St. Louis Air Quality Management Plan

Final Technical Report

MISSOURI
DEPARTMENT OF
NATURAL RESOURCES

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Executive Summary

In October of 2008, the Missouri Department of Natural Resources' Air Pollution Control Program (Air Program) undertook a pilot project to develop and implement an air quality management plan in the Missouri/Illinois bi-state St. Louis area. This final technical report has been prepared by the Air Program to cover the development and implementation the Air Quality Management Plan (AQMP) in St. Louis.

This report wraps up the AQMP project by explaining the process of developing and implementing the AQMP in the St. Louis, identifying lessons learned and barriers and obstacles encountered throughout the process, and offering suggestions for moving forward in regards to multi-pollutant planning strategies across the country.

Time Line

The following time line lists the dates that various milestones were completed and the dates that various obstacles were encountered throughout this project.

Event/Milestone	Date
Development of the work plan to establish the tasks necessary for the successful creation and implementation of the AQMP	**Jan. 2008**
EPA finalizes the 2008 ground-level ozone NAAQS	**Mar. 2008**
Submit a summary of the current status of St. Louis with respect to current air quality, planning activities, problems, outreach efforts, and SIP history	**May 2008**
State Innovation Grant Project Period Start Date	**Oct. 1, 2008**
Submit a draft conceptual model for the AQMP document	**Jan. 2009**
Submit draft of a quality assurance project plan (QAPP) for the creation and implementation of the AQMP	**Feb. 2009**
The Department purchases computer hardware and software capable of conducting the vast majority of the photochemical modeling and analyses necessary for implementation of the AQMP (not funded by the grant)	**Feb. 2009**
Submit final conceptual model for the AQMP document	**April 2009**
The Department develops a scoping document for programming changes to the Missouri Emission Inventory System (MOEIS) to allow for sources to more easily report speciated air toxics emissions and for the data to be more easily extracted and quality assured	**April 2009**
Development of the draft AQMP document	**April 2009 – Dec. 2009**
The department's information technology services division cancels the programming upgrades to MOEIS for air toxics reporting due to limited staff resources and budgetary restraints within the department	**Sept. 2009**
EPA announces they will reconsider the 2008 ground-level ozone NAAQS, which places implementation of the 2008 standard on hold	**Sept. 2009**
EPA promulgates final area designations for the 2006 24-hour $PM_{2.5}$ NAAQS, the St. Louis area is designated attainment/unclassifiable	**Oct. 2009**
Extraction of Missouri speciated air toxics emission inventory from point sources from 2007 MOEIS data	**Nov. 2009 – Nov. 2011**
Submit draft of the AQMP document to EPA	**Dec. 2009**
EPA proposes their reconsidered ground-level ozone NAAQS to replace the 2008 standard	**Jan. 2010**
Quality assured ambient air monitoring data is submitted to EPA and the design values for 2007 – 2009 in the St. Louis area are in compliance with the 1997 ground-level ozone NAAQS as well as the 1997 annual $PM_{2.5}$ NAAQS	**April 2010**
Submit final AQMP framework document to EPA	**May 2010**
Develop a request for proposals (RFP) to contract an environmental consultant to advise on modeling constructs and develop technical modeling inputs for a multi-pollutant SIP with intended focus on the reconsidered ozone standard	**June 2010 – Nov. 2010**
The Department selects 2007 for the base year for the modeling demonstration	**July 2010**
Department awards the inventory development and modeling input development contract to Environ	**Jan. 2011**
Draft modeling protocol submitted by Environ to the Department and it is shared with the AQMP team	**May 2011**
Final Modeling protocol submitted by Environ to the Department	**Aug. 2011**
EPA announces that they will not revise the Ozone NAAQS until the next 5-year review	**Sept. 2011**
The Department issues a stop work order for the contract with Environ	**Oct. 2011**
The Department submits revised area designation recommendations for the 2008 ozone standard based on more current air quality data	**Dec. 2011**
EPA makes final designations for the 2008 Ozone NAAQS and St. Louis is classified as a marginal nonattainment area	**May 2012**
Environ delivers the inventory data and the meteorological data files they had compiled prior to the stop work order	**June 2012**
The Department closes the contract for Environ	**Aug. 2012**
The Department submits a Final report for the AQMP State Innovation Grant to EPA	**Sept. 2012**
Project Period End Date	**Sept. 30, 2012**

