QUAD CITIES VOLUNTARY OZONE FLEX PLAN
AND
MEMORANDUM OF AGREEMENT

March 2003

This report was prepared in cooperation with the U.S. Environmental Protection Agency, U.S. Department of Transportation, Illinois Environmental Protection Agency, Iowa Department of Natural Resources, Illinois Department of Transportation, Iowa Department of Transportation, Davenport-Rock Island-Moline Urbanized Area Transportation Policy Committee and its subcommittee, the Quad Cities Air Quality Task Force. The contents of this document reflect the views of the author who is responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the resource agencies represented above. This document does not constitute a standard, specification or regulation.

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THE QUAD CITIES MEMORANDUM OF AGREEMENT FOR A VOLUNTARY OZONE REDUCTION PROGRAM

Whereas, the Quad Cities Air Quality Task Force, representing both government and business stakeholders within Rock Island and Scott Counties and established as a subcommittee of the urban Transportation Policy Committee, comprising the Quad Cities Metropolitan Area, Iowa/Illinois have prepared and participated in the development of a Quad Cities Voluntary Ozone Flex Plan;

Whereas, these same stakeholders have reviewed the contents and support its goals set forth for efforts to voluntarily reduce emissions that lead to the formation of ground-level ozone and raise public awareness of the issue;

Whereas, the Quad Cities Voluntary Ozone Flex Plan as part of this Memorandum of Agreement outlines a multi-year implementation strategy and milestones for voluntary ozone education and reduction activities as set forth in the Plan; and

Whereas, public participation has been encouraged throughout this planning process and opportunity to formally comment was provided at a regional public hearing held on February 25, 2003.

Whereas, this Memorandum of Agreement will be in effect for five years from the date of signing. It may be amended with the consent of the signatories and may be terminated by mutual consent of the signing parties. If the agreements contained herein are not being carried out, the termination of this Agreement may occur sixty days after initiation of a dispute resolution process by the agency heads or their designees. For the period of time during which this agreement is in effect, whenever enforceable control measures are implemented in accordance with this agreement, an adequate opportunity will be provided to evaluate the effectiveness of the enforceable measures in maintaining the one-hour National Ambient Air Quality Standard for ozone, prior to initiating a change in the attainment status of the Quad Cities Metropolitan Area. The parties agree to consult on the appropriate time periods and methods for evaluating effectiveness of enforceable measures.

Therefore Be It Resolved that the Quad Cities: Davenport-Rock Island-Moline, Iowa/Illinois Transportation Policy Committee, supports the Memorandum of Agreement for Quad Cities Voluntary Ozone Reduction Program and the bi-state regional goals of voluntary emission reduction and education as contained in the said Plan.

	February 25, 2002
_____________________________ Ann Hutchinson, Chair Transportation Policy Committee	_____________________________ Date
_____________________________ Iowa Department of Natural Resources	_____________________________ Date
_____________________________ Illinois Environmental Protection Agency	_____________________________ Date
_____________________________ U.S. Environmental Protection Agency	_____________________________ Date

QUAD CITIES VOLUNTARY OZONE FLEX PLAN

PURPOSE

In June 2001, the U.S. Environmental Protection Agency (USEPA) issued guidelines for a one-time only program opportunity called the Ozone Flex Program. The purpose of the ozone flex program was to support and reward innovative, voluntary, local strategies to reduce ground-level ozone. The Ozone Flex Program is a voluntary local approach to maintaining good air quality with controls tailored to local conditions for areas currently monitoring attainment for the 1-hour standard but may be close to violating the 8-hour standard. Communities pursuing the ozone flex program had to submit a letter of intent by December 2001 notifying the USEPA of their intent to develop and sign an interagency agreement with USEPA. In December 2001, a letter of intent was submitted to USEPA by the Quad City Transportation Policy Committee. This document represents the interagency agreement, proposed by the Policy Committee to implement voluntary measures related to ozone level reductions.

The Quad Cities Metropolitan Area offers a variety of opportunities for quality housing, employment, schools and recreation. Air quality is an important part of the quality of life of this community. Local officials and businesses are committed to maintaining the Area's good air quality standing. As part of the Memorandum of Agreement, the Quad Cities Voluntary Ozone Flex Plan is intended to outline voluntary strategies and educational efforts that contribute to the reduction in emissions leading to the formation of ground-level ozone.

The purpose of the Quad Cities Ozone Flex Plan is:

- To determine voluntary strategies that have and will be taken by a variety of organizations to reduce precursor ozone emissions;
- To continue public education and awareness of the issues related to air pollution; and
- To project or estimate the cumulative effect of reductions on the emissions that contributes to the formation of ground-level ozone.

By participating in the U.S. Environmental Protection Agency Ozone Flex Program and to the extent that the voluntary measures are implemented, and reductions from the measures can be quantified, the Quad Cities may receive credit toward future planning efforts for the ozone National Ambient Air Quality Standard (NAAQS). By proactively addressing potentially harmful emissions that lead to increases in the area's ozone levels, the Quad Cities stakeholders hope to maintain the 1-hour ozone standard and avoid designation for nonattainment for the 8-hour standard through actions taken in this Plan. If this is unavoidable, then the Plan will be in place to enable the Area to work with regulators on necessary control measures using a flexible approach.

This plan is being submitted to the USEPA for signature. The plan was prepared under the direction of the Quad Cities Air Quality Task Force and approved by the Transportation Policy Committee.

AREA PROFILE

The Quad Cities Metropolitan Area is located along the Mississippi River in eastern Iowa and western Illinois. For planning purposes, the Ozone Flex Plan will focus on both Scott and Rock Island Counties. Map 1 illustrates the location of the planning area. The population of these two counties amounts to 308,042. The following outlines demographic information by county from the 2000 Census.

Figure 1
Demographic information on Planning Area

	Rock Island County	Scott County	Total
Population	149,374	158,668	308,042
Total Households	60,712	62,334	123,046
Total Housing Units	64,489	65,649	130,138
Labor Force	76,299	83,927	--
Median Income (by household)	38,608	42,701	--
Vehicles Available (1 or more)	55,493	57,711	113,204

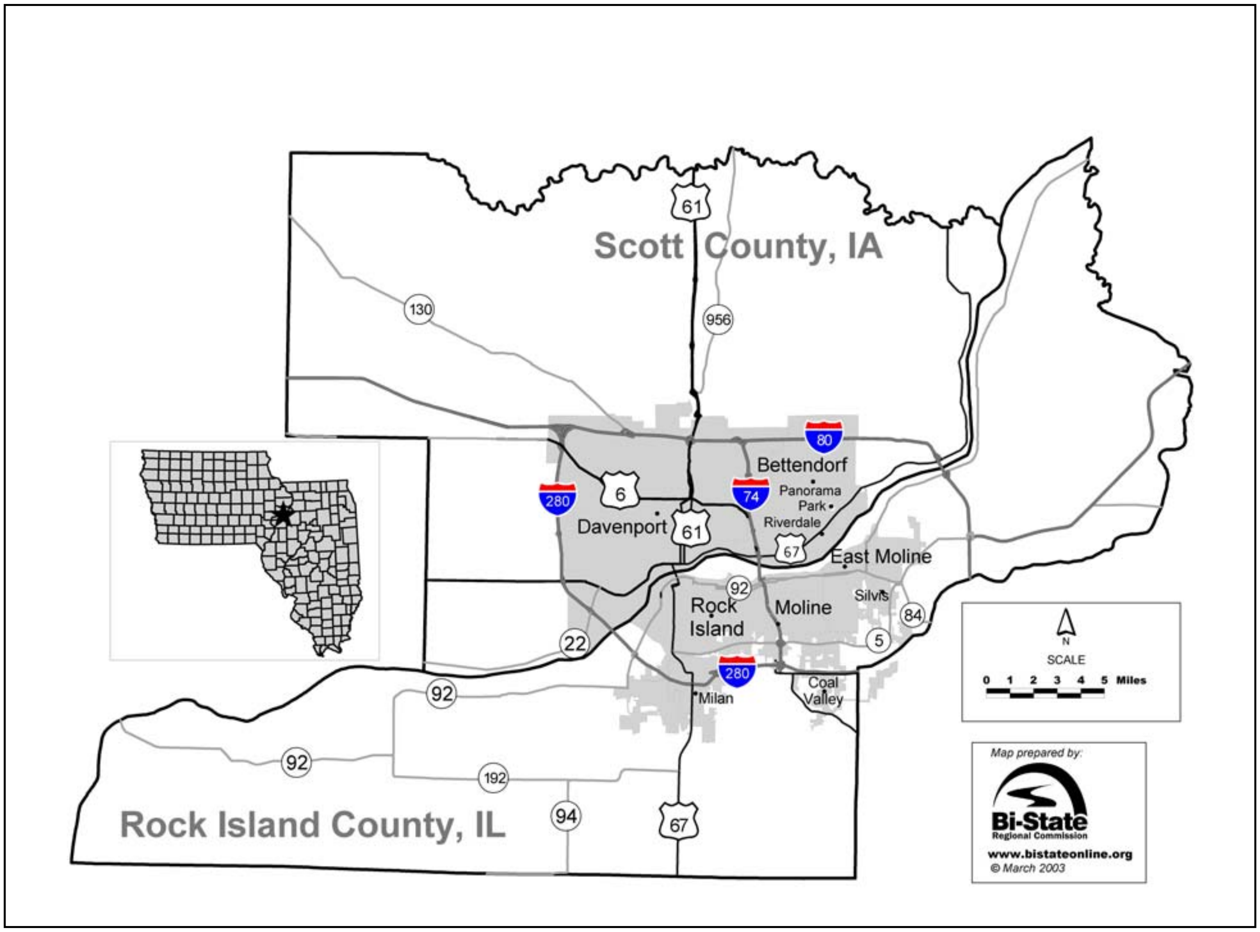
Transportation and commerce play an important role in air quality. Emissions from mobile transportation sources and industry contribute to the formation of ground-level ozone. The Quad Cities Metropolitan Area is served by four interstate highways, five United States primary highways, and an excellent secondary highway system. There are over 100 motor freight carriers in the Quad Cities, 61 truck terminals and 18 ground couriers. Three mass transit systems and one regional transit system serve the Quad Cities. In addition to highways, the metropolitan area is served by a commercial airport, general aviation airport, railroad network providing freight service and over 30 barge terminals serving water navigation needs.

In the Metropolitan Statistical Area, the largest employment sector is services, representing 31% of the employment. Trade represents 29% and manufacturing represents 18%. The largest employers in the Quad Cities include Deere & Co., Rock Island Arsenal, Genesis Medical Center, Davenport Community Schools, ALCOA, Trinity Regional Health System, IBP Inc., Kraft Foods North America Inc. and MidAmerican Energy Company. Each company employs more than 1,000 workers, based on October 2002 figures.

The Quad City Metropolitan Area, Iowa/Illinois is uniquely positioned in two states and bisected by a major river. With relatively equal populations in both Scott and Rock Island Counties as well as major employers in each of these counties, commuting patterns illustrate the area functions as a unit. Of workers 16 years of age and over, 20% worked outside of their state of residence illustrating the significant amount of commuting between the two states. river crossings are a vital transportation link for the movement of goods and people. Efforts are underway to reduce congestion and improve traffic flow along the central river corridors. These efforts will contribute to improved air quality over time.

Map 1

Planning Area
Quad Cities Metropolitan Area and Vicinity



BACKGROUND ON AIR QUALITY

Introduction. The bi-state area is currently in attainment for all national ambient air quality standards. The area experiences from one to three multi-day episodes per year of unhealthy ground-level ozone concentrations. Ozone is a ground-level pollutant that is generally formed from a photochemical reaction between nitrogen oxides (NOx) and volatile organic compounds (VOC). High levels of ozone can affect healthy people but are especially harmful to children, the elderly and those already suffering from respiratory diseases like asthma.

In 1997, the U.S. Environmental Protection Agency (USEPA) modified the ozone ambient air quality standards from a 1-hour to an 8-hour average. At the present, the 1-hour ozone standard remains in effect. USEPA anticipates making designations for the 8-hour standard in April 2004. Since fall 1998, the Quad Cities' officials have been alerted by the Iowa Department of Natural Resources (IADNR) and Illinois Environmental Protection Agency (IEPA) that the metropolitan area has experienced a few summer days where ozone levels in the atmosphere have been considered unhealthy. Although the general air quality in the Quad Cities is considered good by the existing ambient air quality standards, there was concern that increases in ozone levels may make it difficult for the bi-state area to meet the proposed 8-hour ozone standard. It is this health-based threshold that concerns Quad Cities officials and the state agencies.

Monitors. There are two ozone monitors in Scott County and one in Rock Island County. The two Scott County monitors are located at Argo and Scott County Park, often referred to as the Davenport monitor. Both monitors are north of the metropolitan area outside the urbanized area. The monitor in Rock Island County is located on Arsenal Island near Moline. Refer to Map 2 for the monitor locations within the planning area.

Attainment Status. The proposed 8-hour ambient air quality standard for ozone is 85 parts per billion (ppb). The concentration for a local area that compares itself to the ozone standard threshold is called the design value. This design value is derived on a monitor-by-monitor basis by calculating the three-year average of the fourth highest daily monitored 8-hour ozone concentration of the year. The highest design value for all Quad Cities monitors is located at the Scott County Park site. For the most recent 3-year span (2000-2002), the design value is 79 ppb. The design value (the monitored number compared to the standard) at this site is the closest value to the proposed 8-hour ozone standard or 93% of the NAAQS for ozone. The design value for the previous 3-year span (1999-2001) was also 79 ppb at the Scott County Park monitor. Refer to Figure 2 for historical trends of the Quad Cities ozone design value between 1989 and 2002.

Since 1999, there have been five or less exceedances of the 8-hour ozone standard in the planning area. In 1999, there were five followed by four in 2002. In looking at the upwind sites in Scott County (Argo and Scott County Park), the data indicates the highest average 8-hour ozone values appear in June at the Argo and Scott County Park monitoring sites. The exception occurred in 1999 in the month of October when the average 8-hour ozone reading exceeded 60 ppb. Refer to Figures 3 and 4 for this monitoring data.

Refer to the appendices for emission inventories of Scott and Rock Island Counties.

