integrated into the 2005 ozone model. As a result of the new load factor data, NOx emissions were reduced by 11 tons/day in the 5-county area. 2005 day-specific satellite fire emissions data for the Eastern U.S. were added to the model, as well as TCEQ's drill rig emission inventory.

2005 CAMx Base Case and Baseline Ozone Modeling

Once the sensitivity testing and emission inventory updates were completed, a final base case run was made. This run exhibited excellent model performance, meeting EPA benchmarks on 23 out of 25 days overall and on 4 of the 5 highest ozone days. The May-June 2005 ozone model can therefore be used for SIP attainment demonstration and control strategy development

Upon completion of the base case 2005 model, a baseline model for the year 2005 was prepared for use in future year ozone projections. The only difference between the base case model and the baseline model is that the baseline model uses typical ozone season day EGU emissions, while the base case has hourly EGU emissions derived from continuous emissions monitoring data. The 2005 baseline EGU emissions are used to represent typical conditions (no shutdowns for maintenance, for example) in order to be consistent with the 2012 future year emissions, which also represent typical conditions.

2012 Emission Inventory Development

NETAC's 2012 emission inventory builds on prior TCEQ efforts where possible. TCEQ has developed 2012 data for some source categories (on-road mobile, area sources), and NETAC incorporated these into its 2012 emission inventory. For the Houston-Galveston-Brazoria SIP revision, TCEQ has developed an emission inventory for 2018 for regions within Texas and outside of Texas. The TCEQ emission inventory is focused on the Houston area and so has the greatest detail in that region. During 2009, NETAC adapted TCEQ's 2018 inventory to 2012 for remaining components of inventory for which TCEQ had not developed 2012 data and added components where necessary. A detailed description of the 2012 emissions modeling will be provided in the 2012 ozone modeling report.

Once the draft 2012 emission inventory had been developed, NETAC added inventory improvements specific to Northeast Texas. Operators of the major local point sources were contacted to determine whether the emissions for their facilities in the draft inventory were reasonable estimates of their projected 2012 emissions. The operator's recommendations were incorporated into a revised emission inventory. For oil and gas emissions sources within the 5-County area, emissions growth/decline from 2005 to 2012 was based on projections made using oil and gas production data from the Texas Railroad Commission, and the effects of the East Texas Combustion Rule were taken into account.

Ozone Modeling of 2012 and 2012 Emissions Sensitivity Tests

Using the 2012 emission inventory described above, NETAC carried out modeling of 2012. The only difference between the 2012 and 2005 models is the anthropogenic emission inventory, as the purpose of the modeling was to determine how changes in local and regional emissions from 2005 to 2012 affect Northeast Texas ozone. The ozone modeling showed regional reductions of 4-6 ppb in the projected ozone design value in going from 2005 to 2012. The decrease is somewhat lower in the area of intensive oil and gas development and production within Northeast Texas, The results of the 2012 ozone modeling are detailed in the 2012 ozone modeling report.

Ozone impacts of the development of the Haynesville Shale were investigated by adding the emissions from the Haynesville Shale for low, medium, and high development scenarios to the 2012 emission inventory and running the 2012 ozone model for each scenario. The study showed that significant 8-hour ozone impacts occurred within Northeast Texas as a result of development in the Haynesville Shale and that ozone enhancements from the Haynesville Shale can affect regions outside Northeast Texas and Northwest Louisiana. The ozone impacts of the East Texas Combustion Rule were also assessed.

Modeling of High HRVOC/Ozone Events at CAMS 19 During 2008

During August-October, 2008, NETAC carried out a successful monitoring program which confirmed the presence of intermittent plumes containing very high concentrations of highly reactive VOCs (HRVOCs) at CAMS 19. HRVOCs were detected using a reactive alkene detector (RAD) which made a measurement once every second, 24 hours a day, providing a nearly continuous record of HRVOCs at CAMS 19. The high resolution RAD data confirmed the intermittent character of anthropogenic HRVOC impacts suggested by 2006 VOC monitoring data from CAMS 19, and showed that HRVOCs are present on a significant fraction of days, with 10 of 64 days showing strong RAD signals above 30 ppb. The natural background for HRVOCs (i.e. biogenic HRVOCs whose primary constituent is isoprene) may be expected to be approximately 10 ppb at midday. NETAC has investigated the relationship between periods of high ozone and high HRVOC levels at CAMS 19. Many periods of high HRVOC levels were not associated with high ozone at CAMS 19; most of these occurred at night. Some days with strong HRVOC signals may not have been conducive to ozone formation (lower temperatures, clouds). However, high 1-hour ozone values coincided with HRVOC spikes under northerly winds on 3 days in September, suggesting Eastman Complex impacts.

On March 11, 2009, NETAC sent a request for information to the Eastman Chemical Company Westlake Chemical Company, and Flint Hills Resources asking whether they had had any upsets or unusual events on the days when HRVOC spikes were observed at CAMS 19. All three companies investigated the 2008 days with HRVOC events and found no unusual activity on those days.

Since the HRVOC measurements suggest that the Eastman Complex can play a role in high ozone events at CAMS 19, a modeling effort was undertaken in 2009 in order to improve our understanding of sources within the Eastman Complex. The main purpose of this modeling was to determine the magnitude of emissions required to produce HRVOC spikes at CAMS 19, assuming that the HRVOCs originate within the Eastman Complex. NETAC carried out modeling of September 2008 using two different models: the AERMOD dispersion model and a specific implementation of the CAMx photochemical grid model that is different from the 2005/2012 NETAC ozone model described above.