Chapter 1 – Development of the St. Louis Air Quality Management Plan

1.1 Project Background

In the summer of 2007 based on on-going recommendations from the Clean Air Act Advisory Committee, Air Quality Subcommittee, the U.S. Environmental Protection Agency (EPA) asked states to consider volunteering for a pilot program to evaluate the use of Air Quality Management Plans (AQMP). The Clean Air Act Advisory Committee recommended the use of a multi-pollutant planning approach for air quality management by states instead of the traditional single-pollutant approach. An AQMP approach would examine effects of control strategies on multiple pollutants, reduce duplication of technical efforts, and allow for development of overall air quality priorities for each state/community in a more comprehensive fashion. The AQMP process is inherently designed to evaluate multiple pollutants collectively and incorporate ancillary issues associated with air quality planning (e.g., climate change, smart growth, transportation planning). Pursuant to this concept, EPA hosted a kick-off meeting in Raleigh, North Carolina to communicate the benefits and requirements of the AQMP approach.

The State of Missouri committed to developing an AQMP for the bi-state St. Louis area. The State of Illinois partnered with Missouri in the development of the St. Louis Air Quality Management Plan describing the AQMP process, priorities, and goals. USEPA Regions V and VII provided assistance and coordination for the effort along with personnel from the Office of Air Quality Planning and Standards (OAQPS). In addition, the local air quality agencies in St. Louis County and the City of St. Louis along with many other local stakeholders became involved with this effort. The AQMP effort in St. Louis was designed with an emphasis on reducing multiple air pollutants (including air toxics) and determining which control strategies will result in the greatest benefits for the St. Louis air shed.

The State of Missouri has completed dozens of State Implementation Plan (SIP) submittals. Each submittal requires a series of technical steps including evaluating historic meteorological events that contribute to nonattainment for a pollutant in a given area, developing emissions inventories for all relevant sources in the local area and beyond, selecting regional and local controls enabling the area to demonstrate compliance with the applicable air quality standard, and evaluating ambient air quality monitoring/modeling data to ensure compliance with the standard(s) based on the controls chosen. These submittals have required years of effort and countless staff hours. The development of the AQMP approach was intended to allow for a more efficient SIP process. In addition, the AQMP effort would include a consistent and comprehensive public outreach campaign to allow for all stakeholders to be involved at every point in the process and involve the EPA Regional Offices earlier in the process. The AQMP framework is envisioned to be the foundation for the next generation of SIP submittals, with the objective of designing modeling demonstrations and control strategies that address multiple criteria pollutants, such as ozone, fine particulates, sulfur dioxide, nitrogen dioxide, lead, while also considering air toxics exposure as an additional metric for evaluating control strategies.