Map 2

Location Of Ambient Air Quality Monitors

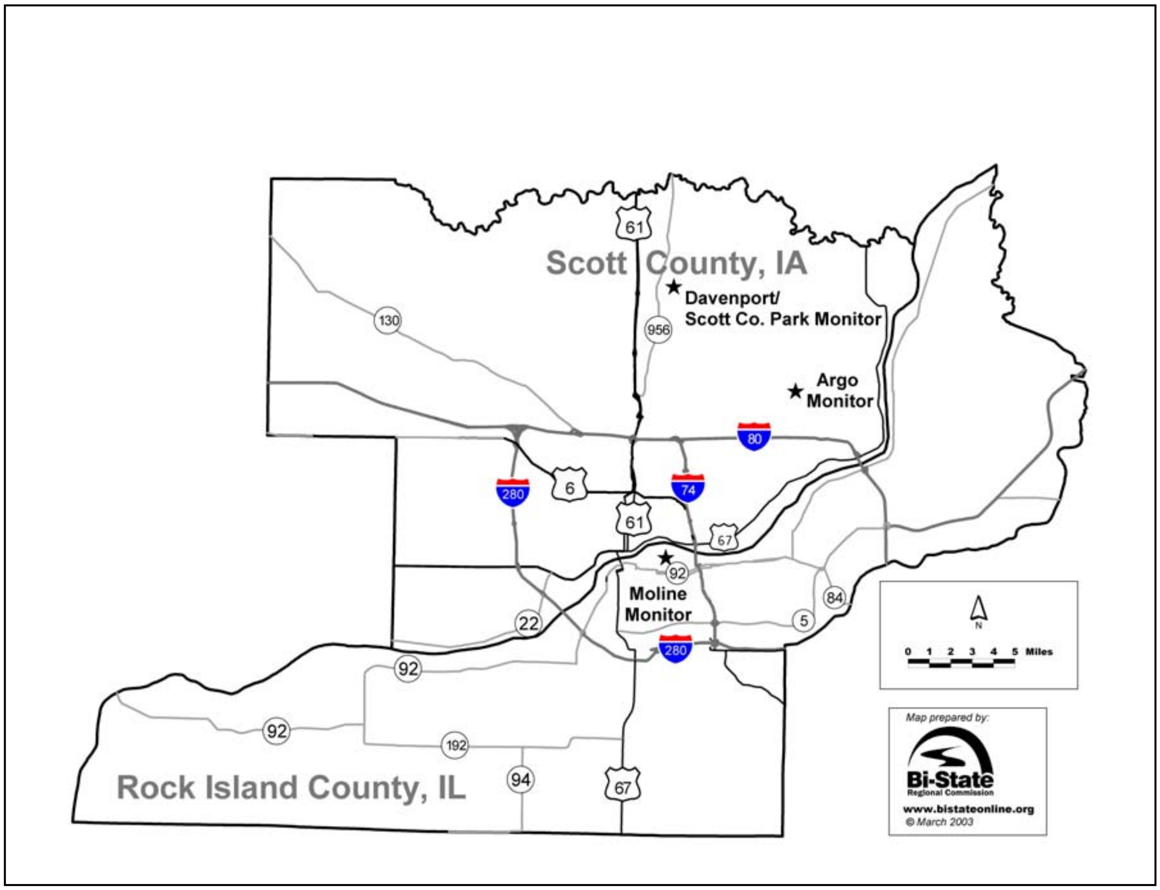


Figure 2

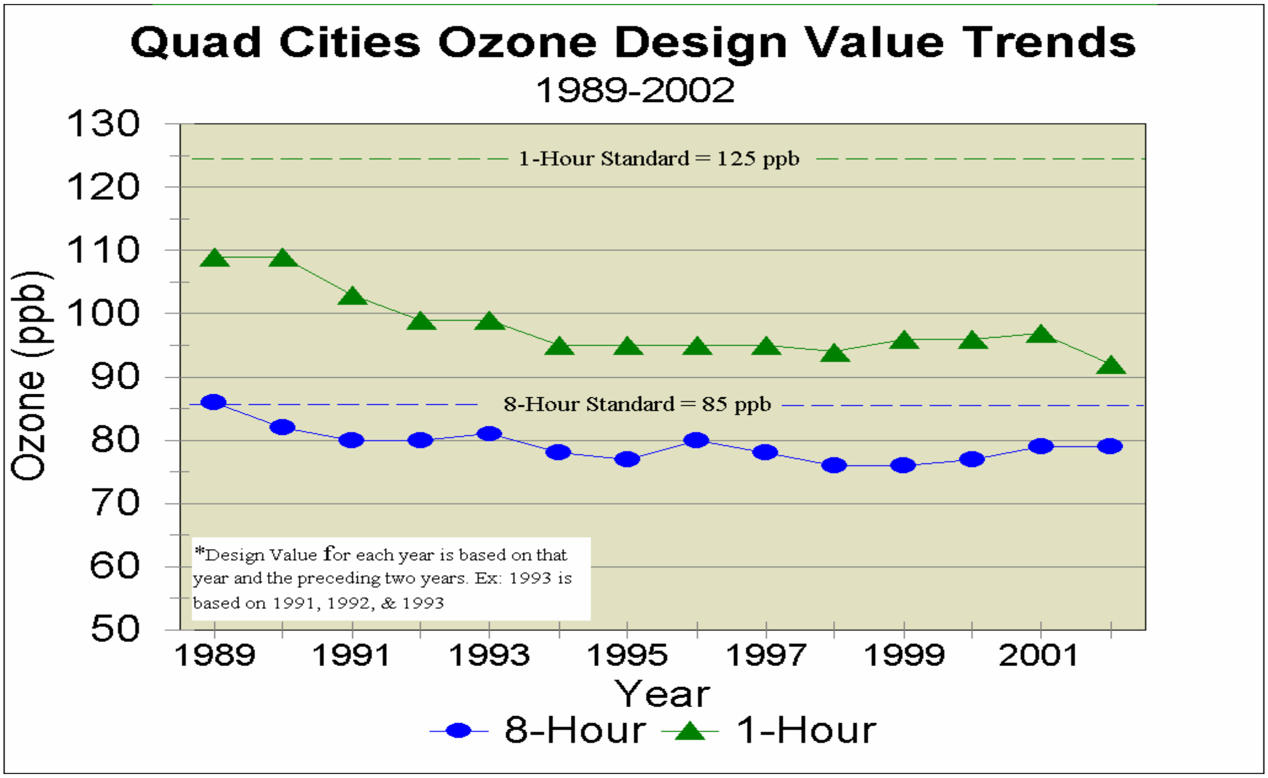

Quad Cities Ozone Design Value Trends
1989-2002
1-Hour Standard = 125 ppb
8-Hour Standard = 85 ppb
*Design Value for each year is based on that year and the preceding two years. Ex: 1993 is based on 1991, 1992, & 1993
Ozone (ppb)
130
120
110
100
90
80
70
60
50
1989
1991
1993
1995
1997
1999
2001
Year
8-Hour
1-Hour

Figure 3

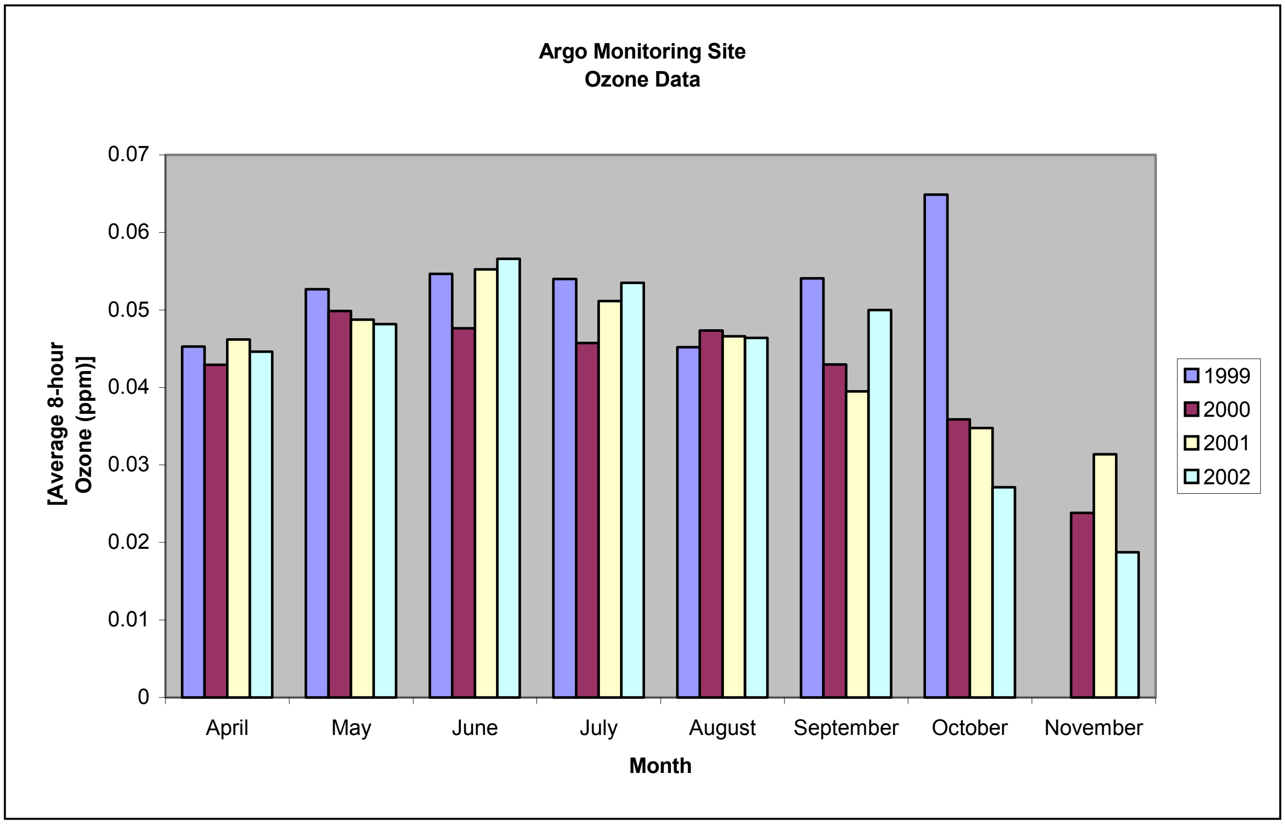
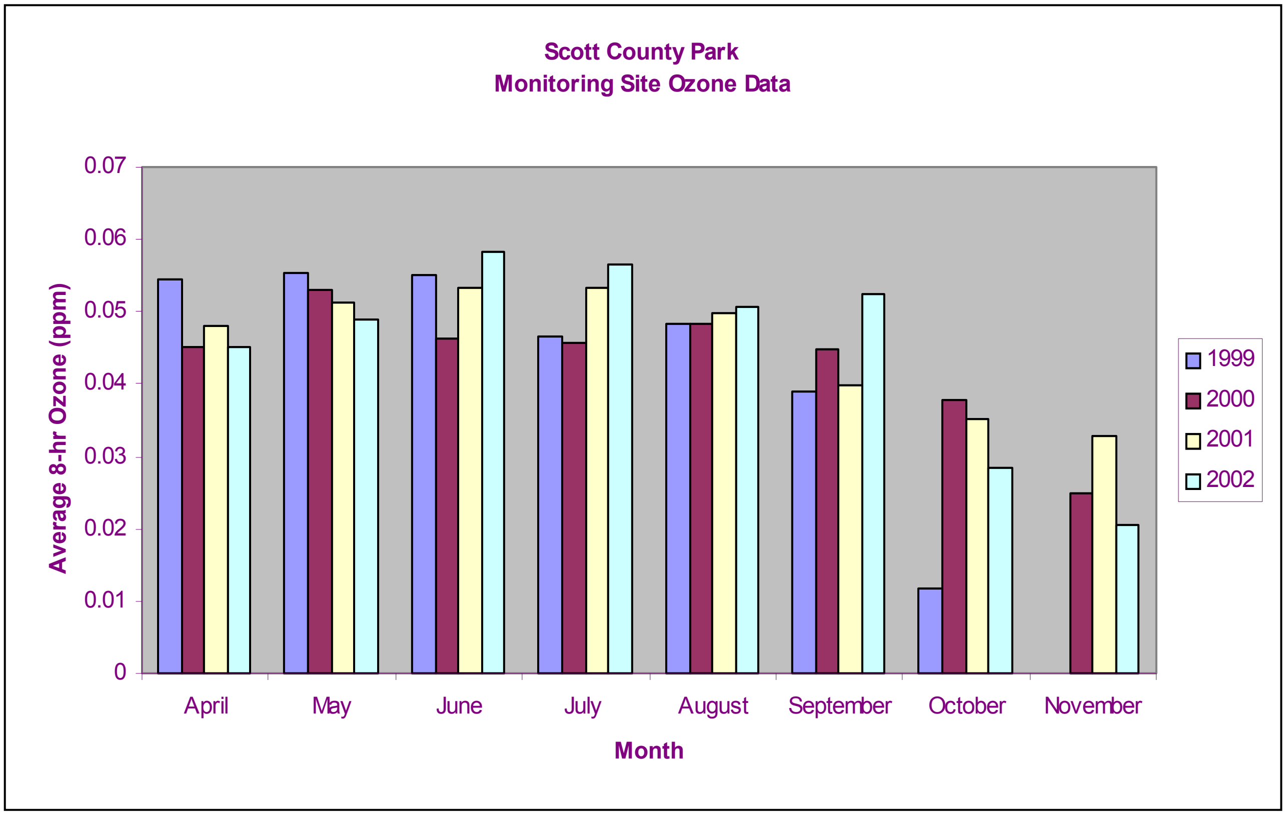

Argo Monitoring Site
Ozone Data
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
[Average 8-hour Ozone (ppm)]
April
May
June
July
August
September
October
November
Month
1999
2000
2001
2002

Figure 4



Scott County Park
Monitoring Site Ozone Data
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
Average 8-hr Ozone (ppm)
April
May
June
July
August
September
October
November
Month
1999
2000
2001
2002

BACKGROUND ON STAKEHOLDERS

Formation. In Fall 1998, the Quad Cities Air Quality Task Force, as a subcommittee of the Transportation Policy Committee, was formed to monitor the ozone situation and to begin education efforts within the community in order improve Quad Cities' air quality. The Task Force is composed of the following stakeholders based on geographic representation from Rock Island, Illinois and Scott County, Iowa:

- Local City Engineers/Public Works Officials/Transit Managers
- County Health Departments
- Chambers of Commerce Representatives
- Quad City Development Group Staff
- Representatives of Major Industries
- State Agencies' Staff – IADNR, IEPA, DOTs, IDED, DCCA
- Interstate Resource Conservation and Development Council Staff
- Quad City Conservation Alliance Representative
- Education and Medical Representatives
- Interested Citizens

Bi-State Regional Commission as the Metropolitan Planning Organization serves as staff to the Transportation Policy Committee and the Quad Cities Air Quality Task Force. Bi-State staff has served in coordinating regular Task Force meetings, procuring grants to conduct public education on air quality issues, monitoring the status of ozone exceedances and coordinating with State and Federal resource agencies to further the mission of the Task Force.

Mission. With the establishment of the Task Force, a mission was developed. It includes the following:

- To maintain attainment status for ground level ozone through voluntary measures;
- To provide for communication between public and private entities on voluntary measures by sharing experiences and knowledge; and
- To support individual and group voluntary measures/activities such as public education, and mobile/stationary source reduction initiatives.

Activities. Since the inception of the Task Force, a variety of voluntary education and emission reduction efforts have occurred. Those directly related to the Task Force include:

- Quad Cities Air Quality Task Force Meetings – On-Going
- Voluntary Ozone Council Teleconferencing by USEPA, Region 7 – On-Going
- Community Presentations & Media Releases on Air Quality Issues – On-Going
- "Aware of Air" Brochure – 255,000 printed (Newspaper Insertion & Area School Distribution)
- Alternatives Fuels Workshop Fall '99
- Consumer Awareness Survey – Spring/Fall '99
- National Conference on Ozone Action Programs – December '99

- Travel Demand Management Information for Major Employers – May ‘00
- Teacher Training Workshop – Fall ‘00
- “Aware of Air” website pages: http://www.bistateonline.org – Fall ‘00
- Midwest Transportation Planning Conference (Air Quality Session) – May ‘01
- Transportation Policy Committee, IEPA Green Fleets Program – June ‘01
- “It all adds up to cleaner air.” Newspaper Ad Campaign – July/August ‘01
- Regional Clean Cities Coordinators Meeting – October ‘01
- Letter of Intent for USEPA Ozone Flex Program – December ‘01
- Quad Cities Ozone Flex Planning Survey – March ‘02
- Eastern Iowa Tire Initiative Partnership – May ‘02
- Iowa Clean Air Attainment Program (ICAAP) Grant – August ’02 - June ‘03
- “It all adds up to cleaner air” Newspaper Insert – August ‘02
- U.S.EPA 105 Grant – Public Education for Voluntary Reduction Measures – February ‘03

Other efforts related to voluntary reduction activities and education:

- Annual Quad Cities Road and Bridge Construction Notice – On-Going
- Ozone Planning Conference – June ‘00
- ILDOT/MPO Conference (Air Quality Session), Quad Cities – October ‘00
- IADNR Smoking Tailpipe Program – Bald Eagle Days Promotions Distribution – January ‘02
- Compressed Natural Gas Buses & Fueling Station, MetroLINK/Moline – August ‘02
- Biodiesel Fuel Testing, Bettendorf Transit – Summer ‘02
- Bus Emission Education Program (BEEP), Iowa – Fall ‘02

ACTION PLAN

In accordance with the guidelines provided by the U.S. Environmental Protection Agency, the action plan is suggested to describe specific air quality planning and discretionary control measures that stakeholders commit to undertake. Without any strategies being implemented, it appears that the Quad Cities Area would remain below the current 1-hour ozone standard; however, in adherence with the Ozone Flex Guidelines (June 2001), the Action Plan will include contingency measures in the unlikely event that the 1-hour ozone standard is exceeded. The Action Plan also addresses the proposed 8-hour standard and outlines voluntary measures that may result in the reduction of ozone precursors.

Modeling Results Summary. Three separate time periods during the summer of 1999 experienced elevated levels of ozone. Each event was analyzed to determine which pollutants and which emission sources led to the elevated ozone levels. Knowing the cause of high ozone levels can enable the bi-state area to address those sources specifically and assist policymakers in the development of an action plan. Through use of sophisticated tools, such as photochemical models, simulation of the creation, movement and dispersion of atmospheric ozone can be recreated for historical ozone events using exact emissions, weather and chemistry that existing on those days.

Computer modeling was conducted by the Iowa Department of Natural Resources. The model was first calibrated using the information from each of the three time periods when elevated ozone levels were experienced. By adequately recreating the physical and chemical atmospheric conditions that existed during the three distinct historical ozone events, IADNR was able to evaluate the impact on ozone levels for possible emission control strategies.

For each time period of elevated ozone ambient levels, a series of emission reductions or "control strategies" were applied to evaluate resulting changes in ambient ozone concentrations. In order to address the atmospheric transport of ozone and ozone precursor pollutants into the Quad Cities Area wide geographic area was included in the modeling analysis. The spatial extent of this area extends from just north of Minneapolis to just south of Dallas and from extreme western Nebraska to the eastern border of Ohio. This domain allowed the Iowa Department of Natural Resources to evaluate ozone formation and transport from heavily industrialized Ohio and Tennessee River Valleys as well as important urban centers. The domain was also designed to evaluate the predominant Quad Cities ozone events associated with the southerly wind regimes.

Results from the modeling analyses indicate that ozone production in the Quad Cities Area appear to be limited by the availability of volatile organic compounds. In evaluating the sources of air pollutants in the area that lead to the high ozone ambient concentrations, modeling suggested that a substantial percentage (on the order of 85%) of the simulated ozone concentrations within the Quad Cities, is the result of pollutants transported into the region. Further modeling and future emission inventories will be evaluated to support the results of this modeling effort and to evaluate if this remains the case.

Ozone Precuror Reduction Scenarios. To determine the effect of particular control strategies that could be undertaken in the Quad Cities Area, simulated emission reductions were used to see what resulting change in ambient ozone levels could be expected. By knowing the resulting impact on ozone levels from generalized emission reductions, the selection of the most cost effective individual control recommendations could be provided to the area. Below are some different scenarios of generalized emission reductions that were evaluated as to their impact on ozone levels in the Quad Cities.