First, NETAC used the AERMOD dispersion model to model hypothetical emissions from Eastman Complex. AERMOD is EPA's guideline model for assessing local impacts from industrial sources. AERMOD treats dispersion of pollutants, but does not model their chemical transformation in the atmosphere. Surface meteorology from CAMS 19 was supplied to AERMOD. Using Eastman Complex total reported 2005 ethene emissions as the emissions source causes AERMOD to underestimate the observed ethene at CAMS 19. In order to obtain agreement with the CAMS 19 HRVOC observations for surface-level source, it was necessary to at least double the ethene emissions (to 833 lbs/hr).

Next, simplified CAMx modeling was carried out using a nested modeling system whose finest grid was a 200 meter grid focused on Eastman and CAMS 19. The model was run for a single day and used CALMET diagnostic meteorology based on local CAMS observations, with the evolution of mixed layer height determined from Longview radar profiler observations. The model was initially run with emissions from Eastman Complex sources as characterized in the 2005 TCEQ inventory for a typical ozone season day, and did not reproduce observed HRVOC or ozone peaks at CAMS 19. With an additional 2500 lbs/hr ethene emitted from a near-surface source, CAMx simulates the timing and magnitude of the observed HRVOC peak. CAMx requires more HRVOC emissions than AERMOD to reproduce the observed HRVOC peak because of differences in plume dispersion between the models. CAMx was able to reproduce the observed ozone peak with reasonable skill, although the magnitude of the peak was slightly underestimated. This modeling indicates that (1) the high ozone observed concurrent with HRVOC plumes is attributable to the HRVOC emissions, and (2) CAMx can reproduce the observed ozone when precursors are accurately simulated

The AERMOD and CAMx modeling both suggest that the HRVOC emissions needed to produce observed spikes are greater than the typical day emission inventory. Ethene emissions of ~2500 lbs/hr can cause observed morning ozone spikes at CAMS 19 through interaction with readily available NOx. Potential sources of such emissions are not understood. Estimates of Eastman Complex ethene (HRVOC) inventory derived from 2006 NETAC aircraft flight are consistent with the TCEQ 2005 emission inventory for a typical ozone season day. The Eastman Complex operators believe that such a large release (about 1 ton per hour) could not have occurred without

detection by their control and/or safety instrumentation. Therefore, the origin of these HRVOC spikes remains unclear. NETAC will undertake additional HRVOC monitoring during 2010 using event-triggered canister data sampling. Analysis of canister samples taken during HRVOC spikes will allow chemical fingerprinting of the source(s) of the spikes that can further our understanding of high HRVOC/ozone events at CAMS 19.

Attachment 1

NETAC TECHNICAL ADVISORY COMMITTEE (18)

- City of Longview
  - Robert Ray, Assistant City Attorney
- Longview MPO
  - Karen Owen
- City of Marshall
  - Winston Robinson
- City of Tyler
  - Greg Morgan
- Tyler MPO
  - Barbara Holly
  - Tony Filipinni
- EPA
  - Carrie Page
  - Erik Sndyer
- TCEQ
  - Kathy Singleton
  - Doug Boyer
  - Michelle Baetz
- NETAC General Counsel
  - Jim Mathews, Mathews and Freeland
- TxDOT
  - Dale Booth
- AEP/SWEPCO
  - Kelly Spencer
  - Kimberly Hughes
  - N. N. Dharmarajan
- CenterPoint Energy
  - Laura Guthrie
  - Gary Thiemann
- Eastman Chemical Company
  - Sharon Wellman
- Flint Hill Resources
  - Mark McMahon
- Luminant
  - David Duncan
  - Dick Robertson
  - Rick Hanning
- BP America
  - Dana Wood
- Caddo Lake Institute, Inc.

  - Rick Lowerre, Lowere & Frederick
- Environmental Defense Fund
  - Mr. Ramon Alvarez, Ph.D.,
- Westlake Chemical Company
  - Scott Snedden

NETAC POLICY COMMITTEE (16 ACTIVE/3 NONACTIVE)

ACTIVE

- Gregg County
  - Judge Bill Stoudt, Co-Chair
- Harrison County
  - Judge Richard Anderson
- Rusk County
  - Judge Sandra Hodges
- Smith County
  - Judge Joel Baker
- Upshur County
  - Judge Dean Fowler
- City of Henderson
  - Mayor Buzz Fullen
- City of Kilgore
  - Jeff Howell, City Manager
- City of Longview
  - Mayor Jay Dean
  - Councilman Daryl Williams
- City of Marshall
  - Winston Robinson
- City of Tyler
  - Mayor Barbara Bass, Co-Chair
  - Greg Morgan
- Longview Economic Development Corp. (LEDCO)
  - John Stroud
- WE CAN
  - Ms. Tammy Campbell
- AEP/SWEPCO
  - Keith Honey
- Eastman Chemical Company
  - Darrell Rachels
- Luminant
  - David Duncan
- Westlake Chemical Company
  - Scott Snedden

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NONACTIVE

- City of Gilmer
  - Jeff Ellington
- Tyler Economic Development Corporation (TEDCO)
  - Tom Mullins
- Marshall Economic Development Corp. (MEDCO)
  - Cliff Todd

NETAC Public Education/Outreach Committee

- Robert Ray, Assistant City Attorney, City of Longview
- Greg Morgan, Project Coordinator, City of Tyler
- Winston Robinson, City of Marshall
- Sharon Wellman, Eastman Chemical Company
- Rick Hanning, TXU
- Jack Holsomback, TCEQ-Tyler
- Leigh Ann Brunson, TCEQ-Austin
- Kelly Spencer, AEP/SWEPCO
- Scott McCloud, AEP/SWEPCO