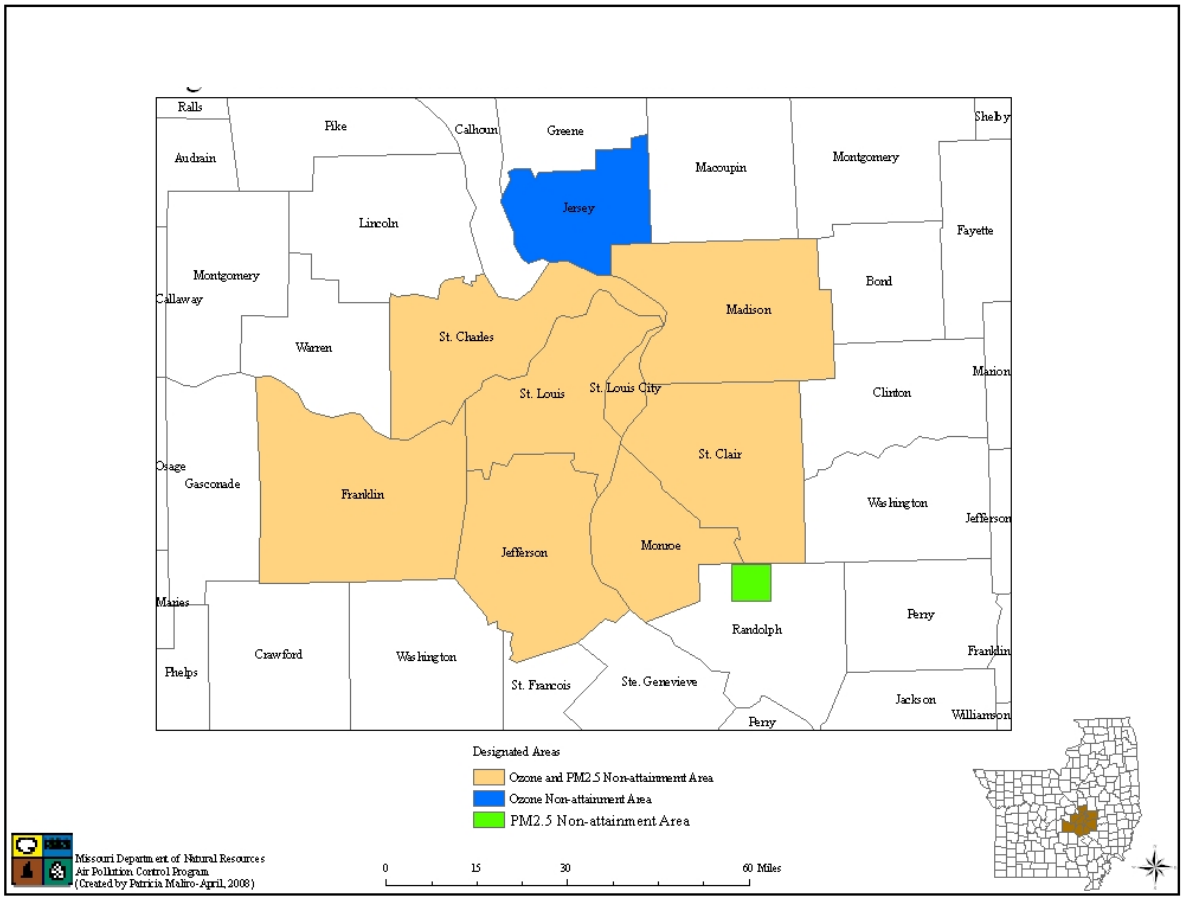
The air toxics to be addressed in the AQMP pilot were based on a monitoring study conducted during 2004-05 by the St. Louis academic and environmental community in conjunction with the state of Missouri. This group produced a report titled "St. Louis Community Air Project Air Toxics Risk Characterization." This report was a direct result of the region's effort to address environmental concerns expressed by residents, workers, and business owners in St. Louis. Specific air toxics of concern to the community cited in the report included: acetaldehyde, arsenic compounds, benzene, chromium compounds, formaldehyde, and diesel particulate matter. The AQMP pilot considered the co-benefits of reducing concentrations of these six air toxics when developing control strategies for criteria pollutant SIPs in the St. Louis area.

The overall goal of the AQMP is to provide a new mechanism to accomplish air quality planning and generate air quality improvements in a more efficient, expeditious, transparent, and cost-effective manner. The AQMP process is designed to allow for the flexibility necessary to adapt to changing air quality priorities that result from NAAQS revisions, improvement in air quality concentrations of certain pollutants, and new scientific knowledge. The lessons learned during the development of this plan and its implementation will allow the state of Missouri to communicate the problems, solutions, and outcomes of this process to other states and EPA for their implementation.

1.2 AQMP Pilot Project - Development of the Framework

At the time the AQMP framework was being developed, St. Louis was a bi-state nonattainment area for the 1997 annual fine particulate matter ($PM_{2.5}$) National Ambient Air Quality Standard (NAAQS) and the 1997 ozone NAAQS. The 1997 annual $PM_{2.5}$ nonattainment area included the following counties in Missouri and Illinois: (1) Franklin County, MO; (2) Jefferson County, MO; (3) St. Charles County, MO; (4) St. Louis County, MO; (5) St. Louis City, MO; (6) Madison County, IL; (7) Monroe County, IL; (8) St. Clair County, IL; and (9) a portion of Randolph County, IL (Baldwin Village). The 1997 8-hour ozone nonattainment area included all the previous counties and Jersey County, IL, but did not include the portion of Randolph County, IL in the annual $PM_{2.5}$ area. Figure 1 includes a map of the St. Louis nonattainment areas.