The following six control strategy options were evaluated for each ozone episode:

- **Strategy A1**: 25% reduction of Scott and Rock Island county mobile source emissions (NOx and VOC). This reduction represents an approximate 17% decrease in daily anthropogenic NOx and VOC emissions in the two county area. The reduction in NOx emissions estimated with this strategy was 6.1 tons per day. The reduction in VOC emissions estimated with this strategy was 5.8 tons per day.
- **Strategy A2**: 25% reduction of mobile source emissions (NOx only). This reduction represents an approximate 17% NOx reduction in the two county area. The reduction in NOx emissions estimated with this strategy was 6.1 tons per day.
- **Strategy A3**: 25% reduction of mobile source emissions (VOC only). This represents an approximate 17% VOC reduction in the two county area. The reduction in VOC emissions estimated with this strategy was 5.8 tons per day.

- **Strategy B**: 25% reduction of nearby major source NOx emissions. This reduction results in a 17.8 ton per day NOx reductions from downwind sources within approximately 150 miles.
- **Strategy C**: Mississippi River Stage I & II vapor recovery. The reduction assumes that stage I and II vapor recovery are implemented in the counties bordering the Mississippi River in an attempt to reduce nearby VOC emissions. The reduction in VOC emissions estimated with this strategy was 10.3 tons per day.
- **Strategy D**: NOx SIP call. This reduction scenario estimates the potential ozone reduction to be expected from a major source NOx controls required by the EPA to address violations of the 1-hour ozone standard in the eastern United States and anticipated to result in lowered ozone values in eastern United States. NOx emission reductions resulting from the NOx SIP Call modeled by the Iowa Department of Natural Resources may reduce ozone values in eastern Iowa and the Quad Cities may benefit from this reduction. The NOx SIP Call controls are expected to be fully implemented by May 2003.

Predicted Ozone Effect from Application of the Above Strategies. Minor ozone reductions in the Quad Cities Area (<1 ppb) are predicted with the application of Strategies A3 and C. Significant ozone reductions (~5-8 ppb) in the Quad Cities Area are expected from the application of Strategy D. All other control strategies above resulted in surprising increases to the ambient ozone concentrations in the Quad Cities Area. This increase in ozone concentrations is explained as follows. NOx currently being emitted in the Quad Cities Area is destroying ozone. If the NOx being emitted is decreased, less ozone will be destroyed resulting in increased ambient ozone levels. While these increased ozone levels are predicted to occur in the Quad Cities Area, slight ozone reductions are predicted to occur further downwind, outside the planning area. In all cases other than the NOx SIP call, NOx reductions are likely to result in local increases in ambient ozone while VOC reductions yielded barely measurable ozone reductions locally.

Modeling analyses indicate that even with the implementation of substantial local VOC control initiatives, local ambient ozone levels will remain highly dependent on transport from upwind sources. Large-scale ozone reduction initiatives, such as implementation of NOx SIP call reductions, may benefit ozone air quality in the Quad Cities Area more than any feasible local control initiatives.

Stakeholder Assessment. In addition to emissions modeling, efforts have been taken to understand the policy issues related to a voluntary ozone reduction program. An initial assessment was prepared and distributed to local Quad Cities officials from municipal and county government and business in February 2002. The assessment asked which measures does your organization have in place or may consider implementing in the next five years. Seventeen organizations responded to the assessment. While the return on the assessment represented approximately 28%, the respondents included a sampling of larger governments and firms as well as smaller governments and firms and transit systems.

Many organizations are already using either commute solutions, fleet emission reduction measures or other types of emission reduction measures that contribute to improved air quality.

A glossary of terms was provided to the recipients of the assessment to enable them to interpret the voluntary measures. The following measures are already being implemented by at least 50% of the respondents:

- Direct Deposit;
- Resource Conservation;
- Right Sizing of Vehicles;
- Regular Vehicles Fleet and Equipment Maintenance; and
- Material Recycling.

Other existing voluntary measures being implemented by more than 25% include:

- Flexible Work Schedule;
- Brown Bag Lunch;
- Cleaner Diesel;
- Tree Planting;
- Bicycle & Pedestrian Facilities; and
- e-Government and/or e-Commerce.

In the initial assessment, over 50% of the respondents were willing to consider the following voluntary measures within the next five years, with the top eight highlighted (*) below:

- Flexible Work Schedule;
- Carpool or Alternative Transportation Incentives;
- Ozone Action Day Response Program*;
- Brown Bag Lunch*;
- Less Meetings During Ozone Season;
- Alternative Fuel Vehicles;
- Low Emission Vehicles*;
- Non-Peak Hour Deliveries;
- 5-Minute Limit on Diesel Idling;
- Cleaner Diesel;
- Ordinance Requiring Vapor Recovery on New Fueling Stations;
- Low VOC Asphalt and Striping Materials*;
- Equipment Specifications*;
- Employee Education Program*;
- Public Education Program;
- Ozone Action Day Notification Program*;
- Low Emission Gas Cans;
- Signal and Traffic Flow Improvements;
- Tree Planting;
- e-Government and/or e-Commerce;
- Fueling Vehicles in the Evening;
- Shaded Parking; and
- Lawn/Landscape Maintenance Postponement on Alert Day*.

Voluntary Measures and Milestones. Based on the conclusions from the modeling effort to investigate reduction scenarios, the Quad Cities Area will likely only marginally contribute to ozone decreases through voluntary control measures. The Quad Cities can reasonably focus its efforts on a relatively small local contribution to ozone formation based on the modeling results. It was identified in these results that targeting VOCs locally would have a more effective impact on the reduction of ozone than NOx. Since 1998, the Quad Cities Air Quality Task Force has taken a broad public education approach to raise awareness and suggest voluntary measures. Efforts have addressed education with schools, major employers, local government and general audiences. These efforts will continue through the Quad Cities Air Quality Task Force.

The Quad Cities Air Quality Task Force represents major local governments and a sampling of major employers in the Quad Cities. These area stakeholders recognize the benefits of being proactive for improved air quality. Although local efforts toward voluntary reductions may have a marginal impact on reducing the formation of ozone, the community is willing to participate so it may continue to enjoy good air quality. The intent of this Ozone Flex Plan is to recognize and quantify the efforts to date, continue voluntary measures and analyze the effects of plan implementation.

The following voluntary measures are in place in varying degrees. These measures will be encouraged to continue and expanded in the Quad Cities over the next five years (2003-2008):

- Direct Deposit to reduce vehicle trips;
- Resource Conservation to reduce energy consumptions during peak daylight hours, recycling programs, etc.;
- Right Sizing of Vehicles for improved gas mileage and reduce emissions;
- Regular Vehicles Fleet and Equipment Maintenance;
- Material Recycling for household hazardous materials;
- Flexible Work Schedule;
- Brown Bag Lunch to reduce trips during the heat of the day;
- Cleaner Diesel with lower emission specifications;
- Tree Planting to reduce the heat island effect and save air conditioning costs;
- Bicycle & Pedestrian Facilities to facilitate alternatives to vehicles; and
- e-Government and/or e-Commerce to provide electronic transactions and reduce vehicle trips.

For example, both Scott and Rock Island Counties offer material recycling for their residents, including programs for drop-off and curbside collection programs of general recyclable materials and drop-off collection of household hazardous materials. In particular, the Waste Commission of Scott County operates two sites to drop-off household hazardous materials (HHM) and the Rock Island County Waste Management Agency contracts for its residents to use this program developed by Scott County. In 2002, 610 households in Rock Island County properly disposed of 22,002 HHM items while in Scott County 1,741 households properly disposed of 48,775 HHM items. Removing 1,000 gallons of high-volatile organic compound (VOC) paint from the environment is equivalent to reducing one ton of smog-forming VOC emissions. These programs are expected to continue and aid in the reduction of pre-cursor emissions forming ozone. One aspect of these programs would be to investigate the ability to quantify HHM items by chemical type in order equate them with emission reductions.

Another example of existing reductions relates to resource conservation. Many communities for energy cost savings are converting to the use of LED lights in traffic signals. The Cities of Bettendorf, Davenport and Moline have converted to LED lights within the last few years. Using this type of lighting results in a 90% reduction in energy consumption.

The Quad Cities Air Quality Task Force will continue to meet on a regular basis. With the assistance of the state resource agencies, the Task Force will continue to monitor ozone levels and continue efforts to raise awareness of voluntary reduction measures.

Other voluntary efforts will include:

- **Creation of speakers bureau through Bi-State Regional Commission** (Initiate Year 1: 2003 and continued thereafter).
  - Develop presentation format and training program.
  - Advertise availability of presentations to service clubs, organizations and businesses in the Quad Cities Area.
  - Present on a request basis.
  - Maintain status reporting through Air Quality Task Force and Transportation Policy Committee.

- **Continued efforts to market voluntary measures through mailings, news releases, Commission reports, meeting reports, website information, conferences, workshops, advertising as opportunities and resources present themselves** (Years 1-5: 2003-2008).
  - Prepare ozone seasonal marketing strategy per year of program.
  - Host conference or workshop(s) in Year 2 (2004) and 4 (2006) related to alternative fuels and green purchasing/construction/materials.
  - Further "Aware of Air" website information related to voluntary measures Year 1 (2003)
  - Conduct advertising and outreach per Iowa Clean Air Attainment Program (ICAAP) grant and USEPA 105 grant in Year 1 (2003)
  - Pursue other funding opportunities to further outreach efforts. Year 1-5 (2003-2008)

- **Evaluation of the effectiveness of establishing an ozone alert program if the frequency of unhealthy ozone episodes number more than five per year** (2003-2008).
  - Establish subcommittee of Air Quality Task Force to develop ozone alert program if frequency of ozone episodes exceeds five per year (Situation dependent, no milestone set).

- **Investigation of designation in Department of Energy's Clean Cities program to promote decreased dependence on foreign petroleum and use of alternative fuels (2003) and working with the Illinois Green Fleets Program and Iowa Bus Emission Education Program** Years 1-5 (2003-2008).
  - Research program requirements in Year 1 (2003).
  - Pursue Clean Cities designation if program criteria met in Year 2 (2004).
  - Continue progress. Year 3-5 (2005-2008)

- **Work to reduce congestion at the river crossings and increase capacity by pursuing short-range and long-range strategies outlined in the Mississippi River Crossing Strategy Implementation Plan, such as removing tolls on the Centennial Bridge,**

implementing Intelligent Transportation System (ITS) technology for early warning and incident detection on I-74 Bridges, and on-going maintenance and construction coordination and public relations programs.

- Conduct annual bridge restrictions coordination meetings to compile bridge maintenance and construction schedules. Years 1-5 (2003-2008)
- Disseminate bridge restriction information to the media and provide on website. Years 1- 5 (2003-2008)
- Monitor plan implementation for river crossings. Centennial Bridge transfer in Year 2 (2004). I-74 Incident Management Study in Years 1-2 (2003-2004). East River Crossing Feasibility in Years 1-3 (2003-2005). I-74 Capacity Study in Years 1-3 (2003-2005).

- **Monitor voluntary efforts' progress through monitoring and emission inventories** Years 1-5 (2003-2008)
  - Determine annually the design value for the 8-hour ozone monitors in Scott and Rock Island Counties provided by the IADNR and IEPA, which can be included in scheduled reporting to the USEPA. Years 1-5 (2003-2008)
  - Review annually by IADNR reported Title V facilities in Scott County to determine if there are any notable changes in emissions. DNR will provide a comparison of reported emissions for each year. Years 1-5 (2003-2008)
  - Conduct a detailed emission inventory for Scott County by IADNR. Annual emissions from calendar year 2003 from all sources will be re-tabulated. This data will eventually be included in the National Emission Inventory (NEI) database. Year 3 (2005).
  - Conduct an emission inventory for the State of Illinois by IEPA, which includes Rock Island County. The most recent was conducted in 2002. The next will occur in Year 3 (2005).
  - Model 8-hr ozone "episodes" which occurred in 2002. Any future modeling depends on any recent "quality" emissions inventory, which will not be available until 2005. If modeling results warrant, modeling will be performed with higher resolution to determine specific contributing sources. Year 3 (2005) and reevaluated thereafter.

Contingency Measures. Should designation of the Quad Cities as a non-attainment area become imminent, the following contingency measures may be considered:

- Reconsideration of an ozone alert program, assuming a program has not yet been established or if established, consideration of a more intensive program;
- Enhanced employee education programs on travel demand management, commuter choice and other resource conservation options;
- Low emission vehicle and equipment specifications for new fleets/small-spark engine equipment, any low emission engines and clean fuel fleets; and
- Low VOC materials programs

To engage action towards these contingency measures, the Quad Cities would utilize a trigger based on a second excursion of a one-hour monitored value of 124 ppb or greater at either the

Scott County Park, Argo or Moline monitors within an annual ozone season. (The one-hour ozone standard is 125 ppb.) The trigger would be effective twelve months from the date of the second occurrence. The trigger would immediately result in an issuance of a media release on ozone levels bordering on unhealthy values for the one-hour ozone standard and offer voluntary tips on reducing emissions. It would also require convening the Quad Cities Air Quality Task Force to consider the measures noted above and identify a strategy for implementation within the twelve month period. If no other occurrences were registered in the twelve month period, the Quad Cities could subsequently reconsider the contingency measures strategy and lessen the urgency of the strategies identified.

Coordination and Public Participation. The Ozone Flex Plan was developed under the direction of the Quad Cities Air Quality Task Force and approved by the Transportation Policy Committee. A Resource Agency Work Group, representing the state resource agencies, Bi-State staff and Task Force Chair, facilitated the plan development under the direction of the Quad Cities Air Quality Task Force. The Work Group provided the technical analysis and modeling information to allow stakeholders the ability to formulate the action plan. A regional public hearing on the plan allowed for public notification and input into the plan development. The public hearing was held on February 25, 2003 as part of the Transportation Policy Committee meeting.

Schedules/Reporting. The Ozone Flex Plan will be reviewed annually for changes in conditions and updates to voluntary efforts. Monitoring will be conducted on an on-going basis by the state resource agencies in coordination with local officials. Reporting to the U.S. Environmental Protection Agency will occur on a schedule through mutual agreement.

GLOSSARY OF TERMS

Due to the technical nature of the Quad Cities Ozone Flex Plan, a glossary of terms was developed to aid readers in interpreting technical expressions and terminology.

Technical Terms

Ambient Air. The outside air that surrounds us; the air that we breathe.

CARB. California Air Resources Board.

Control Strategy. Specific tactics, approaches, policies or plans for controlling emissions and reducing ambient levels of pollutants in order to satisfy Clean Air Act requirements.

Emissions. A general term describing the discharge of pollutants to the air or water. Examples include the hydrocarbons and oxides of nitrogen that contribute to the formation of ground level ozone.

Emission Standard. A limit placed on the amount of air pollutants that can be released into the air from a particular source. For example, new passenger cars have to meet certain emission standards before they are allowed to be manufactured.

Episode. Refers to a period of time when higher ground level ozone readings are observed. A high ozone episode can be as short as a few hours or as long as several days.

National Ambient Air Quality Standards (NAAQS). Federally established standards for pollutant concentrations that states, cities and towns must meet by specified deadlines. NAAQS have been set for six criteria pollutants – carbon monoxide, lead, nitrogen dioxide, ozone, particulate matter (10 microns and 2.5 microns), and sulfur dioxide.

Nonattainment. A designation by the U.S. Environmental Protection Agency of a specific geographic area based on failure to meet the National Ambient Air Quality Standards (NAAQS).

NOx. A collective term for all compounds of nitrogen and oxygen, includes nitrogen monoxides, nitrogen dioxides, etc.

NOx SIP Call. Regulations related to the reduction of nitrogen oxides to be included in State Implementation Plans (SIPs), a state's air quality plan. Emphasis is placed on emission reductions by power plants.

Ozone. A highly reactive, complex form of oxygen and at ground level is considered a secondary pollutant. It is formed when primary pollutants, such as hydrocarbons (volatile organic compounds or VOCs) and nitrogen oxides (NOx), mix with the energy from the sun. Sources for VOCs and NOx include emissions from motor vehicles, power plants, factories and commercial products, such as paints and solvents.

Ozone as Health-Based Concern. Scientists have determined that ozone can irate the respiratory system, reduce lung function, aggregate asthma and inflame and damage the lining of the lung. Four groups of people are particularly sensitive to ozone – children, adults who are active outdoors, people with respiratory diseases, such as asthma, and people with unusual susceptibility to ozone.

Ozone Season. Typically spans May 1st through September 30th when monitors are taking readings for ground level ozone.

Parts Per Billion. A unit of concentration. With regard to ozone, it is the number of unit volumes of ozone, which can be found in one billion volumes of air.

Photochemical Reaction. A response between chemicals in the atmosphere that occurs in the presence of sunlight.

Precursors. Pollutants released from the operation of motor vehicles, power plants, factories and commercial products/processes that combine to form other pollutants. Hydrocarbons and NOx are precursors of ozone.

Transport. Refers to the movement of precursors and ozone molecules from one area to another. Transport is affected by topography, wind speed and wind direction.

Volatile Organic Compounds (VOC). Gaseous compounds made of carbon and hydrogen (used interchangeably with hydrocarbons.

Commute Solutions

Compressed Work Week. Eligibility and participation in 4/40 or 9/80 workweek, or derivative of a shorten week schedule but a longer hours per day.

Flexible Work Schedule. Eligibility and participation in flextime or staggered hours.

Carpool or Alternative Transportation Incentives. Promote multiple occupancy vehicle trips to work place via carpool/vanpool programs using incentives such as preferential parking, guaranteed ride home, carpool subsidies, parking pricing, or ride-matching.

Transit Pass Subsidized by Employer. Employer provides incentive to utilize transit by offering subsidy on transit passes during ozone season.

Ozone Action Day Response Program. Employer distributes or conveys information on trip reductions, carpooling, transit usage, etc. to employees on days predicted for high ozone levels and/or implement action activities such as incentive programs/subsidies.

