

Section II: Rider 8 Workplan for the Technical Assessment of Ozone Formation
Budget Allocation: \$425,000

**Rider 8: Corpus Christi Ozone Near Non-attainment Area
Air Quality Research Activities**

Proposed by the

Department of Environmental Engineering
Texas A&M University – Kingsville

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Mr. Robert Castro

Laboratory Manager: Mr. Don Marek

External
Advisory Board: Mr. Bill Hennings
Chairman of Air Quality Committee, City of Corpus Christi

Mr. Ron Barnard
Environmental Specialist, City of Corpus Christi

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Task I. Monitoring of Current Air Pollution Levels

A. Responsible Party: Department of Environmental Engineering
Texas A&M University-Kingsville

Personnel Assignment: Dr. Kuruvilla John and Dr. Alvaro Martinez will supervise the activities listed in this task. Drs. David Ramirez and Yifang Zhu will lead the hot spot analysis for mobile sources. Research Associates (Ms. Saritha Karnae and Ms. Priya Subramoney), a laboratory manager (Mr. Don Marek) and an environmental engineering graduate student (Mr. Bob Castro) will jointly perform this task.

Funding Request: **\$ 256,000**

Overview

The Air Monitoring Group housed in the Department of Environmental Engineering at Texas A&M University-Kingsville (TAMUK) is currently involved in the ambient air quality monitoring for the Corpus Christi Near Non-attainment Area. The Texas Commission on Environmental Quality (TCEQ) maintains and operates two compliance grade continuous ambient monitoring stations (CAMS 04 and CAMS 21) in the Corpus Christi urban airshed. Continuous measurement of air pollutants including ozone and meteorological parameters is carried out at these sites.

As an integral part of the previous Rider 8 (2004-2005) air quality research and planning activities for the Corpus Christi Near Non-attainment Area, TAMUK has setup three additional non-compliance grade monitoring sites within the urban airshed. These three monitoring sites include: (1) an upwind site at the waste water treatment plant in Aransas Pass (CAMS 659), (2) a downwind site located in Violet near Robstown (CAMS 664), and (3) an urban site at the municipal water station south of South Padre Island Drive (SPID) on Holly Road (CAMS 660). Each site has ozone analyzers, weather sensors and data loggers for continuous measurement and data collection. The ozone and weather data from these three sites operated by TAMUK is currently uploaded to TCEQ's air monitoring data acquisition system entitled LEADS using wireless modems and is posted on the TCEQ website.

Additional monitoring of ozone precursors including continuous measurement of oxides of nitrogen (NO_x) at CAMS 660 and canister-based sampling of volatile organic compounds (VOCs) is conducted during the ozone season at CAMS 664. The canister-based samples are analyzed for 55 hydrocarbon species using a Gas Chromatograph/Mass Spectrometer (GC/MS) located in the South Texas Ambient Hydrocarbon laboratory at TAMUK.

As part of a Supplemental Environmental Project (SEP), TAMUK has recently received authorization from TCEQ to develop three additional monitoring sites in San Patricio county. At each of these SEP sites, ozone analyzers and weather stations are to be installed. Continuous sampling of ozone and meteorological parameters will be undertaken starting in September of 2006. At one of these sites, continuous monitoring for oxides of nitrogen (NO_x) will be

conducted during the ozone season. The data from these sites will also be posted on TCEQ's website and will also be made available to stakeholders and policy makers.

In addition, a continuous air monitoring site will be installed at the Corpus Christi Museum of Science and History to support public outreach activities by the Corpus Christi Air Quality Committee. Data collected from the operational monitor housed in the museum will concurrently be displayed along with an educational piece on air quality, its sources, impacts and control. The educational and outreach piece is being developed by a National Science Foundation supported Center for Research Excellence in Science and Technology (CREST-RESSACA) at TAMUK. Currently, there are no monitoring sites available in the vicinity of the growing downtown of Corpus Christi. This proposed monitoring site at the museum will provide much-needed air quality data for the downtown area.