Figure 1 –Nonattainment Area for 1997 8-hour Ozone and 1997 Annual $PM_{2.5}$



The AQMP framework development process included input from numerous stakeholders through many meetings and conference calls throughout the process. In 2008, the AQMP team developed a document that summarized the current air quality and current air quality management strategies in the St. Louis area. This document outlined the anticipated NAAQS revision schedules at the time, summarized the design values in the St. Louis area for numerous pollutants and laid out expected planning priorities based on the current design values and the scheduled revisions of several NAAQS. The document is included in this report as Appendix A.

The next step was to develop the conceptual model for the AQMP. The conceptual model outlined the purpose of the AQMP along with the expected final products. The overall goal is to use the AQMP process to develop State Implementation Plans for criteria pollutants in violation of a NAAQS while considering air toxics exposure on the public. The conceptual model outlined the history and current status of the criteria pollutants ozone, lead, and $PM_{2.5}$ in the St. Louis area and also summarized the current air toxics inventory available for the St. Louis area. This conceptual model, which is included in this report as Appendix B, pointed to the need for creating a modeling construct that considers multiple pollutants and supports decision-making regarding control strategies with multi-pollutant benefits.

Once the conceptual model was completed, the team developed a draft quality assurance project plan (QAPP) for the AQMP process. The QAPP outlined the steps and tasks necessary for the successful implementation of the AQMP, identified sources where inventory data would be obtained, and specified how modeling and inventory data would be quality assured. The draft QAPP was submitted to EPA in December 2008, and EPA had several comments and issues regarding the document. Because the AQMP was still being developed, and the actual modeling constructs and sources for inventory development had not yet been selected, the EPA could not approve the QAPP. Nevertheless, the overall scope and general purpose of the draft QAPP, which is included in this report as Appendix C, could still be used. It was decided that once the SIP development process began for a criteria pollutant, an inventory development/modeling protocol document would also be created to outline the specific emissions inventory data sources and steps that would be taken to quality assure the data and inputs.

The conceptual model identified that the draft of the St. Louis Air Quality Management Plan needed to be completed by December 2009 in order for the project to remain on pace. Through a coordinated effort from the AQMP team with numerous conference calls, early document reviews, and meetings, the Air Program submitted the draft AQMP document to EPA by the December deadline. After a complete review by EPA and the AQMP team, comments were submitted and addressed and the final document was completed in May 2010. Although the Air Quality Management Plan was not an actual SIP revision and therefore did not need to be adopted by the Missouri Air Conservation Commission, the commission was kept informed throughout the pilot project. The commission has expressed support for the AQMP approach for air quality planning in the St. Louis area in the future. The final Air Quality Management Plan is included in this final report as Appendix D.

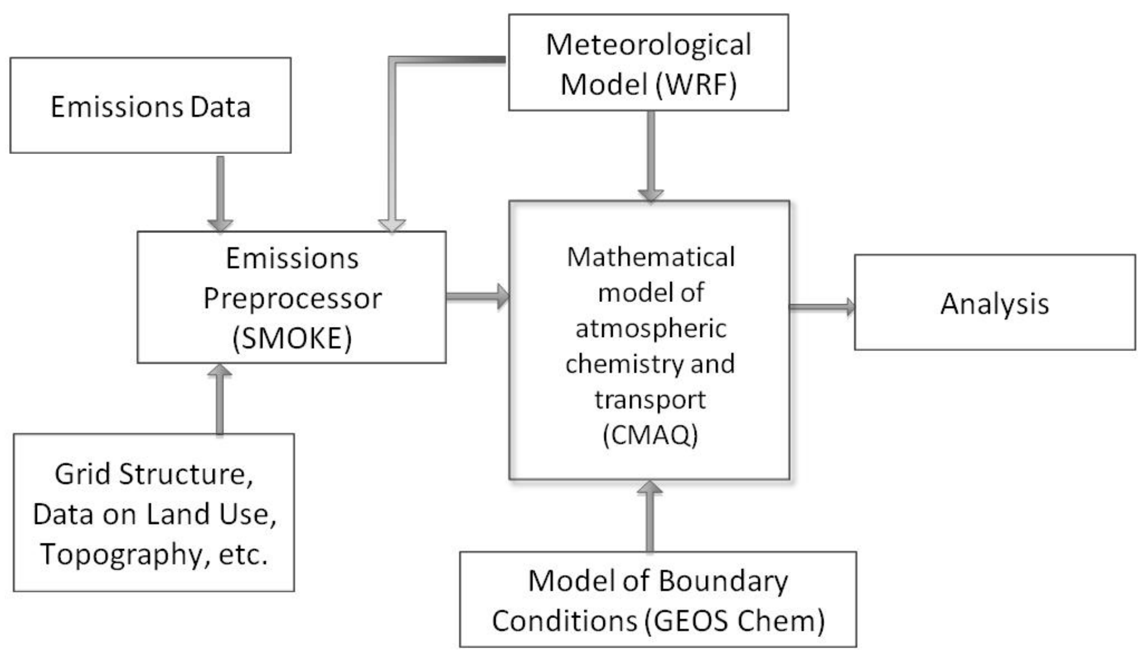
The conceptual model, draft QAPP, and final Air Quality Management Plan wrapped up successful completion of the pilot project. The next phase was to test the AQMP concept through development of an actual SIP revision. With more stringent ozone and $PM_{2.5}$ NAAQS on the way and the potential for new nonattainment issues in the St. Louis area, the Air Program committed to attempting to address these multiple issues in an integrated fashion by applying the principles and methods outlined in the AQMP framework to SIP development.