Teleworking (Full time/Part time). Employee has ability to work from home, either part time or full time.

Direct Deposit. Paychecks for employees are directly deposited in a financial institution of their choice to reduce an additional vehicle trip.

Brown Bag Lunch. Employees encouraged to bring a sack lunch during ozone season to reduce vehicle trips during the heat of the day.

Resource Conservation. Employer based energy conservation program(s) to reduce energy consumption during peak daylight hours, recycling programs, etc.

Meeting Scheduling. Employees schedule no meetings before 10:00 a.m. during the ozone season or schedule meetings in late afternoon or evening.

<u>Fleet Emissions Reduction Solutions</u>

Alternative Fuel Vehicles. Vehicles designed to use alternative fuels (such as methanol, denatured ethanol, and other alcohols; mixtures containing 85% or more by volume of methanol, denatured ethanol, and other alcohols with gasoline or other fuels; natural gas; liquefied petroleum gas; hydrogen; coal-derived liquid fuels; non-alcohol fuels (such as biodiesel) derived from biological material; and electricity. 'P-Series' fuels were added to this list since the original definition in EPAct). As defined by the Energy Policy Act, any dedicated, flexible-fuel, or dual-fuel vehicle designed to operate on at least one alternative fuel. For more information visit the Department of Energy website, http://www.afdc.doe.gov/

Alternative Fueling Stations. A site providing an alternative fuel for refueling a vehicle.

Low Emissions Vehicles. A vehicle that meets EPA's CFV or LEV standards or CARB's California LEV standards. CFV: Any vehicle certified by EPA as meeting certain federal emissions standards. The three categories of federal CFV standards from least to most stringent are LEV, ULEV, and ZEV. The ILEV standard is voluntary and does not need to be adopted by states as part of the Clean-Fuel Fleet Program. CFVs are eligible for two federal programs, the California Pilot Program and the Clean-Fuel Fleet Program. CFV exhaust emissions standards for light-duty vehicles and light-duty trucks are numerically similar to those of CARBs. California Low-Emission Vehicle Program. California Low Emission Vehicle Program: State requirement for automakers to produce vehicles with fewer emissions than current U.S. Department of Environmental Protection Agency's (EPA) standards. The four categories of California Low-Emission Vehicle Program standards from least to most stringent are transitional low emission vehicles (TLEVs), low emission vehicles (LEV), ultra low emission vehicles (ULEV), and zero emission vehicles (ZEV).

Recycle/Impound Old Vehicles. A program or practice of recycling or impounding older vehicles, which are often producers of larger percentages of emissions.

Right Sizing. Selection of vehicle size, gas mileage and type for the average usage by occupancy or by task.

Non-Peak Hours Deliveries. Scheduling trips either early in the day or late in the day to avoid peak hour traffic, usually 7:00 - 9:00 a.m. and 3:30 - 6:00 p.m.

Vapor Recovery Ordinance. An ordinance implemented by a community requiring that containment of vapors at new refueling sites, e.g. gas/service stations. VOC vapors that escape from the vehicle fuel tank during refueling would be recovered. Storage II pump controls and onboard refueling vapor recovery systems (ORVR) are intended to control these emissions.

5-Minute Limit on Diesel Idling. A time limit set on idling of vehicles fueled with diesel fuel at fleet staging areas, weigh stations, refueling sites, etc.

Clean Diesel. An evolving definition of diesel fuel with lower emission specifications, which strictly limit sulfur content to 0.05 weight %; in California, aromatics content is further limited to 10 volume % (for large refiners).

Vehicle/Equipment Maintenance. Periodic/scheduled maintenance of vehicles and fueled equipment provides better engine performance and reduces emissions. This includes proper tire maintenance through balancing, rotation and inflation.

Vapor Recovery on Pumps. Installation or retrofitting Storage II pump controls and onboard refueling vapor recovery systems (ORVR) for controlling VOC emissions.

<u>Miscellaneous Emissions Reductions</u>

Low VOC Asphalt. Asphalt emits low amounts of VOCs. Could be considered as a roadway project specification. Also eliminating dark asphalt to reduce its heating effects on the urban area.

Low VOC Striping Material. Pavement striping material that emits low amounts of VOCs. Could be considered as a roadway project specification.

Equipment Specifications. Requirements outlined in a bid or purchasing process that indicate the item being specified should emit low amounts of VOCs or NOx.

Employee Education Program. Employer distributes and conveys information to employees on employer emission reduction efforts as well as individual activities that can reduce emissions.

Public Education Program. Organization participates in education of the public on activities that can reduce emissions, such as sponsoring event or ad campaign, distributing information (e.g. brochures, flyers), participating in an event/program, promoting environmental awareness, etc.

Ozone Action Day Notification Program. Organization would disseminate notice of predicted unhealthy levels of ozone to employees and/or public. Notification of alert would come from central source to be distributed in each respective organization in order to call employees to action to reduce emissions on the given Ozone Action Day.

Material Recycling. Household hazardous materials (HHM), such as paints and solvents, can contribute to the formation of ozone. Commitment to the local HHM program by recycling and properly disposing of these items through education and collection events. Programs established for the recycling of paper, glass, plastic, cardboard, etc.

Low-Emission Gas Cans. Program to replace gas cans with ones that limit vapors.

Intelligent Transportation Systems. Technology is used to improve traffic flow and congestion through variable message signs, incident warning/management systems, automated weigh stations, pass-card tolling, etc.

Intersection Improvements. Geometric or signal timing changes to facilitate better traffic flow and reduce vehicle idling and/or accidents.

Signal and Traffic Flow Improvements. Traffic signal synchronization in corridors is utilized to facilitate better traffic flow and reduce congestion.

Transit-Oriented Development. General patterns of land use that favor higher density development with a mix of residential and employment opportunities and are served by mass transit and greater pedestrian corridors.

Tree Planting. Urban landscaping of streets, parking lots, rooftops, etc. can reduce the heat island effect, saves on air conditioning costs by homeowners and eliminates carbon dioxide from the atmosphere.

Bicycle and Pedestrian Facilities. Community or business installs or replaces sidewalks and trails to facilitate travel in corridors within a community or business park. Provision of pedestrian and bicycle amenities, such as benches, bus stops, bicycle racks, and curbcuts should be considered.

e-Government and/or e-Commerce. Organization provides on-line web-based services to reduce trips to the base of operation. On-line services expand an organizations hours of operation by providing transactions via the Internet.

Fueling Vehicles in the Evening. Procedures established to recommend/require refueling vehicles at the end of the day when the solar intensity has lessened and fueling will have lower impacts on the formation of ozone.

Shaded Parking. Parking areas are shaded to reduce the impact of the photochemical reaction between the sun and the ozone forming pollutants (VOCs and NOx).

Parking Pricing/Subsidies. Measures related to varying costs of parking based on time and day or related to offering subsidy if transit is linked to trip and parking needs.

Park and Ride Facilities. Designated location where people can park their vehicles and ride mass transit to a single or multiple locations. Events often utilize this technique to shuttle participants to a specific location.

Lawn/Landscape Care and Maintenance Postponement on Alert Day. Organization sets policy that on an Ozone Action or Alert Day that lawn or landscaping activities, such as mowing or leaf blowing or street sweeping will be postponed until another day or when the sun is less intense, before 10:00 a.m. or after 4:00 p.m.

APPENDIX A

Appendix A: Photochemical Modeling

A. Introduction

Photochemical modeling was conducted by the Iowa Department of Natural Resources in order to more fully investigate the causes and possible solutions to elevated ozone levels occasionally measured in the Quad Cities Area. Computer simulations are used to investigate the chemical processes responsible for ozone development and the physical processes responsible for transport of ozone and ozone precursors. This methodology is commonly applied for purposes of demonstrating future attainment of a National Ambient Air Quality Standard and is often required as part of a State Implementation Plan to address air quality concerns.

Computer modeling of processes effecting ambient air quality offers several advantages over other methods. Most importantly, the ability to evaluate multiple approaches to solving a particular problem allows decision-makers the flexibility to observe the estimated effectiveness of a particular emissions reduction strategy prior to "real world" implementation of promulgating regulations on emission sources.

A distinct advantage of computer modeling over mere reliance on fixed monitoring locations is that modeled air quality concentrations are available across a large area instead of being limited to specific monitor point locations. This provides a more complete depiction and evaluation of the formation, transport, and possible source regions that contribute to elevated ozone levels. In general, the modeling process involves three steps; recreating historical conditions (i.e. model validation process), altering the pollutant emissions, and observing the resulting changes in ambient pollutant concentration estimates that result from changes in pollutant emissions. In order to maintain a balance between regulatory time constraints and resource limitations, photochemical models are designed to simulate an approximation of the science of ozone formation. However, as with all models, the results contain some uncertainty due to simplification of the mathematical computations inherent in the model. As such, photochemical models are best used as one of many tools that policymakers can utilize to help guide them in their decision-making.

For ozone modeling purposes, the modeling tools utilized can be divided into three categories: meteorological, emissions, and photochemical. The meteorological model is applied to recreate historical atmospheric conditions such as wind speed, wind direction, temperature and humidity within a three-dimensional region representing the area of study, also commonly called the modeling domain. These values are calculated hourly and provide the information necessary for calculations conducted in both the emissions and photochemical models. Once the most accurate fields are developed using the meteorological model, they remain unchanged throughout the remainder of the modeling process.

Emissions processing with the emissions model is more iterative than that of the meteorological modeling. For each update to the emissions inventory or emission reduction strategy to be assessed, the emissions model is re-run to provide an hourly three dimensional emissions data set used in the photochemical model. In general, the emissions model apportions annual county level emission inventory data into hourly grid cell specific, or for major sources, stack specific, emission rates. Seasonal, weekly and daily adjustments are applied to the annual inventory to more closely represent realistic emissions. For example, emissions from motor vehicles are not consistent throughout the day, but peak during the morning and afternoon rush hours. The emissions model apportions the hourly motor vehicle emissions to reflect this temporal cycle in traffic emissions. The emissions model is also used to generate emissions fields for the photochemical model, representing specific changes in emissions for evaluation of impact on ambient ozone levels. Emissions from specific sectors such as mobile, or specific facilities such as large NOx sources can be altered within the emissions model and applied for evaluation in the photochemical model.

Executing the photochemical model is the final step in the modeling process. Using the atmospheric variables developed in the meteorological model and the emissions data developed with the emissions model, the photochemical model calculates the transport, dispersion, chemical transformation and removal of air pollutants. It is the results of the photochemical model that illustrate the spatial extent of elevated ozone concentrations and transport, and allow for comparison of potential emission reduction strategies in terms of ambient ozone concentrations. Before any future emission control strategies are considered, the photochemical model is first applied in an effort to accurately recreate historically monitored ozone values. Once this step has been achieved, the validated (i.e. successful replication of an historical episode) photochemical model is re-run with different emissions information to examine the resulting ozone concentration changes. This process is applied in an iterative manner, in conjunction with the emissions modeling, to evaluate many different potential emissions reduction and chemical sensitivity strategies. It is the combined results of all of the simulations conducted with the photochemical model that enables the modelers and decision makers to gain insight into the chemical and physical processes contributing to ambient ozone concentrations in the area of interest.

B. Modeling Results

Episode Selection-Conceptual Model

Three 1999 ozone episodes were selected as modeling candidates to evaluate the nature of elevated ozone concentrations in the Quad Cities Area. The candidate episodes were chosen based on key criteria such as occurrence of high ozone concentrations, episode duration, and meteorological complexity. Figure 1 depicts the observed ozone concentrations measured in the Quad Cities region for each of the three episodes.

All three episodes are characterized by the persistence of meteorological conditions conductive to ozone formation, which persist for several days, permitting the photochemical reaction time to 'cook' and build toward unhealthy levels. Ozone gradually builds up day after day until an air mass change occurs. The sudden decrease in ozone concentrations is typically triggered via a frontal passage, which ushers cleaner air into the region and marks the end of the episode.

Meteorological Model Selection

The Fifth Generation Penn State University/National Center for Atmospheric Research Mesoscale Model (MM5) was selected to develop the meteorological fields, which drives the air quality model and also provides inputs to the biogenics portion of the emissions model. MM5 was originally developed in the 1970's and has seen repeated use in scientific, regulatory, and numerical weather prediction applications. During this time scientific peer-reviewed innovations and improvements have been incorporated into the model, thus maintaining its status as a state-of-the-science meteorological model. Recent regulatory applications of MM5 include the development of 1996 and 2001 annual simulations by EPA to support such efforts as the Clear Skies Initiative and regional haze regulations.

Emissions Model Selection

The Sparse Matrix Operating Kernel Emissions (SMOKE) model version 1.3 was selected for emissions processing. The SMOKE model undergoes continuous evaluation and revision and is regarded as a state-of-the-science emissions processing system.

Air Quality Model Selection

The Comprehensive Air Quality Model with Extensions (CAMx) version 3.10 was the chosen platform for conducting the air quality model simulations. Developed by Environ to fulfill the technical requirements of a state-of-the science air quality model, CAMx is built upon solid chemical mechanisms and transport physics (CAMx User's Guide, 2000). CAMx additionally includes numerous tools and technologies, which aid in the post processing and diagnosis of ozone episodes.

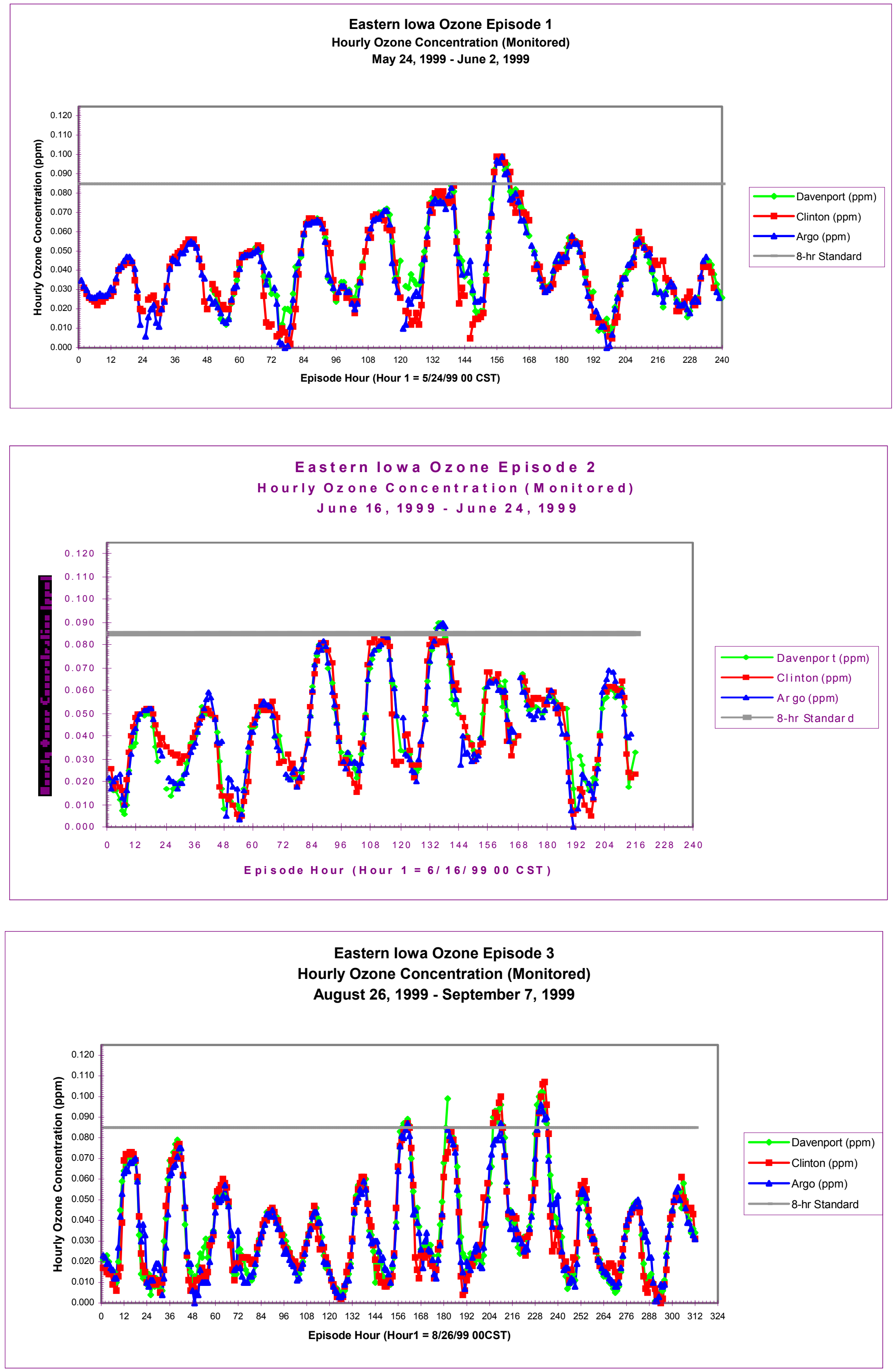


Figure 1. Observed ozone concentrations recorded near the Quad Cities Area. Data used in determining modeling episodes.

Meteorological Modeling and Domain Development

Meteorological modeling is the first component in the modeling system triad (meteorology, emissions, air quality), as both the air quality and emissions models require meteorological data as input. However, prior to meteorological modeling, a model domain must be developed. Figure 2 depicts the meteorological modeling domains selected for the Quad Cities region.