Figure 1 displays the location of air monitoring sites currently under operation and proposed on a map of the Coastal Bend region. The site locations shown with red bullets are TAMUK facilities, while those located using blue bullets are operated by TCEQ. Further details of all of the TAMUK monitoring sites are summarized in Table 1.

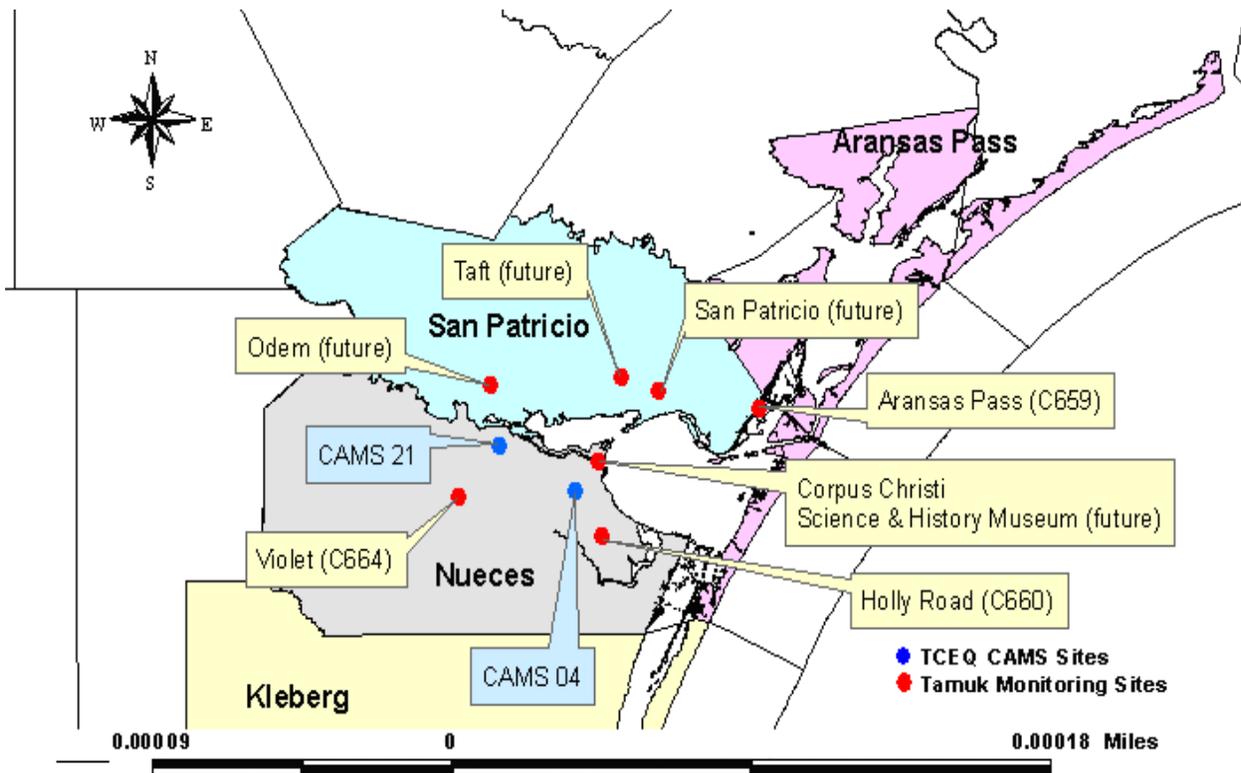


Figure1. Location of Air Monitoring Sites within the Corpus Christi Urban Airshed

Table 1. Description of TAMUK's Air Quality Monitoring Stations in Nueces and San Patricio Counties (Lat/Lon in decimal notation)