Chapter 2 – St. Louis AQMP SIP Development Strategy for Ozone, $PM_{2.5}$, and Air Toxics

The foundation of the multi-pollutant SIP would be a photochemical modeling construct that would support evaluation of control strategies and their impacts on ozone and $PM_{2.5}$, as well as co-benefits for air toxics, including acetaldehyde, arsenic compounds, benzene, chromium compounds, formaldehyde, and diesel particulate matter. The co-benefits occur because most of the air toxics being analyzed could also be classified as volatile organic compounds, direct/precursor emissions for fine particulate matter, or both. This would allow the state to perform a single comprehensive evaluation of multiple control strategy options, and demonstrate how various control techniques might impact ambient concentrations/design values for all relevant pollutants. A general modeling framework and protocol used in a similar study in the Detroit area was shared with the Air Program, which established a strong starting point for development of a modeling construct for the St. Louis airshed.

The Air Program decided to develop a modeling protocol and construct for the St. Louis airshed using contractor assistance. The contractor would help train modeling staff and assist in developing some of the technical elements. Specifically, the contractor would develop the modeling protocol, quality assure the emissions inventory information, format the emissions inventory data into model-ready input files, obtain and format meteorological data for the base year, perform the air quality modeling, compare the modeling results to actual air quality monitored values (model performance evaluation), and then model the attainment year for the pollutants of concern under various control strategy scenarios. The following is a diagram of the pieces of a modeling framework required to ultimately select the appropriate control strategies that allow the area to attain a NAAQS. For the AQMP, the general process depicted in the diagram would be followed; the primary distinction of a multi-pollutant approach would be the inclusion of ozone and $PM_{2.5}$ precursors, as well as air toxics, in the mix of pollutants modeled and assessed in the analysis and control strategy evaluation phase.

Basic Photochemical Air Quality Model Diagram



Chapter 3 – Inventory and Model Input Development Contract

In September 2010, the Air Program began developing a request for proposals (RFP) in order to obtain a contract for the technical model development necessary for the successful implementation of the AQMP. In anticipation of the reconsidered ozone standard, the technical requirements of the RFP focused on developing the photochemical model that was expected to be necessary to demonstrate attainment of the ozone NAAQS. The RFP also included development of the photochemical modeling inputs necessary to model $PM_{2.5}$ concentrations and air toxics. The air toxics modeling would only be done for a micro-scale domain focused on the City of St. Louis and a portion of St. Louis County. The primary goal of the project would be to support an attainment demonstration for the reconsidered ozone NAAQS, while also taking into account any co-benefits or negative impacts that control strategy options would have on ambient $PM_{2.5}$ and air toxic concentrations. Due to cost constraints ultimately limiting the $PM_{2.5}$ modeling to four months, it was understood that there would be a less-than-complete view of the co-benefits for $PM_{2.5}$ and the results would not be directly transferrable to any $PM_{2.5}$ NAAQS. In spite of these shortcomings, the limited $PM_{2.5}$ modeling would point to control strategies with potential benefits for $PM_{2.5}$ that could be investigated in further detail at a later point in time.