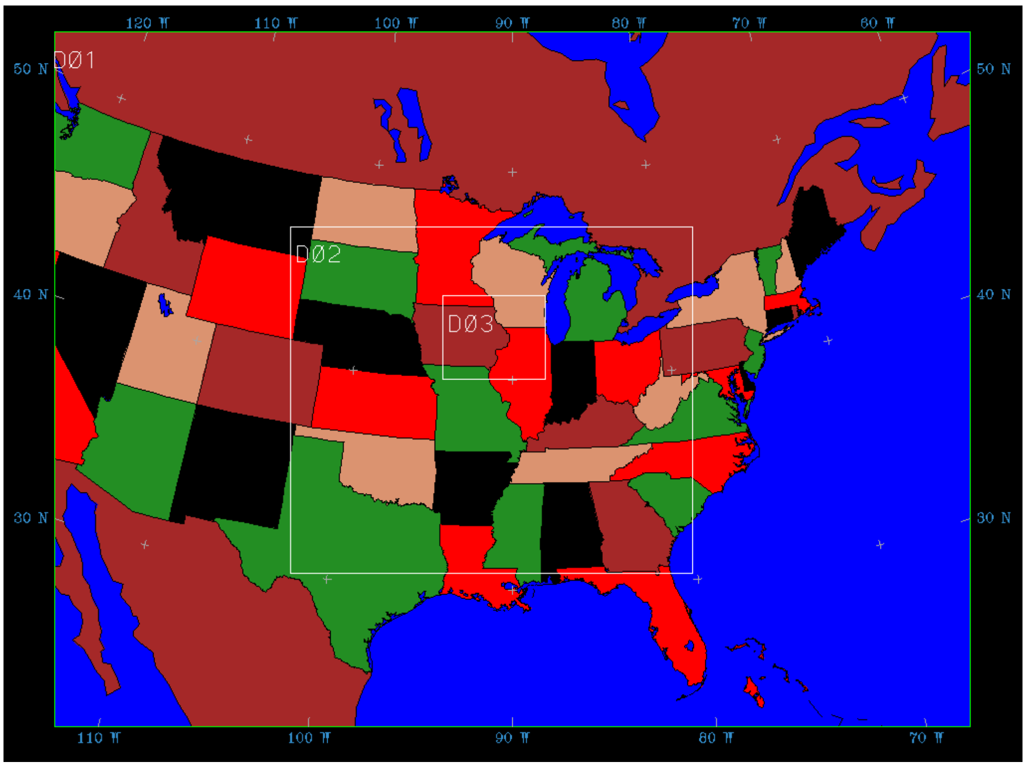


Figure 2. Three meteorological domains defined in MM5. Domain 1 covers the majority of the continental United States with 36 km horizontal resolution. Domain 2 occupies much of the Central and Eastern United States with 12 km horizontal resolution. Domain 3 focuses upon the Quad Cities Area at 4 km horizontal resolution.

Three meteorological modeling domains were defined within MM5, each being of finer resolution. The larger, coarse domain covers the majority of the continental United States at 36 km horizontal resolution. The sole purpose of this coarse domain is to provide domain 2, a 12 km domain, with meteorological boundary conditions. No air quality simulations were conducted with the coarser domain 1. Domain 2 was designed to encompass those sources, which could reasonably be assumed to significantly contribute to ozone transport and formation into the Quad Cities region. Finally, a 4 km domain was developed in case finer resolution was warranted. Meteorological model vertical resolution was defined by using 35 layers, extending from the surface to approximately 15,500 meters above sea level. Layer depths increase from approximately 30 meters at the surface to ~2000 meters at model top.

Figure 3 depicts the air quality domain. The 12 km air quality domain is defined by dimensions of 144 grid points along the abscissa and 130 grid points along the ordinate. Vertical resolution within the air quality model was defined by mapping 14 vertical layers from MM5 to CAMx. Layer depths increased from approximately 30 meters at the surface to ~1500 meters at model top. The model top in CAMx was defined at approximately 6,000 meters.

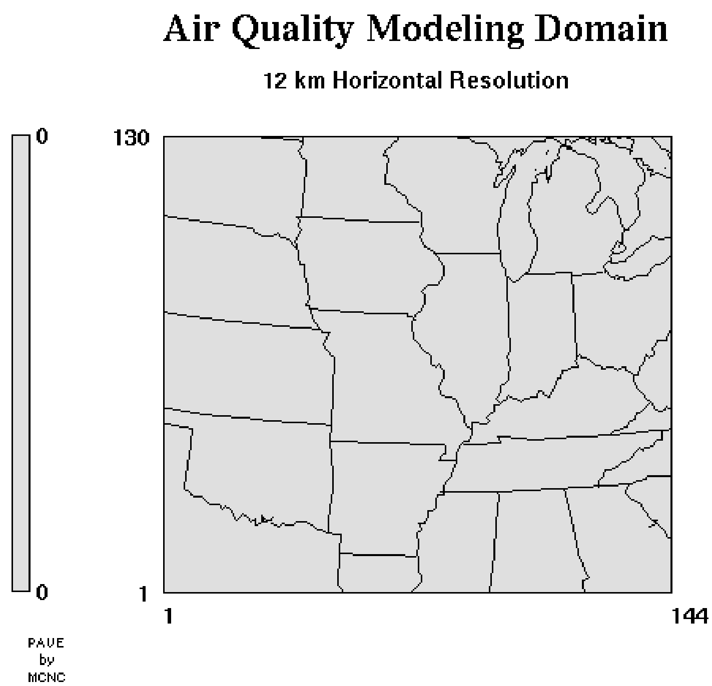


Figure 3. Coverage of the 12 km air quality domain.

Meteorological Model Performance

Results from the meteorological model were evaluated using statistical methods and qualitative comparisons. Statistical evaluation revealed model performance to be within acceptable guidelines for surface wind speed and direction, temperature, and humidity. Qualitative analysis revealed acceptable synoptic performance.

Basecase Development

Development of the basecase air quality simulations follow meteorological and emissions modeling. The basecase is simply defined as the air quality simulation, which accurately recreates historial conditions (a validated simulation). A basecase model run must be generated for each modeling episode. Table 1 defines the temporal distribution of each of the three episodes. Sufficient lead-time was incorporated into episode development to allow the air quality model a 24-hour spin-up of tropospheric chemical processes. This limits the uncertainty incurred from assumed initial and boundary conditions. This spin-up period is not used for model evaluation purposes. Model evaluation focuses upon those critical days, which show a clear build-up of ozone concentrations.

Episode	**Start**	**Finish**	**Episode Duration**
Episode 1	May 24th, 1999	June 2nd, 1999	10 Days
Episode 2	June 18th 1999	June 25th, 1999	8 Days
Episode 3	August 24th, 1999	September 6th, 1999	14 Days

Table 1. Temporal distribution for each of the three air quality modeling episodes.

Air quality model evaluation initially focused upon time series evaluation of model to monitor comparisons. Results were analyzed from the eleven ozone monitors located within Iowa's borders in 1999, with additional focus upon the monitors located near the Quad Cities Area. Figures 4 and 5 compare the results from the first round of simulations for Episode1. Observed concentrations are represented by black dots. The solid line depicts the ozone concentrations predicted by CAMx for the grid cell nearest the monitor location. The shaded area bounding the model predictions indicates the range of modeled ozone concentrations found within the 9 grid cells surrounding the monitor location. The range provides guidance to the spatial variability in predicted ozone concentrations. Model evaluations, which compare predicted versus observed ozone concentrations paired in space and time represent the strictest form of model evaluation and may not accurately represent the true scale of model performance. For this reason, several statistical approaches are taken to evaluate air quality performance.

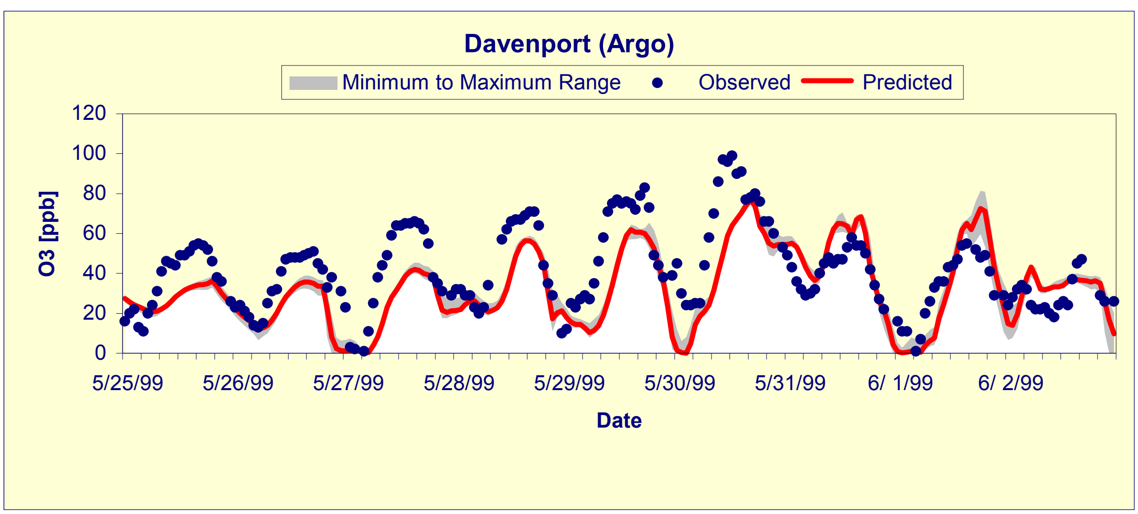


Figure 4. Model to monitor comparison of ozone concentrations from the initial air quality model run for Episode 1 at the Argo ozone monitor.

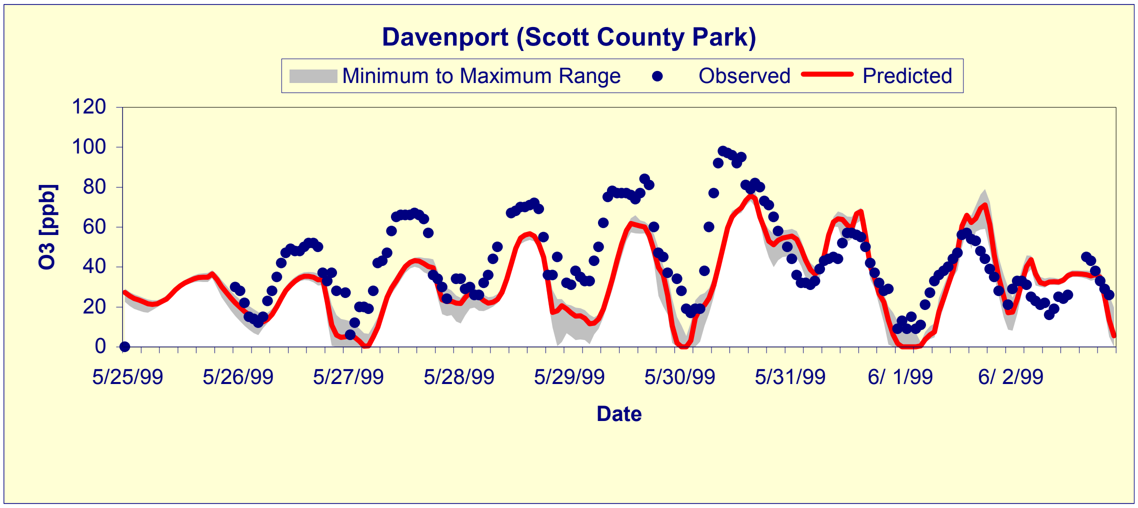


Figure 5. Model to monitor comparison of ozone concentrations from the initial air quality model run for Episode 1 at the Scott County Park monitor.

The USEPA Guideline for Regulatory Application of the photochemical models such as CAMx recommends that performance of the model be evaluated against measured air quality data using, at a minimum, the following three statistical measures. Listed below are these measures and their acceptable ranges.

Statistic	Accepted Range
▪ Unpaired Peak Prediction Accuracy	± 15-20%
▪ Normalized bias of all pairs > 60 ppb	± 5-15%
▪ Gross error of all pairs > 60 ppb	30-35%

Analyzing model performance based upon the above charts, one quickly determines that CAMx fails to reproduce the magnitude of the peak observed concentrations. This point is illustrated in Figures 6 and 7. The model's ability to reproduce the peak ozone concentrations observed within Iowa is statistically reported in Figure 6. Only May 27th - May 30th are examined as this time period captures the critical peaks of the ozone episode. Frontal passage occurs in the latter hours of May 30th, thus the following days are typical for clean air (low ozone concentration) conditions and provide no insight into peak ozone model performance. From Figure 6, it quickly becomes clear that CAMx is underestimating unpaired peak ozone concentrations by 20 - 26 %, which falls marginally below the USEPA guidelines. The average paired (in space, not in time) peak prediction accuracy also illustrates the models tendency to underpredict ozone concentrations.

The statistics presented in Figure 7 are calculated using all available model versus monitored pairings within Iowa. The bias illustrates the model unilaterally underpredicts ozone concentrations relative to USEPA guidelines. Associated error metrics further illustrate poor model performance. The initial simulation is clearly unsuited for use as a basecase simulation.

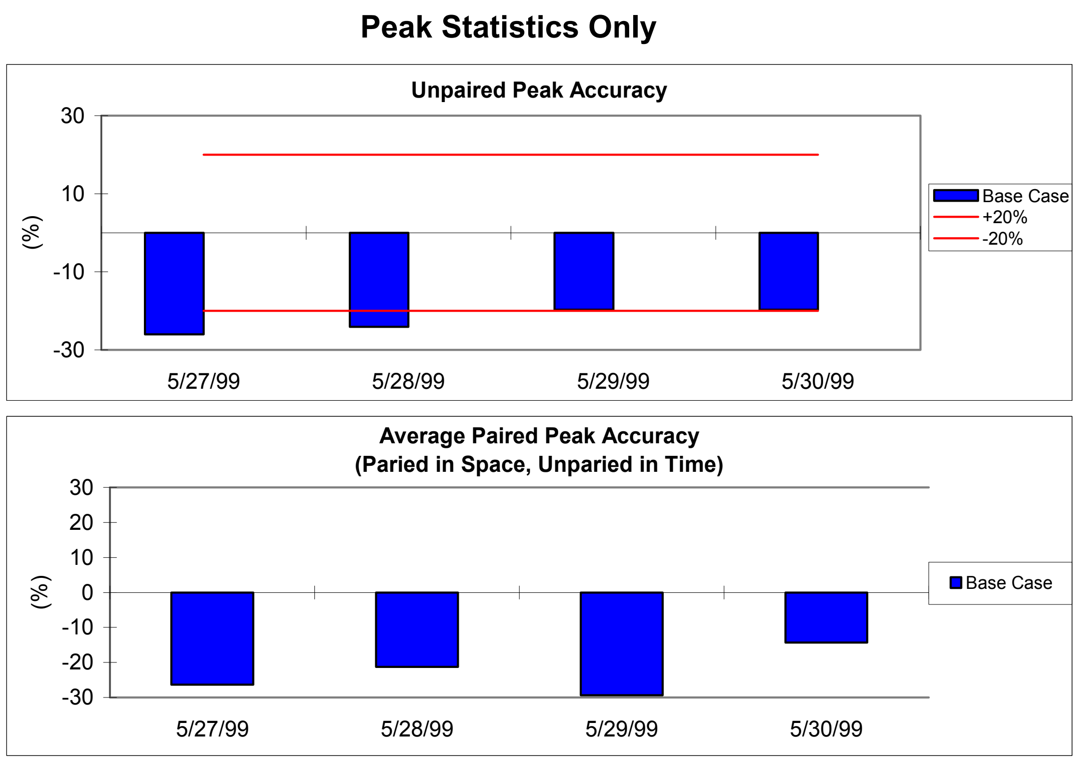


Figure 6. Statistical analysis of the initial air quality model run for Episode 1. Metrics are calculated using the peak observed/modeled ozone concentrations for each of the 11 ozone monitors located in Iowa. Statitics presented are calculated using USEPA reference methods. USEPA guidelines for model performance are indicated in red.

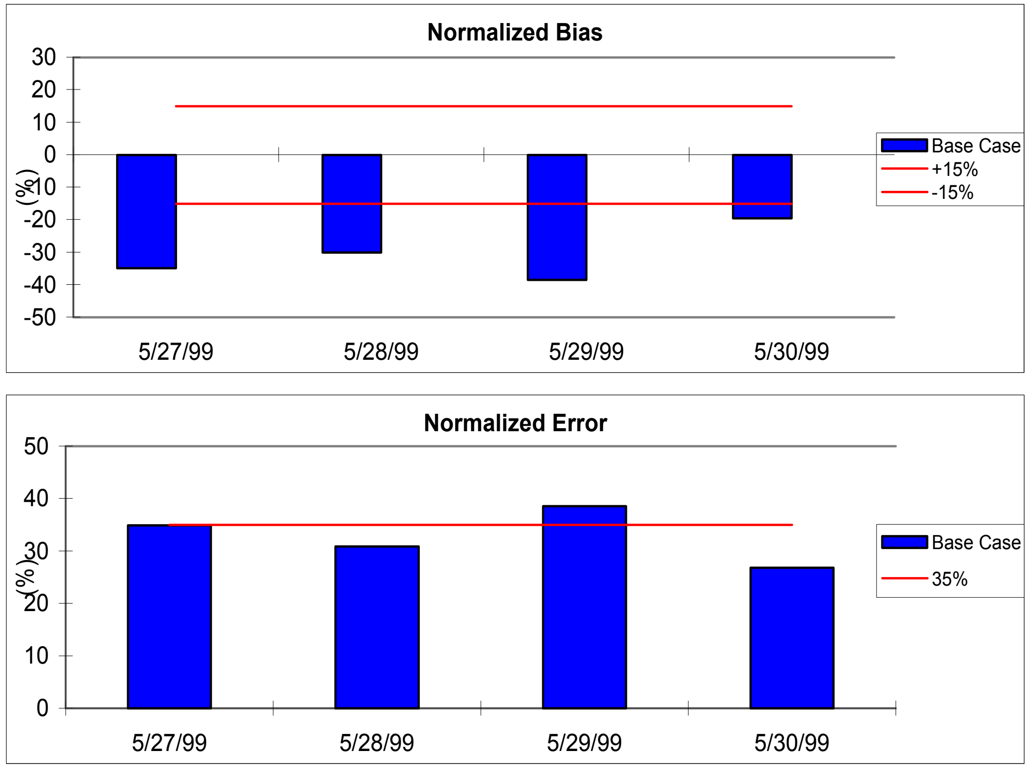


Figure 7. Statistical analysis of the initial air quality model run for Episode 1. Metrics are calculated using all valid model vs predicted ozone pairings for each of the 11 ozone monitors located in Iowa. Statitics presented are calculated using USEPA reference methods. USEPA guidelines for model performance are indicated in red.