Site Name	Description	North	West	Status
<u>Holly Road</u> (CAMS 660)	Water pumping station operated by the City of Corpus Christi located in the growing suburbs of the south side of the City.	27.70	97.39	Active since Sept. 1997
<u>Aransas Pass</u> (CAMS 659)	Wastewater treatment plant operated by City of Aransas Pass and in cooperation with the San Patricio Water District. A coastal location to the NE of Corpus Christi.	27.89	97.14	Active since Aug. 1, 2003
<u>Violet</u> (CAMS 664)	Pumping station located west of Corpus Christi. Rural location surrounded by open field for several miles.	27.76	97.62	Active since Aug. 28, 2003
<u>San Patricio</u>	Pumping station located in between Portland and Aransas Pass off Hwy 361. In between Sherwin Alumina plant and a DuPont/Oxychem PVC production facility.	27.91	97.30	Pending
<u>Taft</u>	Pumping station operated by San Patricio Water District. North of Corpus Christi.	27.93	97.36	Pending
<u>Odem</u>	Pumping station operated by San Patricio Water District. Rural location NW of Corpus Christi.	27.92	97.57	Pending
<u>Corpus Christi Science & History Museum</u>	Corpus Christi Science & History Museum maintained by Texas A&M University-Kingsville located at 1900 N Chaparral St, Corpus Christi.	27.81	97.39	Pending

B. Objectives and Tasks:

The primary objectives of the proposed Rider 8 funded air quality monitoring initiative and the tasks associated with each objective are listed below –

Objective A: To monitor ozone and meteorological parameters within the urban airshed in order to evaluate ambient air quality levels; assess attainment status of the ozone NAAQS; evaluate the spatio-temporal distribution and characteristics during high ozone days; and to develop robust ground-level monitoring datasets required for photochemical modeling and ozone mapping activities.

- TASK 1: Operation and maintenance of monitoring sites CAMS 660 (urban site), CAMS 664 (downwind site) and CAMS 659 (upwind site). The data will be provided online using the TCEQ LEADS system.
- TASK 2: Setup, operation and maintenance of three additional monitoring sites at Water pumping stations rural San Patricio County, and near the towns of Odem and Taft. The monitoring equipment will be purchased using SEP funding. Each site will be retrofitted with TCEQ firmware dataloggers and wireless modems for data acquisition and dissemination purposes. The data will be posted on the TCEQ website and will be made available to the policy makers, stakeholders and others.
- TASK 3: 10m meteorological towers will be setup at CAMS 660 and at the San Patricio site for obtaining better meteorological data needed for modeling.
- TASK 4: Air quality monitoring site exhibit measuring ozone and meteorological parameters will be setup and operated at the Corpus Christi Museum of Science and History to provide data for the rapidly developing downtown area. 42'' flat panels will be acquired for the display of general information about air quality, ozone and current ozone levels as part of a public education and outreach campaign.
- TASK 5: Quality assurance and quality check of data and validation of the data.

Objective B: To monitor-ozone precursors including the oxides of nitrogen (NO_x) and volatile organic compounds (VOC) at selected sites during the ozone season (April-October) in order to evaluate the ambient air levels of ozone precursors during high ozone days and provide better temporally-resolved data needed for photochemical modeling

- TASK 1: Monitor ground-level concentrations of NO_x during the ozone season (April through October) at CAMS 660 (urban site).
- TASK 2: Nitrogen oxides (NO_x) will also be monitored at the San Patricio County site during the ozone season. Equipment needed for this was acquired through a SEP funding.
- TASK 3: Canister based sampling of volatile organic compounds (VOC) on a periodic schedule will be conducted during the ozone season at CAMS 664. The samples will be analyzed for ozone precursor hydrocarbons using Gas Chromatograph/Mass Spectrometer (GC/MS) at the South Texas ambient hydrocarbon research laboratory of TAMUK.

Objective C: To assess roadway vehicle emissions hot spots within the urban airshed in order to better characterize mobile source emissions during the ozone season and develop more accurate datasets required for photochemical modeling.