The limited funding available for the contract constrained the scope of work to development of a partial set of the technical elements needed to complete the multi-pollutant SIP. The Air Program would be responsible for the bulk of the work needed to generate the final product, including a significant portion of model input development, processing and analyzing modeling outputs, and control strategy development and analysis.

The Air Program selected a base year of 2007 for the modeling. The meteorology in 2007 was generally conducive to ozone formation, and many other regions of the country had already started preparing inventories and model-ready inputs for this year, which would reduce the amount of resources necessary to gather this critical data.

The modeling grid configuration included a 36 km domain that encompassed most of the country and portions of Mexico and Canada, a 12 km domain that encompassed most of the states in the Midwest, and a 4 km domain that included the entire state of Missouri and a large portion of Illinois along with small portions of Iowa, Nebraska, Kansas, Oklahoma, Arkansas, Tennessee, and Kentucky. A 1.33-km domain was also proposed that encompassed the City of St. Louis and a portion of St. Louis County. This 1.33 km domain was only to be used to model $PM_{2.5}$ and air toxics. (The original plan of using a 1 km domain for toxics and $PM_{2.5}$ was changed because of the technical difficulties that would have arisen with scaling a 4:1 nesting domain.)

In January 2011, Environ was awarded the contract for the RFP. The contract primarily involved development of the modeling protocol and a portion of the modeling inputs. It also included requirements for Environ to train Air Program staff to use a program that can convert outputs from EPA's Motor Vehicle Emissions Simulator (MOVES) into model ready inputs for the Sparse Matrix Operator Kernel Emissions (SMOKE) model, and also assist Air Program staff in setting up the meteorological and photochemical modeling runs necessary for the modeling process. The original end date of the contract was August 31, 2012.

The first step required in the contract was for Environ to develop a modeling protocol to define the models that would be used, the methods of quality assuring the data, the sources from which the inventory information would be gathered, the responsibilities of each party involved in the contract, and a timeline for when each milestone would be accomplished. The draft modeling protocol was submitted to the Air Program in May 2011, and was shared with the AQMP team for review. The AQMP team comments were discussed with Environ and the final modeling protocol was submitted in August 2011. The modeling protocol is included in this report as Appendix F. This modeling protocol can be used as a foundation for future multi-pollutant photochemical modeling efforts.

In addition to development of the modeling protocol, for the first 7 months of the contract, Environ worked on gathering the necessary 2007 inventory data from various regional planning organizations, states and other organizations. Some of this inventory data was already formatted into SMOKE-ready input files. For areas in the modeling domains where 2007 inventory information was unavailable, Environ obtained data from either 2006 or 2008 to be used as a substitute and made note of the regions and sources for which inventory information for 2007 was unavailable.

In September 2011, the reconsideration was halted and EPA announced they would proceed with implementation of the 2008 ozone standard. Based on the most recent quality-assured data for 2008-2010, St. Louis was anticipated to be a marginal nonattainment area for the 2008 ozone NAAQS, which is not required to develop a modeling-based attainment demonstration. Furthermore, during this time period, the modeling and engineering resources in the Air Program were diminishing as a result of staff turnover and a shift in planning priorities to address the 2010 SO_2 NAAQS and the 2008 lead NAAQS, both of which required modeled attainment demonstrations. In addition, looking ahead, uses for a 2007 base year modeling dataset appeared to be limited because it would be outdated if St. Louis were to be designated nonattainment for a potentially lower ozone or $PM_{2.5}$ NAAQS in the future. For these reasons and in recognition that successful completion of the contract and effort needed to develop a final product would require significant staff time and resources, the Air Program issued a stop work order to Environ.

In May 2012, EPA designated the St. Louis area as a marginal nonattainment area under the 2008 ozone NAAQS. Based on this status, the Air Program requested the inventory and modeling input files compiled by Environ prior to the stop work order in order to review the information and determine potential future uses of the data. Environ submitted this data in May 2012. Through review of the data, the Air Program has developed a better understanding of meteorological and SMOKE modeling input files that are needed to develop regional photochemical modeling constructs with a multi-pollutant focus.