To improve model performance the initial and boundary concentrations (IC/BC) for the modeled chemical species were examined. Default concentrations for the initial and boundary conditions reflect average clean conditions - concentrations typically found in clean air masses (such as oceans) remote from anthropogenic activity. Given domain locations, clean initial and boundary conditions do not accurately reflect actual species concentrations. A series of sensitivity studies adjusting initial and boundary species concentrations were performed to more accurately reflect the IC/BC chemical composition at the 12 km domain boundary. Comparison of doubled IC/BC conditions with observed concentrations measured along the boundaries found the doubled IC/BC concentrations to better replicate the concentrations measured at boundary monitors. The statistical evaluation of model performance using the doubled IC/BC concentrations is shown in Figures 8 and 9.

Peak Statistics Only

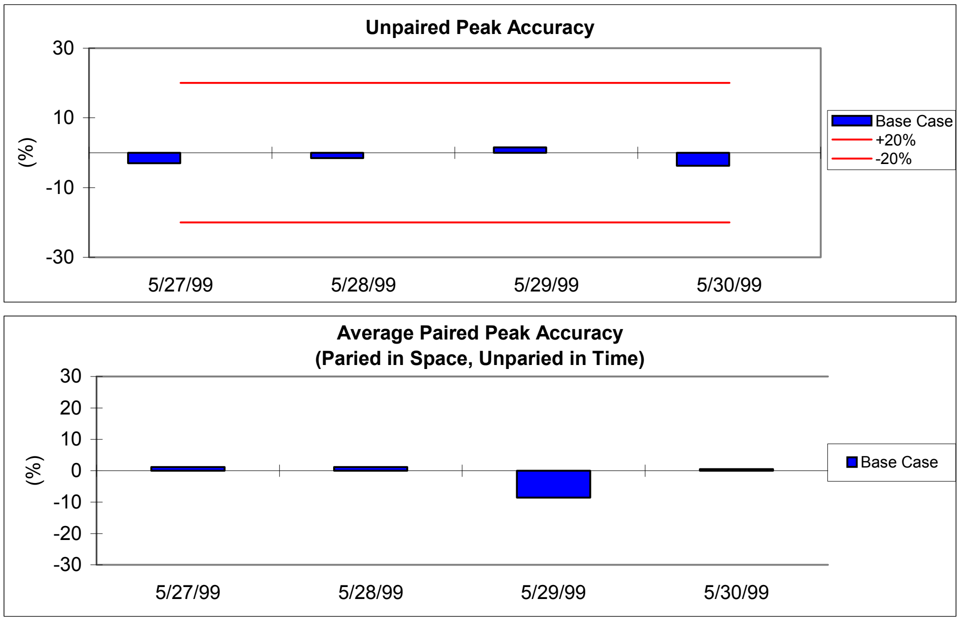


Figure 8. Statistical results using doubled IC/BC concentrations. Metrics are calculated using the methods described in Figure 6.

All Valid Pairings

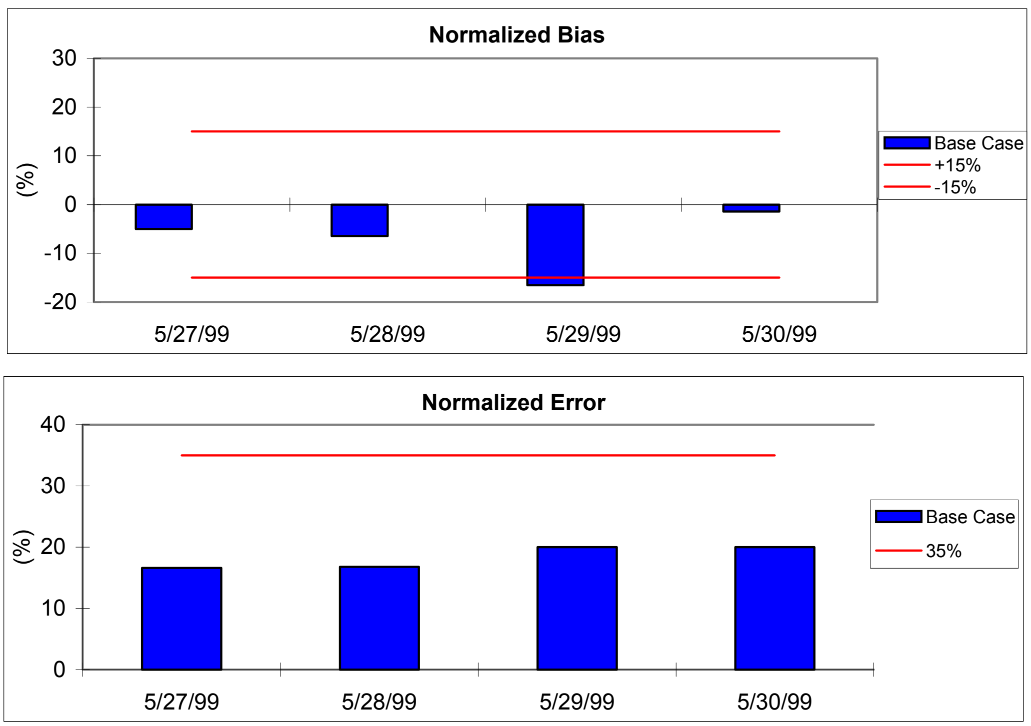


Figure 9. Statistical results using doubled IC/BC concentrations. Metrics are calculated using the methods described in Figure 7.

With the exception of normalized bias on May 29th , statistical results fall well within the USEPA criteria, Additionally, the errors which lead to the higher normalized bias on May 29th are likely attributable to the ozone readings taken at locations outside the Quad Cities Area. The doubled IC/BC simulation demonstrated acceptable model performance and was adopted as the basecase for Episode 1.

A similar iterative process was repeated for Episodes 2 and 3. Results were comparable to the above, with acceptable model performance demonstrated using the doubled IC/BC.

Control Strategy Results

Following generation of the basecase, assessment of control strategies commenced. Table 2 provides a brief description of the control strategies examined. The initial control strategy evaluated was scenario A1. While a 25% reduction in on-road mobile sources is clearly unrealistic, model sensitivity must guide control strategy selection. Regional air quality models are designed to evaluate medium to large scale reductions in ozone precursors over regions on the scale of large metropolitan areas or greater. The control strategies selected offer a balance between local controls and model sensitivity.

Results from control stategy A1 were initially unexpected. In the urban core of the , local ozone concentrations increased by up to 2.5 ppb. Control strategies A2 and A3 were developed in order to investigate ozone sensitivity to decreases in NOx and VOCs separately. Results from control strategy A2 were similar to A1, local ozone concentrations increased as a result of local NOx reductions from mobile sources. Results from control strategy A# (VOC reduction only), however, produced the effect of reducting ozone concetrations; no ozone increases occurred with the control strategy. The magnitude of ozone reduction in the Quad Cities Area resulting from a 25% reduction in mobile source VOCs were on the order of 0.1-0.3 ppb during peak ozone hours. Overall, these results indicate that the Quad Cities Area is VOC limited: a chemical scenario where the VOC to NOx ratio is low and local reductions in NOx subsequently yield local ozone disbenefits (ozone increases) while local VOC reductions lead to local ozone decreases. To further test this hypothesis control strategy C was investigated. Implementing Stage I & II vapor recovery along the counties bordering the Mississippi River from the Quad Cities to the southern border of Iowa yielded local ozone reductions of 0.2 ppb during peak ozone hours. Control strategy B also tested the VOC limited hypothesis. It demonstrated that reducing NOx emissions from the ten largest point sources upwind of the Quad Cities Area yielded ozone disbenefits in the Quad Cities Area.

The final control strategy investigated was implementation of USEPA's NOx SIP Call. While local NOx reductions do increase ozone concentrations over the Quad Cities region, the NOx SIP call should reduce the magnitude of the ozone concentrations being transported into the area. The Iowa DNR air quality model results indicate that a reduction in local ozone concentrations during peak ozone hours of 5 ppb or greater may occur when final NOx SIP call controls are installed and operational.

Control Strategy Description		Reduction (Tons/Day)	
		NO_x	VOC
A1	25% reduction in all on-road mobile source emissions within Scott and Rock Island counties	6.1	5.8
A2	25% reduction in NO_x on-road mobile source emissions within Scott and Rock Island counties	6.1	--
A3	25% reduction in VOC on-road mobile source emissions within Scott and Rock Island counties	--	5.8
B	25% reduction in NO_x emissions from the 10 largest point sources upwind from the Quad Cities Area	17.8	--
C	Stage I & II vapor recovery implemented in a 22 county area along the Mississippi River between Davenport and SE Iowa	--	10.3
SMOKE basecase total anthropogenic emissions for Scott County only (not a reduction) Tons/day		NO_x	VOC
		~36	~34

Table 2. NOx and VOC reduction resulting from control strategies A1, A2, A3, B and C.

Modeling results strongly indicate the Quad Cities Area is VOC limited. However, local VOC controls failed to reduce local ozone concentrations significantly. The largest modeled reduction (in ozone concentrations over the Quad Cities Area) attributable to local controls occurred through control Strategy C and measured only 0.4 ppb. This reduction did not occur during peak ozone hours. In order to investigate the relationships between VOC controls and the resultant magnitude in ozone decreases, the Ozone Source Apportionment Tool (OSAT) available in CAMx was utilized. OSAT offers the modeler data capable of providing a rough estimate of the areas within the modeling domain, which may be contributing to ozone concentrations in the Quad Cities. OSAT was configured to assess the relative contribution of ozone from 19 potential source regions to the modeled peak ozone concentrations in the Quad Cities Area. Each source region is roughly equivalent to State boundaries, with the exception of a small source region encompassing the Quad Cities Area and a few states, which were combined into single source regions. OSAT results indicate that the majority of the ozone impacting the Quad Cities is generated well beyond their borders. A small percentage of the ozone concentration observed near the Quad Cities Area is generated locally; the vast majority is generated in-situ from source regions well beyond the Quad Cities' Metropolitan Area boundaries.

The aforementioned methods were applied to Episodes 2 and 3. All findings reported above were supported by the evaluations of Episodes 2 and 3. No new insights were generated.

APPENDIX B

Appendix B: Model Input Data

A. Information Sources Considered for Use in the Model

Emission data used in the analysis of three 1999 Quad Cities ozone episodes utilized three independent emission inventory estimates.

- An emission inventory is provided in the emissions processing model SMOKE. This inventory provides emission data for the entire United States. Emission data in the SMOKE model was generated from 1996 emissions data.

- The 1999 IDNR emission inventory. A detailed emission inventory was performed in 1999 in Scott County, Iowa. More information on this inventory is provided in Appendix D.

- The USEPA 1999 Air Data emission inventories. Every three years, USEPA provides updated estimates of air emissions in all states. This is reported as in the National Emission Inventory (NEI) and this information can be obtained from the USEPA Air Data web site.

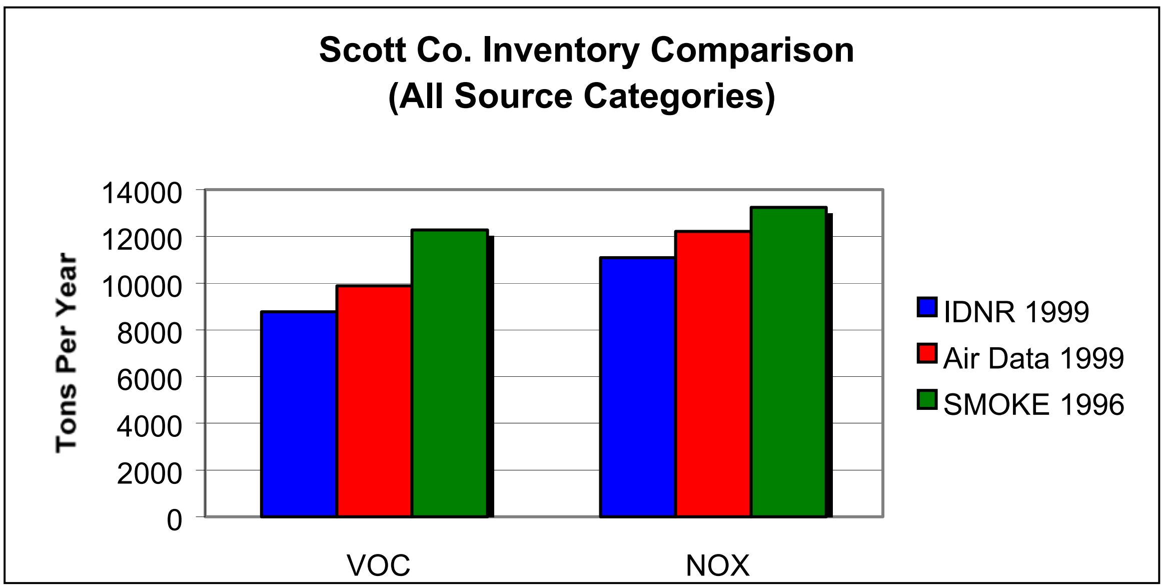


Figure 1: Comparison of available emission inventory information for Scott County, Iowa.

B. Inventory Comparison

Values from the 1996 SMOKE inventory were compared with emission inventory data collected by the Iowa Department of Natural Resources during the 1999 Scott County inventory effort. To further quantify the appropriateness of this approach, the 1996 SMOKE inventory was also compared to USEPA's estimated 1999 emission inventory.

While it was expected that there would be a difference between the 1996 and 1999 emission inventory estimates, it was not anticipated that the lone data set for 1996 would contain the highest amount of emissions for both NOx and VOC emissions tend to increase over time due to population growth and increased VMT. Further analyses of the differences between emission inventory estimates were conducted to identify the reasons why the emissions inventories varied.

The NOx inventories from all three data sources show differences. For point source NOx emission estimates, the SMOKE inventory (1996) and IDNR inventory (1999) compare to within approximately 150 tons per year, while the USEPA estimates (1999) are lower than both by approximately 1,000 tons per year. On-road and areas source NOx emissions were consistently lower in the IDNR inventory than the USEPA or SMOKE inventories.

For VOC emission estimates, the 1996 SMOKE inventory is consistently higher than the other inventories reviewed with the exception of the point source category. In the point source category, the IDNR inventory identified significantly more VOC emissions than either the 1996 SMOKE inventory or USEPA's 1999 inventory. These comparisons are provided in Figures 2 and 3.