- TASK 1: Identify and select sites to characterize roadway emissions from on-road vehicles.
- TASK 2: Design and develop a methodology and operational procedure to measure on-road vehicle emissions.
- TASK 3: Measure volatile organic compounds and nitrogen oxides as precursor reagents for the photochemical formation of ozone on selected days during the ozone season. Assessment of volatile organic compounds and nitrogen oxides will occur during times of minimum traffic and during rush hours and at several locations to collect quality data and obtain statistically reliable estimates of mean emissions.
- TASK 4: Assess traffic flow and vehicle count during field campaign at high emission sites

C. Deliverables:

1. A Quality Assurance Project Plan (QAPP) document consistent with the current TCEQ monitoring operations protocol relevant for research-grade air quality monitoring activity will be developed and submitted to TCEQ for approval by December 2006.
2. Air quality monitors will be calibrated periodically as per the approved QAPP.
3. Air quality data and meteorological parameters, monitored at the existing three TAMUK operated sites as well as from the additional new sites in San Patricio county and the Corpus Christi Museum will be collected remotely via modem transfer for on-line connectivity to the TCEQ's MeteoStar datalogging system.
4. Monthly reports summarizing list of participants, accomplishments, problems and emerging issues for future consideration will be provided.
5. Data for the ozone precursors like oxides of nitrogen and volatile organic compounds, will be provided in an electronic format to TCEQ following the ozone season as indicated in the reporting schedule listed below.
6. An electronic database of all monitored and measured parameters will be provided to TCEQ along with the final report.
7. Summary reports of the 2006 and 2007 ozone seasons will be provided as indicated in the reporting schedules listed below.

- D. Guidance Documents:** EPA/QA R-5 - Quality Assurance Project Plans (QAPP); 40 CFR 50 and 58 for ambient air monitoring; written amendments, and other documents amending, modifying or supplementing the Contract Documents pursuant to the General Conditions.
- E. Previous Work:** See deliverables submitted under Rider 13 (2002-2003) and Rider 8 (2004 – 2005) for further details.
- F. Due Dates and Reporting Schedule:**
1. Monthly reports highlighting air monitoring activities in the Corpus Christi urban airshed will be provided by the 4th of each month.
 2. The QAPP document for the monitoring operations will be submitted by December 15, 2006 for TCEQ review and approval.
 3. The ozone season air quality monitoring report for 2006 and 2007 will be due January 31, 2007 and January 31, 2008, respectively.
 4. Ozone precursor data, in an electronic format, will be submitted on January 31, 2007 and January 31, 2008 along with the ozone season air quality monitoring report.
 5. A final report for the Rider 8 activities and deliverables will be provided by August 31, 2008.

Task II. Emissions Inventory Activity

Through prior Rider appropriations, a very comprehensive emissions inventory (EI) has been developed for the two-county area of the Corpus Christi urban airshed. The last set of EI enhancements was undertaken by ACES, LLC under a subcontract to TAMUK through the Rider 13 (2002-2003) funded research activities. The EI for the base year of 1999 was submitted to and approved by TCEQ. This recent revision of the EI focused on enhancements in several key areas and non-road source categories including oil & gas exploration and production, marine vessels, lawn & garden, construction, etc. The EI developed by ACES, LLC was further refined by researchers at TAMUK during the Rider 8 (2004-2005) funded activities and several key emission categories with large uncertainties were identified for future enhancements.

Through the new Rider 8 funding, it is proposed that further refinement in the Corpus Christi ozone near nonattainment area EI be undertaken as listed below. This will allow for the use of scientifically sound data used as inputs to the photochemical models. This in turn will assist local and regional air quality planners in identifying cost-effective control strategies to maintain the area's attainment status.

A. Responsible Party: Department of Environmental and Civil Engineering
Texas A&M University-Kingsville

Personnel Assignment: Drs. Kuruvilla John and Jhumoor Biswas will supervise the activities listed in this task to be performed by a subcontractor.

Funding Allocation: \$ 100,000

B. Objective: To develop a comprehensive ozone precursor emissions inventory for the Corpus Christi urban airshed in order to assist with air quality planning and research activities required to keep the urban area in attainment.

TASK 1: Develop an Inventory Preparation Plan document (IPP) for the Emissions Inventories that will be submitted to TCEQ for comment and approval. TCEQ's EI staff will be consulted regarding EPA guidance for the IPP preparation.