In terminating the Environ contract, the Air Program fell short of completing the development of the photochemical modeling construct and therefore was unable to perform a control strategy analysis to analyze multiple pollutant impacts from various control strategy options. However, this exercise yielded improvements to the state's air toxics emissions inventory process and understanding as described further in the next chapter. In addition, the modeling protocol developed through the contract and the knowledge gained by the Air Program in reviewing the inventory and modeling input files will be used to improve processes and methods in future modeling efforts that the state undertakes.

Chapter 4 – St. Louis Criteria Pollutant and Air Toxics Emissions Inventories

4.1 Criteria Pollutant and Air Toxic Inventory Development

The point source inventory for Missouri was based on information collected on Emissions Inventory Questionnaires (EIQs). Facilities with a construction or operating permit from the Air Pollution Control Program are required to submit an EIQ on an annual basis per 10 CSR 10-6.110. The EIQ details the amount of air pollution emitted and other operational data for the previous calendar year. 2007 point sources include those with Part 70 and Intermediate operating permits.

Quality assurance of the 2007 Missouri point source emissions data consisted of two phases:

1. Phase I quality assurance consisted of addressing problems with individual EIQs in order to enter them into the Missouri Emissions Inventory System (MoEIS) and reconcile discrepancies with emission fee amounts. Examples of EIQ issues encountered include incorrect Source Classification Codes (SCCs), throughputs and emission factors with inconsistent units of measure, emission unit identifiers that were different from EIQs submitted previously and MoEIS-calculated emissions that differed from the emissions on the hard copy forms. Technical staff conducting these reviews worked with the companies to make corrections to their EIQs and placed written documentation of all changes in the EIQ files stored in the file room.

2. Phase II quality assurance consisted of a "top down" look at the emissions data as a whole after all EIQs had been entered into MoEIS. This phase involved running Access queries to identify potential issues to investigate further. The Phase II quality assurance queries focused on pollutant emission trends and AP-42/FIRE emission factors used for the SCCs contributing to the highest emissions from these types of sources. Any changes made to EIQs during the Phase II quality assurance process were done with input from the companies, and written documentation of all changes was placed in the EIQ files stored in the file room and listed in the EIQ review log. It details the individual EIQs reviewed and follow-up actions taken during both phases of the quality assurance. The column titled "QA" indicates whether the review was triggered by Phase I or Phase II. The review log describes any changes made to the EIQs and summarizes the initial and final emissions values. The log includes reviews conducted by the department's Air Pollution Control Program and the four local air agencies. In all, 187 EIQs had some level of technical review, almost 20% of the total number of full EIQs submitted for 2007.

In 2009, the Air Program began quality assuring 2007 point source air toxics emission data from MoEIS. The Air Program quality assured point source emissions data from sources within the St. Louis nonattainment area counties, and then extracted the air toxics data from MoEIS.

The Air Program has had concerns with the quality of area source air toxics emissions inventories and continues to review methods of developing and quality assuring area source air toxics emissions data. However, at the time of the development of the inventory for the AQMP, the best source for area source air toxics emissions inventories was EPA's National Emissions Inventory, which is updated every three years.

Illinois submitted to Missouri their 2008 criteria pollutants and air toxics inventories data for point, area, onroad and nonroad sources in the national emission inventory format (NIF). Further, the Air program obtained the 2007 point source continuous emission monitoring (CEM) data for both Missouri and Illinois from EPA's Clean Air Markets Division website. The Air program converted the Missouri and Illinois point and area source emissions inventories into SMOKE accepted input files for use in the modeling platform being developed through the Environ contract. The Illinois 2008 and Missouri 2007 point sources criteria and air toxics emissions inventories for each facility in the St. Louis nonattainment area counties can be found in Appendix G.

The SMOKE emissions model supports a variety of text-file input formats for criteria, toxics, and activity data inventories. The Air Program used Microsoft Access and Excel software to reformat and output the data in the specified format. With the exception of the on-road mobile formats for activity data (i.e. VMT and speed), none of the SMOKE inventory formats require specific inventory pollutants or limit the inventory pollutant types that can be imported. The Inventory Data Analyzer (IDA) format is typically used for criteria pollutant inventories, but there is no reason that mercury data, for example, could not be provided to SMOKE using this format (provided that the user does not need to have the MACT code associated with mercury emissions for other processing steps, since MACT codes are not part of the IDA format). Similarly, the One Record per Line (ORL) format is usually used for importing toxics data, but could also be used to import criteria inventories.