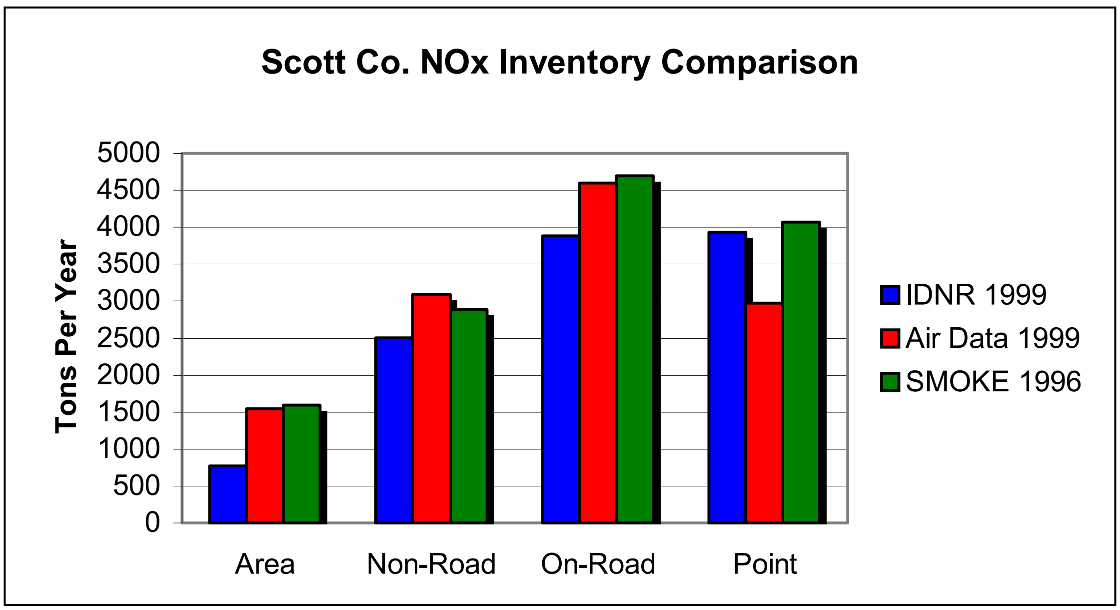


Figure 2: NOx inventory comparison

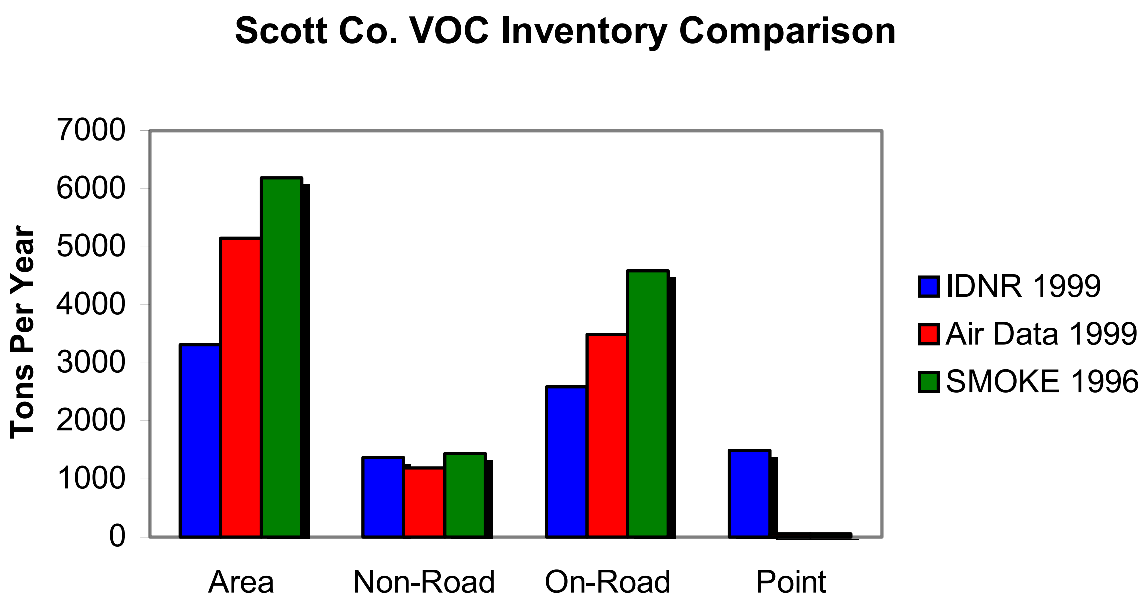


Figure 3: VOC inventory comparison

C. Emission Reduction Approach

For the purpose of evaluating ozone and the chemical processes affecting the production of ozone in the Quad Cities Area it is interesting to note the nearly identical levels of annual anthropogenic emission totals for NOx and VOC (Figure 1). Smog chamber tests have shown that VOC limited conditions generally exist in chemical systems in which the VOC to NOx ratio is at or below 4:1 and NOx limited conditions exist where the ratio exceeds 15:1 (Rethinking the Urban Ozone Problem in Urban and Regional Air Pollution 1992). Knowing the ozone limiting chemical regime (or lack thereof) allows for more effective emissions reduction plans to be developed. It should be noted that determination of the controlling constituent, either VOC or NOx, can only be evaluated in a very cursory manner from the base emission inventory information. Initial indications based on all three available inventories are that the Quad Cities Area, in general, and Scott County specifically, may exist in a atmospheric chemical regime where ozone production is limited by the availability of VOC emissions. In addition, intense agriculture common in the upper mid-west serves to reduce the amount of biogenic VOC emissions common in the south and south-east United States where the controlling chemical conditions are more often NOx limited.

As a VOC limited area, ozone formation may be more sensitive to changes in VOC emissions. Due to this assumption, comparisons of the available emission inventories were further refined to identify more specific discrepancies in the available VOC emission inventories. The results of this analysis are presented in Figure 4.

As can be seen from Figure 4, significant differences exist between the sectors of area source VOC emissions that account for almost one half of the anthropogenic VOC emissions in Scott

County. Several areas of discrepancy are illustrated in Figure 4, with the solvent utilization category standing out as the most significant category of area source VOC emission inventory estimates requiring future refinement.

While the focus of the emission inventory comparison was on Scott County emissions, the evaluation provided the basis for assuming that the relative inventory differences held domain wide and utilization of the 1996 NEI provided with the SMOKE model was acceptable for performing modeled evaluations of ozone. Future modeling assessments would benefit from the use of updated inventories of the Quad Cities Area and the modeling domain as a whole.

D. Conclusion

In all cases the 1996 SMOKE inventory, provided with the SMOKE emissions model, was used for modeling purposes. It was selected because it was readily available for use and provided emissions information comparable to other available emissions inventory data sets. As can be seen from Figure 1, the modeling inventory (listed as SMOKE 1996) used in this analysis represents the upper bounds of total emissions estimates for both VOC and NOx in Scott County.

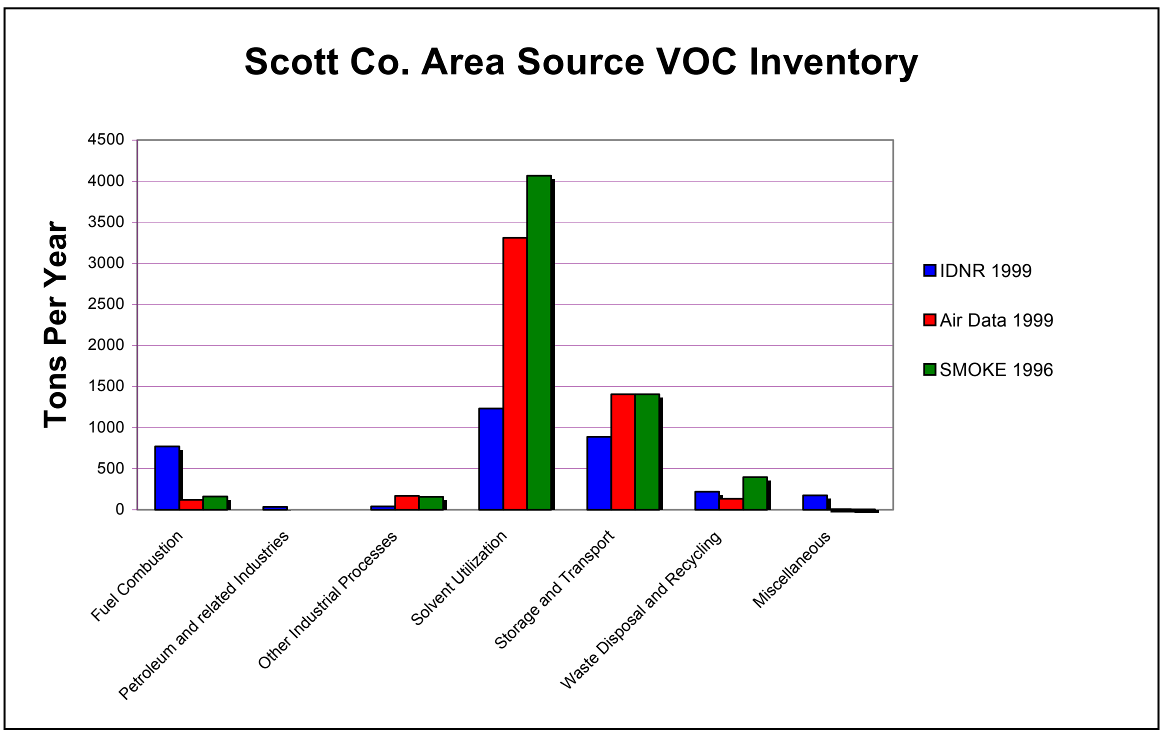


Figure 4: Comparison of VOC sources

APPENDIX C

Appendix C is a separate .pdf document, the 1999 Scott County Air Emission Inventory.

APPENDIX D

ILLINOIS STATEWIDE OZONE PRECURSOR EMISSIONS INVENTORY
1999 TYPICAL SUMMER DAY EMISSIONS OF
VOLATILE ORGANIC MATERIALS (VOM)
ROCK ISLAND COUNTY
*** Emissions Stated in Tons Per Day (TPD) ***

SOURCE CATEGORIES	POINT	AREA	ON-ROAD	OFF-ROAD	TOTAL
STORAGE & MARKETING OF VOC:	0.30	0.96	0.00	0.00	1.26
Oil & Gas Production	0.00	0.00	0.00	0.00	0.00
Natural Gas & Gasoline Processing	0.00	0.00	0.00	0.00	0.00
Other Petroleum Processing	0.00	0.00	0.00	0.00	0.00
Gasoline & Crude Oil Storage:	0.08	0.00	0.00	0.00	0.08
Floating Roof Tanks	0.00	0.00	0.00	0.00	0.00
All Other Tanks	0.08	0.00	0.00	0.00	0.08
Volatile Organic Liquid Storage	0.21	0.00	0.00	0.00	0.21
VOL Transfer:	0.00	0.01	0.00	0.00	0.01
Ship and Barge	0.00	0.01	0.00	0.00	0.01
Tanker Ballasting	0.00	0.00	0.00	0.00	0.00
Barge and Tanker Cleaning	0.00	0.00	0.00	0.00	0.00
Bulk Gasoline Terminals	0.01	0.00	0.00	0.00	0.01
Bulk Gasoline Plants	0.01	0.00	0.00	0.00	0.01
Service Station Loading (Stage I)	0.00	0.11	0.00	0.00	0.11
Vehicle Refueling (Stage II)	0.00	0.72	0.00	0.00	0.72
Gasoline Tank Truck Leaks	0.00	0.03	0.00	0.00	0.03
Underground Storage Tank Breathing	0.00	0.09	0.00	0.00	0.09
Aircraft Refueling	0.00	0.01	0.00	0.00	0.01
INDUSTRIAL PROCESSES:	0.44	0.00	0.00	0.00	0.44
Petroleum Refineries:	0.00	0.00	0.00	0.00	0.00
Vacuum Systems	0.00	0.00	0.00	0.00	0.00
Fugitive Leaks	0.00	0.00	0.00	0.00	0.00
Wastewater Collection-Process	0.00	0.00	0.00	0.00	0.00
Wastewater Collection-Fugitive	0.00	0.00	0.00	0.00	0.00
Lube Oil Manufacture	0.00	0.00	0.00	0.00	0.00
Organic Chemical Manufacture:	0.20	0.00	0.00	0.00	0.20
SOCMI:	0.00	0.00	0.00	0.00	0.00
Polyethylene	0.00	0.00	0.00	0.00	0.00
Polypropylene	0.00	0.00	0.00	0.00	0.00
Polystyrene	0.00	0.00	0.00	0.00	0.00
Fugitive Leaks	0.00	0.00	0.00	0.00	0.00
Air Oxidation	0.00	0.00	0.00	0.00	0.00
Others	0.00	0.00	0.00	0.00	0.00
Inorganic Chemical Manufacture	0.00	0.00	0.00	0.00	0.00
Fermentation Processes	0.00	0.00	0.00	0.00	0.00
Vegetable Oil Processing	0.00	0.00	0.00	0.00	0.00

S O U R C E C A T E G O R I E S	POINT	AREA	ON-ROAD	OFF-ROAD	TOTAL
Pharmaceutical Manufacture	0.00	0.00	0.00	0.00	0.00
Plastics Products Manufacture	0.09	0.00	0.00	0.00	0.09
Rubber Tire Manufacture	0.00	0.00	0.00	0.00	0.00
SBR Rubber Manufacture	0.00	0.00	0.00	0.00	0.00
Synthetic Fiber Manufacture	0.00	0.00	0.00	0.00	0.00
Iron and Steel Manufacture	0.00	0.00	0.00	0.00	0.00
Iron and Steel - Process	0.00	0.00	0.00	0.00	0.00
Iron and Steel - Hot/Cold Rolling	0.00	0.00	0.00	0.00	0.00
Coke Ovens - Process	0.00	0.00	0.00	0.00	0.00
Coke Ovens - Fugitive	0.00	0.00	0.00	0.00	0.00
Other	0.15	0.00	0.00	0.00	0.15
INDUSTRIAL SURFACE COATING:	1.43	0.00	0.00	0.00	1.43
Large Appliances	0.00	0.00	0.00	0.00	0.00
Magnet Wire	0.00	0.00	0.00	0.00	0.00
Autos and Light Trucks	0.00	0.00	0.00	0.00	0.00
Cans	0.00	0.00	0.00	0.00	0.00
Metal Coils	0.00	0.00	0.00	0.00	0.00
Paper	0.00	0.00	0.00	0.00	0.00
Fabric	0.00	0.00	0.00	0.00	0.00
Metal and Wood Furniture:	0.00	0.00	0.00	0.00	0.00
Metal Furniture	0.00	0.00	0.00	0.00	0.00
Wood Furniture	0.00	0.00	0.00	0.00	0.00
Miscellaneous Metal Products	0.03	0.00	0.00	0.00	0.03
Flatwood Products	0.00	0.00	0.00	0.00	0.00
Plastic Products	0.00	0.00	0.00	0.00	0.00
Large Ships	0.00	0.00	0.00	0.00	0.00
Large Aircraft	0.00	0.00	0.00	0.00	0.00
Others	1.40	0.00	0.00	0.00	1.40
NON-INDUSTRIAL SURFACE COATING:	0.00	1.28	0.00	0.00	1.28
Architectural Coatings	0.00	0.85	0.00	0.00	0.85
Auto Refinishing	0.00	0.31	0.00	0.00	0.31
Others:	0.00	0.00	0.00	0.00	0.00
Traffic/Maintenance Painting	0.00	0.13	0.00	0.00	0.13

S O U R C E C A T E G O R I E S	POINT	AREA	ON-ROAD	OFF-ROAD	TOTAL
OTHER SOLVENT USE:	0.02	2.88	0.00	0.00	2.90
Degreasing:	0.01	0.67	0.00	0.00	0.67
Cold Cleaners	0.00	0.67	0.00	0.00	0.67
Vapor/Conveyorized	0.01	0.00	0.00	0.00	0.01
Dry Cleaning:	0.02	0.10	0.00	0.00	0.12
Perchloroethylene	0.02	0.00	0.00	0.00	0.02
Petroleum	0.00	0.10	0.00	0.00	0.10
Graphic Arts	0.00	0.38	0.00	0.00	0.38
Adhesives	0.00	0.00	0.00	0.00	0.00
Emulsified Asphalt Paving	0.00	0.76	0.00	0.00	0.76
Consumer & Commercial Solvents	0.00	0.97	0.00	0.00	0.97
Personal Care Products	0.00	0.22	0.00	0.00	0.22
Household Products	0.00	0.34	0.00	0.00	0.34
Auto Aftermarket Products	0.00	0.09	0.00	0.00	0.09
Adhesive Products	0.00	0.05	0.00	0.00	0.05
Pesticide Products	0.00	0.02	0.00	0.00	0.02
Miscellaneous Consumer Products	0.00	0.26	0.00	0.00	0.26
Others	0.00	0.00	0.00	0.00	0.00
WASTE DISPOSAL:	0.31	0.04	0.00	0.00	0.35
Municipal Waste:	0.01	0.04	0.00	0.00	0.05
Combustion:	0.01	0.04	0.00	0.00	0.05
Residential	0.00	0.02	0.00	0.00	0.02
Commercial/Institutional	0.00	0.02	0.00	0.00	0.02
Governmental	0.00	0.00	0.00	0.00	0.00
Industrial	0.01	0.00	0.00	0.00	0.01
Landfills	0.00	0.00	0.00	0.00	0.00
Hazardous Wastes TSDFs:	0.00	0.00	0.00	0.00	0.00
Process	0.00	0.00	0.00	0.00	0.00
Fugitive	0.00	0.00	0.00	0.00	0.00
Solvent Waste Recovery	0.00	0.00	0.00	0.00	0.00
POTWs	0.29	0.00	0.00	0.00	0.29
Industrial WWTFs	0.01	0.00	0.00	0.00	0.01
WWTFs Process	0.00	0.00	0.00	0.00	0.00
Pretreatment	0.01	0.00	0.00	0.00	0.01
Industrial Boiler Co-firing	0.00	0.00	0.00	0.00	0.00
Others	0.00	0.00	0.00	0.00	0.00