TASK 2: Enhance the 2002 emissions inventory for several uncertain categories of emission sources that needed further investigation as per the Rider 13 and the Rider 8 EI reports. These categories include minor point sources and small stationary sources, compressors from oil and gas facilities, fugitive emissions from pipelines, and offshore oil & gas platforms. In addition, non-road source emissions from commercial and military aircrafts, ships, barges and marine vessels, locomotives and switch engines, railroad tank cars, other military sources, commercial and industrial engines, agricultural equipments, construction equipments and water-based pleasure craft engines will be refined.

TASK 3: Develop a refined 2002 emissions inventory for the Corpus Christi urban airshed. Activity data representing 2002 will be collected where available in order to develop an accurate 2002 inventory. Appropriate growth factors will be used to grow from the 1999 EI, in consultation with TCEQ for all other categories missing activity data for 2002.

TASK 4: Develop a comprehensive 2005 annual EI for the Corpus Christi urban airshed for all area and non-road source categories.

TASK 5: Refine ozone day specific emissions for the high ozone episode days in September 2002 based on a survey of the major facilities in the urban airshed for ozone precursor emissions including highly reactive hydrocarbon emissions. Develop a model-ready hourly point source inventory of ozone precursors that reflects true temporal fluctuations in the actual emissions and validate this using CEMS data, upset statistics, and results from an activity-based survey of the Port Industries of Corpus Christi.

TASK 6: All emissions data will be submitted in the EPA NIF, version 2.0, format for input into the National Emissions Inventory.

C. Deliverables: A comprehensive assessment of the ozone precursor emissions in the Corpus Christi urban airshed will be provided in an EI report to TCEQ. This report will contain an enhancement to the 2002 Emissions Inventory for the Corpus Christi airshed emissions categories listed above. The EI effort will also develop ozone episode specific model-ready emission inputs spatially allocated for use in photochemical modeling of the 2002 ozone episode. The report and the data will be electronically provided as per the schedule listed below.

D. Guidance Documents: Emissions Inventory Guidance for Implementation of Ozone and Particulate Matter National Ambient Air Quality Standards (NAAQS) and Regional Haze Regulations (EPA-454/R-99-006); EIIP and NEI input Guidance documents; written amendments, and other documents amending, modifying or supplementing the Contract Documents pursuant to the General Conditions.

E. Previous Work: See reports submitted under Rider 13 (2002-2003) and Rider 8 (2004-2005) for further details.

F. Due Dates:

1. Monthly activity reports that address emissions inventory development will be provided by the 4th of each month.
2. Draft EI report will be submitted by December 15, 2007.

3. Final EI report will be submitted by August 31, 2008.

Task III. Air Quality Modeling

- A. Responsible Party:** Texas A&M University-Kingsville
- Personnel Assignment:** Drs. Kuruvilla John and Jhumoor Biswas will supervise the activities listed in this task to be performed by a research scientist and a graduate engineering student.
- Funding Allocation:** \$ 69,000

B. Objectives and Tasks:

Objective A: To develop new seasonal and episodic modeling simulations for a new base year of 2002 in order to provide an additional modeling episode that will be used for developing robust control strategies for attainment demonstration purposes.

TASK 1: Develop and conduct seasonal modeling simulations (meteorological, emissions and photochemical) for the summer of 2002 over the months of April- September using meteorological model MM5, emissions processor EPS and photochemical model CAMx as the modeling framework. One of the primary objectives of choosing this time period is to make an in-depth evaluation of the bimodal distribution of ozone occurring between April – June and between August- October which may arise as a consequence of the meteorological conditions or transport phenomenon in this region. The time period will include the high ozone episode of September 2002. The new modeling domain will in addition have a fine grid resolution of 2km focusing on the Corpus Christi area. The modeling simulations will comprise of refined meteorological inputs and updated emissions inventory for the region of Corpus Christi. A seasonal modeling system of this type can supplement information on ozone control strategies which have been devised on the basis of episode-specific simulations. The finer grid resolution may enable to capture the “hot spots” in the Corpus Christi region.

TASK 2: Evaluate the photochemical modeling system on a seasonal and episodic basis for the year 2002 using observations of ozone and its precursors depending on their availability in the modeling domain. The seasonal modeling simulations help to reduce the uncertainty in predicted ozone values associated with individual ozone episodes.