SOURCE CATEGORIES	POINT	AREA	ON-ROAD	OFF-ROAD	TOTAL
OTHER MISCELLANEOUS SOURCES:	0.86	30.50	0.00	0.00	31.37
Fuel Combustion (external):	0.71	0.02	0.00	0.00	0.73
Utilities	0.00	0.00	0.00	0.00	0.00
Distillate Oil	0.00	0.00	0.00	0.00	0.00
Residual Oil	0.00	0.00	0.00	0.00	0.00
Natural Gas	0.00	0.00	0.00	0.00	0.00
Coal	0.00	0.00	0.00	0.00	0.00
Other	0.00	0.00	0.00	0.00	0.00
Industrial	0.71	0.00	0.00	0.00	0.71
Distillate Oil	0.00	0.00	0.00	0.00	0.00
Residual Oil	0.00	0.00	0.00	0.00	0.00
Natural Gas	0.02	0.00	0.00	0.00	0.03
Coal	0.01	0.00	0.00	0.00	0.01
Other	0.67	0.00	0.00	0.00	0.67
Commercial/Institutional	0.00	0.01	0.00	0.00	0.01
Distillate Oil	0.00	0.00	0.00	0.00	0.00
Residual Oil	0.00	0.00	0.00	0.00	0.00
Natural Gas	0.00	0.01	0.00	0.00	0.01
Coal	0.00	0.00	0.00	0.00	0.00
Other	0.00	0.00	0.00	0.00	0.00
Residential	0.00	0.01	0.00	0.00	0.01
Distillate Oil	0.00	0.00	0.00	0.00	0.00
Natural Gas	0.00	0.01	0.00	0.00	0.01
Open Burning:	0.00	0.11	0.00	0.00	0.11
Structural Fires	0.00	0.01	0.00	0.00	0.01
Forest/Agricultural	0.00	0.03	0.00	0.00	0.03
Other	0.00	0.07	0.00	0.00	0.07
Pesticide Applications	0.00	2.05	0.00	0.00	2.05
Stationary Internal Combustion Engines:	0.15	0.00	0.00	0.00	0.15
By Utilities	0.02	0.00	0.00	0.00	0.02
Reciprocate Engines	0.00	0.00	0.00	0.00	0.00
Distillate Oil	0.00	0.00	0.00	0.00	0.00
Residual Oil	0.00	0.00	0.00	0.00	0.00
Natural Gas	0.00	0.00	0.00	0.00	0.00
Other	0.00	0.00	0.00	0.00	0.00
Turbines Engines	0.01	0.00	0.00	0.00	0.01
Distillate Oil	0.01	0.00	0.00	0.00	0.01
Residual Oil	0.00	0.00	0.00	0.00	0.00
Natural Gas	0.00	0.00	0.00	0.00	0.00

SOURCE CATEGORIES	POINT	AREA	ON-ROAD	OFF-ROAD	TOTAL
Other	0.00	0.00	0.00	0.00	0.00
Non-Utilities	0.14	0.00	0.00	0.00	0.14
Reciprocate Engines	0.00	0.00	0.00	0.00	0.00
Distillate Oil	0.00	0.00	0.00	0.00	0.00
Residual Oil	0.00	0.00	0.00	0.00	0.00
Natural Gas	0.00	0.00	0.00	0.00	0.00
Other	0.00	0.00	0.00	0.00	0.00
Turbines Engines	0.14	0.00	0.00	0.00	0.14
Distillate Oil	0.00	0.00	0.00	0.00	0.00
Residual Oil	0.00	0.00	0.00	0.00	0.00
Natural Gas	0.13	0.00	0.00	0.00	0.13
Other	0.00	0.00	0.00	0.00	0.00
Bakeries	0.00	0.00	0.00	0.00	0.00
Biogenic Sources	0.00	28.32	0.00	0.00	28.32
MOBILE SOURCES:	0.00	0.00	6.60	12.48	19.08
On-highway Vehicles:	0.00	0.00	6.60	0.00	6.60
Light-duty Gasoline Cars (LDGV)	0.00	0.00	3.58	0.00	3.58
	0.00	0.00	2.07	0.00	2.07
Heavy-duty Gasoline Trucks (HDGV)	0.00	0.00	0.34	0.00	0.34
Heavy-duty Diesel Trucks (HDDV)	0.00	0.00	0.41	0.00	0.41
Other Highway Vehicles:	0.00	0.00	0.21	0.00	0.21
Motorcycles (MC)	0.00	0.00	0.20	0.00	0.20
Light-duty Diesel Cars (LDDV)	0.00	0.00	0.01	0.00	0.01
Light-duty Diesel Trucks (LDDT)	0.00	0.00	0.00	0.00	0.00
Inspection & Maintenance Credits	0.00	0.00	0.00	0.00	0.00
TCMs Credits	0.00	0.00	0.00	0.00	0.00
Non-highway Vehicles:	0.00	0.00	0.00	12.48	12.48
Rail	0.00	0.00	0.00	0.17	0.17
Aircraft	0.00	0.00	0.00	0.11	0.11
Military	0.00	0.00	0.00	0.02	0.02
Commercial	0.00	0.00	0.00	0.07	0.07
Civil	0.00	0.00	0.00	0.02	0.02
Airport Service Equipment	0.00	0.00	0.00	0.00	0.00
2-Stroke Gasoline	0.00	0.00	0.00	0.00	0.00
4-Stroke Gasoline	0.00	0.00	0.00	0.00	0.00
Diesel	0.00	0.00	0.00	0.00	0.00
Vessels:	0.00	0.00	0.00	1.61	1.61

S O U R C E C A T E G O R I E S	POINT	AREA	ON-ROAD	OFF-ROAD	TOTAL
Commercial Vessels	0.00	0.00	0.00	0.09	0.09
Distillate	0.00	0.00	0.00	0.09	0.09
Residual	0.00	0.00	0.00	0.00	0.00
Pleasure Craft	0.00	0.00	0.00	1.52	1.52
2-Stroke Gasoline	0.00	0.00	0.00	1.27	1.27
4-Stroke Gasoline	0.00	0.00	0.00	0.26	0.26
Diesel	0.00	0.00	0.00	0.00	0.00
Others Non-highway:	0.00	0.00	0.00	10.59	10.59
Recreational Equipment	0.00	0.00	0.00	0.67	0.67
2-Stroke Gasoline	0.00	0.00	0.00	0.41	0.41
4-Stroke Gasoline	0.00	0.00	0.00	0.26	0.26
Diesel	0.00	0.00	0.00	0.00	0.00
Agricultural Equipment	0.00	0.00	0.00	0.53	0.53
2-Stroke Gasoline	0.00	0.00	0.00	0.00	0.00
4-Stroke Gasoline	0.00	0.00	0.00	0.04	0.04
Diesel	0.00	0.00	0.00	0.49	0.49
Lawn & Garden Equipment	0.00	0.00	0.00	7.07	7.07
2-Stroke Gasoline	0.00	0.00	0.00	3.39	3.39
4-Stroke Gasoline	0.00	0.00	0.00	3.67	3.67
Diesel	0.00	0.00	0.00	0.01	0.01
Industrial Equipment	0.00	0.00	0.00	0.26	0.26
2-Stroke Gasoline	0.00	0.00	0.00	0.07	0.07
4-Stroke Gasoline	0.00	0.00	0.00	0.15	0.15
Diesel	0.00	0.00	0.00	0.04	0.04
Light Commercial Equipment	0.00	0.00	0.00	0.12	0.12
2-Stroke Gasoline	0.00	0.00	0.00	0.08	0.08
4-Stroke Gasoline	0.00	0.00	0.00	0.05	0.05
Diesel	0.00	0.00	0.00	0.00	0.00
Logging Equipment	0.00	0.00	0.00	0.04	0.04
2-Stroke Gasoline	0.00	0.00	0.00	0.04	0.04
4-Stroke Gasoline	0.00	0.00	0.00	0.00	0.00
Diesel	0.00	0.00	0.00	0.00	0.00
Construction Equipment	0.00	0.00	0.00	1.90	1.90
2-Stroke Gasoline	0.00	0.00	0.00	0.02	0.02
4-Stroke Gasoline	0.00	0.00	0.00	1.60	1.60
Diesel	0.00	0.00	0.00	0.28	0.28
SUB-TOTALS ANTHROPOGENIC	3.37	7.34	6.60	12.48	29.79
G R A N D T O T A L S	3.37	35.66	6.60	12.48	58.11

ILLINOIS STATEWIDE OZONE PRECUSOR EMISSIONS INVENTORY
1999 TYPICAL SUMMER DAY EMISSIONS OF OXIDES OF NITROGEN (NOx)
ROCK ISLAND COUNTY

*** Emissions Stated in Tons Per Day (TPD) ***

S O U R C E C A T E G O R I E S	POINT	AREA	ON-ROAD	OFF-ROAD	TOTAL
EXTERNAL FUEL COMBUSTION:	3.39	0.55	0.00	0.00	3.94
Utility Boilers	0.00	0.00	0.00	0.00	0.00
Distillate Oil	0.00	0.00	0.00	0.00	0.00
Residual Oil	0.00	0.00	0.00	0.00	0.00
Natural Gas	0.00	0.00	0.00	0.00	0.00
Coal	0.00	0.00	0.00	0.00	0.00
Other	0.00	0.00	0.00	0.00	0.00
Industrial Boilers	3.37	0.18	0.00	0.00	3.55
Distillate Oil	0.00	0.17	0.00	0.00	0.17
Residual Oil	0.00	0.01	0.00	0.00	0.01
Natural Gas	1.10	0.00	0.00	0.00	1.10
Coal	2.14	0.00	0.00	0.00	2.14
Other	0.13	0.00	0.00	0.00	0.13
Commercial/Institutional	0.02	0.18	0.00	0.00	0.19
Distillate Oil	0.00	0.00	0.00	0.00	0.00
Residual Oil	0.00	0.00	0.00	0.00	0.00
Natural Gas	0.01	0.18	0.00	0.00	0.19
Coal	0.00	0.00	0.00	0.00	0.00
Other	0.01	0.00	0.00	0.00	0.01
Residential	0.00	0.19	0.00	0.00	0.19
Distillate Oil	0.00	0.00	0.00	0.00	0.00
Natural Gas	0.00	0.19	0.00	0.00	0.19
STATIONARY INTERNAL COMBUSTION:	3.02	0.00	0.00	0.00	3.02
Utilites	0.46	0.00	0.00	0.00	0.46
Reciprocating Engines	0.04	0.00	0.00	0.00	0.04
Distillate Oil	0.00	0.00	0.00	0.00	0.00
Residual Oil	0.00	0.00	0.00	0.00	0.00
Natural Gas	0.00	0.00	0.00	0.00	0.00
Other	0.04	0.00	0.00	0.00	0.04
Turbines Engines	0.42	0.00	0.00	0.00	0.42
Distillate Oil	0.42	0.00	0.00	0.00	0.42
Residual Oil	0.00	0.00	0.00	0.00	0.00

SOURCE CATEGORIES	POINT	AREA	ON-ROAD	OFF-ROAD	TOTAL
Natural Gas	0.00	0.00	0.00	0.00	0.00
Other	0.00	0.00	0.00	0.00	0.00
Non-Utilities	2.56	0.00	0.00	0.00	2.56
Reciprocating Engines	0.00	0.00	0.00	0.00	0.00
Distillate Oil	0.00	0.00	0.00	0.00	0.00
Residual Oil	0.00	0.00	0.00	0.00	0.00
Natural Gas	0.00	0.00	0.00	0.00	0.00
Other	0.00	0.00	0.00	0.00	0.00
Turbines Engines	2.56	0.00	0.00	0.00	2.56
Distillate Oil	0.14	0.00	0.00	0.00	0.14
Residual Oil	0.00	0.00	0.00	0.00	0.00
Natural Gas	2.43	0.00	0.00	0.00	2.43
Other	0.00	0.00	0.00	0.00	0.00
OTHER COMBUSTION:	0.02	0.10	0.00	0.00	0.12
Waste Disposal (incineration):	0.02	0.08	0.00	0.00	0.10
Industrial	0.02	0.00	0.00	0.00	0.02
Governmental	0.00	0.00	0.00	0.00	0.00
Commercial/Institutional	0.00	0.05	0.00	0.00	0.05
Residential	0.00	0.03	0.00	0.00	0.03
Open Burning:	0.00	0.02	0.00	0.00	0.02
Structural Fires	0.00	0.00	0.00	0.00	0.00
Forest/Agricultural	0.00	0.00	0.00	0.00	0.00
Other	0.00	0.01	0.00	0.00	0.01
INDUSTRIAL PROCESSES:	0.09	0.00	0.00	0.00	0.09
Chemical Manufacturing:	0.00	0.00	0.00	0.00	0.00
Adipic Acid	0.00	0.00	0.00	0.00	0.00
Nitric Acid	0.00	0.00	0.00	0.00	0.00
Other Acid	0.00	0.00	0.00	0.00	0.00
Other	0.00	0.00	0.00	0.00	0.00
Iron and Steel Manufacturing	0.01	0.00	0.00	0.00	0.01
Iron and Steel - Process	0.01	0.00	0.00	0.00	0.01
Iron and Steel - Hot/Cold Rolling	0.00	0.00	0.00	0.00	0.00
Coke Ovens - Process	0.00	0.00	0.00	0.00	0.00
Coke Ovens - Fugitive	0.00	0.00	0.00	0.00	0.00
Mineral Products:	0.08	0.00	0.00	0.00	0.08
Cement	0.00	0.00	0.00	0.00	0.00

SOURCE CATEGORIES	POINT	AREA	ON-ROAD	OFF-ROAD	TOTAL
Glass	0.00	0.00	0.00	0.00	0.00
Other	0.08	0.00	0.00	0.00	0.08
Petroleum Refining	0.00	0.00	0.00	0.00	0.00
Other	0.01	0.00	0.00	0.00	0.01
MOBILE SOURCES:	0.00	0.00	12.28	6.81	19.09
On-highway Vehicles:	0.00	0.00	12.28	0.00	12.28
Light-duty Gasoline Autos (LDGV)	0.00	0.00	4.12	0.00	4.12
Light-duty Gasoline Trucks (LDGT1&LDGT2)	0.00	0.00	2.28	0.00	2.28
Heavy-duty Gasoline Trucks (HDGV)	0.00	0.00	0.50	0.00	0.50
Heavy-duty Diesel Trucks (HDDV)	0.00	0.00	5.26	0.00	5.26
Other Highway Vehicles:	0.00	0.00	0.11	0.00	0.11
Motorcycles (MC)	0.00	0.00	0.05	0.00	0.05
Diesel Autos (LDDV)	0.00	0.00	0.05	0.00	0.05
Diesel Trucks (LDDT)	0.00	0.00	0.01	0.00	0.01
Inspection & Maintenance Credits	0.00	0.00	0.00	0.00	0.00
TCMs Credits	0.00	0.00	0.00	0.00	0.00
Non-highway Vehicles:	0.00	0.00	0.00	6.81	6.81
Rail	0.00	0.00	0.00	0.67	0.67
Aircraft	0.00	0.00	0.00	0.26	0.26
Military	0.00	0.00	0.00	0.01	0.01
Commercial	0.00	0.00	0.00	0.24	0.24
Civil	0.00	0.00	0.00	0.01	0.01
Airport Service Equipment	0.00	0.00	0.00	0.00	0.00
2-Stroke Gasoline	0.00	0.00	0.00	0.00	0.00
4-Stroke Gasoline	0.00	0.00	0.00	0.00	0.00
Diesel	0.00	0.00	0.00	0.00	0.00
Vessels:	0.00	0.00	0.00	0.63	0.63
Commercial Vessels	0.00	0.00	0.00	0.55	0.55
Distillate	0.00	0.00	0.00	0.55	0.55
Residual	0.00	0.00	0.00	0.00	0.00
Pleasure Craft	0.00	0.00	0.00	0.08	0.08
2-Stroke Gasoline	0.00	0.00	0.00	0.02	0.02
4-Stroke Gasoline	0.00	0.00	0.00	0.04	0.04
Diesel	0.00	0.00	0.00	0.02	0.02
Others Non-highway:	0.00	0.00	0.00	5.25	5.25
Recreational Equipment	0.00	0.00	0.00	0.00	0.00
2-Stroke Gasoline	0.00	0.00	0.00	0.00	0.00
4-Stroke Gasoline	0.00	0.00	0.00	0.00	0.00

S O U R C E C A T E G O R I E S	POINT	AREA	ON-ROAD	OFF-ROAD	TOTAL
Diesel	0.00	0.00	0.00	0.00	0.00
Agricultural Equipment	0.00	0.00	0.00	2.30	2.30
2-Stroke Gasoline	0.00	0.00	0.00	0.00	0.00
4-Stroke Gasoline	0.00	0.00	0.00	0.00	0.00
Diesel	0.00	0.00	0.00	2.30	2.30
Lawn & Garden Equipment	0.00	0.00	0.00	0.20	0.20
2-Stroke Gasoline	0.00	0.00	0.00	0.00	0.00
4-Stroke Gasoline	0.00	0.00	0.00	0.13	0.13
Diesel	0.00	0.00	0.00	0.07	0.07
Industrial Equipment	0.00	0.00	0.00	0.54	0.54
2-Stroke Gasoline	0.00	0.00	0.00	0.16	0.16
4-Stroke Gasoline	0.00	0.00	0.00	0.05	0.05
Diesel	0.00	0.00	0.00	0.33	0.33
Light Commercial Equipment	0.00	0.00	0.00	0.03	0.03
2-Stroke Gasoline	0.00	0.00	0.00	0.00	0.00
4-Stroke Gasoline	0.00	0.00	0.00	0.00	0.00
Diesel	0.00	0.00	0.00	0.03	0.03
Logging Equipment	0.00	0.00	0.00	0.00	0.00
2-Stroke Gasoline	0.00	0.00	0.00	0.00	0.00
4-Stroke Gasoline	0.00	0.00	0.00	0.00	0.00
Diesel	0.00	0.00	0.00	0.00	0.00
Construction Equipment	0.00	0.00	0.00	2.18	2.18
2-Stroke Gasoline	0.00	0.00	0.00	0.00	0.00
4-Stroke Gasoline	0.00	0.00	0.00	0.00	0.00
Diesel	0.00	0.00	0.00	2.18	2.18
Biogenic Sources	0.00	1.31	0.00	0.00	1.31
SUB-TOTALS ANTHROPOGENIC	6.52	0.64	12.28	6.81	26.25
G R A N D T O T A L S	6.52	1.95	12.28	6.81	27.56

Included with Appendix D is a separate document, the Illinois Periodic Emission Inventory - 1999, prepared the Illinois Environmental Protection Agency.