TASK 3: Inter-compare the physical attributes and chemical characteristics leading to the elevated ozone concentrations during the two episodic periods of

September 1999 and 2002. This would enable to further clarify the origin of ozone precursors (source-receptor) during an ozone episode in this area and assess the effect of local emissions versus long-distance transport on ozone concentrations during the build up of an ozone episode in the Corpus Christi region.

TASK 4: Elucidate the sensitivity of peak 1-hr and 8-hr ozone concentrations to the meteorological conditions arising from the two ozone episodes by executing additional model simulations for the 2002 ozone episode using the emissions, boundary conditions and initial conditions from base year 1999.

TASK 5: Assess the impact of different meteorological regimes and appraise the effect of seasonal versus episodic model runs on the potential control strategies to be implemented in the region. This kind of evaluation will facilitate in development of robust emission reduction strategies for the Corpus Christi region.

Objective B: To evaluate modeled coastal meteorology in order to develop enhanced meteorological inputs required for photochemical modeling activities.

TASK 1: Use observational based nudging in MM5 in the Corpus Christi region. In addition to the TCOON data which was used for the earlier 1999 model runs along the coastal region, the meteorological model will be nudged towards sea surface temperatures obtained from satellite network and other meteorological variables acquired from vertical profilers installed in the Corpus Christi area to capture upper atmospheric processes in the meteorological model. These are crucial components of the ocean-atmospheric system that drive convection over the open sea and induce sea-breeze circulation close to land.

TASK 2: Conduct meteorological simulations for the high ozone episode of September 2002 with another meteorological model such as RAMS/WRF and usage of a finer grid resolution (1.3) km for characterization of coastal meteorological regime in both the meteorological models.

TASK 3: Evaluate and inter-compare the two meteorological modeling simulations with respect to observations and with regard to each other for the year 2002 to compute the uncertainty in the meteorological model predictions in the coastal region.

TASK 4: Analyze seasonal and multiple episodic meteorological model simulations of base years 1999 and 2002 in order to develop a better understanding of the chemical and physical dynamics of coastal sea breeze and help identify the basic limitations in the meteorological models which prevent the

model from capturing the physical characteristics of the meteorological processes in the coastal region.

Objective C: To perform seasonal and episodic emission sensitivity runs to test the impact of various potential emission control strategies in the Corpus Christi region.

- TASK 1: Evaluate the effects of urban sprawl and transportation trends on ozone concentrations in the Corpus Christi region.
- TASK 2: Test the impact of major new point sources in the Corpus Christi region on the ozone levels.
- TASK 3: Investigate the consequence of the potential transport of ozone from source region outside of the Corpus region.
- TASK 4: Analyze the outcome of emissions from non-road mobile sources such as construction equipment and lawn mowers on ozone concentrations.
- TASK 5: Evaluate the impact of marine, aircraft and locomotive emissions in the Corpus Christi region.
- TASK 6: Test the influence of variable control strategies incorporating reductions in one or more of the source categories.

Objective D: To assist the City of Corpus Christi with its new regional O3Flex Agreement by performing different modeling tasks to evaluate the efficacy of various voluntary emission control strategies identified in the approved plan.

- TASK 1: Assess the impact of voluntary emission reductions from different source categories using modeling simulations.

C. Deliverables:

- 1. Interim Report on Base Case Modeling Analysis
- 2. Final Report detailing Photochemical Modeling for the Corpus Christi NNA

D. Guidance Documents: Draft Guidance on the Use of Models and Other Analyses in Attainment Demonstrations for the 8-hour Ozone NAAQS (EPA-454/R-99-006, May 1999), documentation on the CAMx model; and all other inventory or modeling guidance, Written Amendments, and other documents amending, modifying or supplementing the Contract Documents pursuant to the General Conditions.

E. Previous Work: See reports submitted under Rider 13 (2002-2003) and Rider 8 (2004-2005) for further details.

F. Due Dates:

1. Monthly activity reports that address photochemical modeling activities will be provided by the 4th of each month.
2. Interim modeling report will be submitted by January 31, 2008.
3. Final report will be submitted by August 31, 2008.