For this project, the Air Program converted VOC, CO, NOx, SO_2, PM_{10}, $PM_{2.5}$ and ammonia emissions to the IDA format and the toxics emissions (acetaldehyde, arsenic compounds, benzene, chromium compound and formaldehyde) to the ORL format. The toxics emissions are identified by their Chemical Abstract Service (CAS) registry number in the NIF. Table 1 shows the CAS numbers that were used to extract the toxics pollutants from the NIF for this project. The IDA and ORL formats used for the area-, onroad-, and point-source inventories require a set of header records at the beginning of each text file. The general format of the header records is shown in Table 2. Additional information on the specifications for the IDA and ORL input files is available on the SMOKE website (http://www.smoke-model.org/index.cfm).

The Air Program conducted two sets of quality-assurance of the process of converting the "raw" NIF emissions inventory data files into the SMOKE IDA and ORL input files. The first QA step was to export the IDA and ORL text file into a new Access database and sum emissions for each pollutant to ensure that each pollutant's total matched the original inventories from the NIF database. The second QA check involved processing the point and area source inventories in SMOKE and generating emissions reports based on tons/day. These reports were also compared to the original NIF datafiles.

Table 1: Chemical Abstract Service Registry Numbers for AQMP's Toxics

Toxics Name	**CAS**
Acetaldehyde	75070

Arsenic Compounds	EXH__7440382, 7440382, 7784409, 7778394, 7784421, 1327533, 3141126, 10031137, 93, EXH__93 & 1303282
Benzene	71432
Chromium Compounds	18540299, 7788989, 10294403, 18454121, 10588019, 14977618, 14018952, 7788967, 13765190, 7738945, 7758976, 13530659, 10034829, 14307336, 7789095, 7789006, 13530682, 7775113, 7789120, 1333820, 7778509, 7789062, 14307358, 11103869, EXH__18540299, 16065831, 50922297, 1308141, 10025737, 21679312, 1308389, 10060125, 10049055, 10101538, 12018018, 12018198, EXH__16065831, 136, EXH__7440473 & 7440473
Formaldehyde	50000

Table 2: Inventory Header Commands for IDA and ORL

Command	Parameter	Description and Values
#IDA #ORL #ORL NONPOINT #ORL FIRE #ORL FIREEMIS	N/A	N/A
#TYPE	File type	First nonblank character after #TYPE to the last character of the line. For on-road mobile activity data, the word "activity" must appear in this header entry; otherwise, SMOKE assumes that the file contains emissions data.
#COUNTRY	Country name	Valid names are those in the COSTCY file (US, CANADA, MEXICO, etc.)
#YEAR	Data year	Number from 1900 to 2200
#DESC	Description	Description of the data (not used by SMOKE)
#DATA or #POLID	data1 data2 ... data *n*	In IDA-format files, it defines the pollutants for which emissions data is provided; "data1" in the ID of the first pollutant, "data2" is the ID of the second pollutant, and so on. In wild/Rx fires ORL format files and day-specific #ORL FIREEMIS file, it defines a complete list of pollutant names from day-specific ORL FIREEMIS files; "data1" is the first pollutant name or CAS number, "data2" is the second pollutant name(or CAS number), and so on.
#UNITS	units1 units2 ... units *n*	Only used for on-road mobile activity data in IDA format. Defines the units associated with the activity data; "units1" are the units for "data1", "units2" are the units for "data2", and so on. Not used for emissions data because the units are built into the file formats.

The onroad mobile source air toxics inventory was intended to be determined by EPA's Motor Vehicle Emission Simulator (MOVES). The MOVES model was also to be used in developing the on road mobile inventory for ozone and $PM_{2.5}$ precursors. Because work was halted on developing the modeling construct, the Air program did not run the MOVES model to develop these emissions inventories for the purposes of the AQMP. However, several Air Program staff have attended MOVES trainings and developed the technical skills necessary to develop MOVES modeling inputs and analyze the MOVES outputs. Additionally, Air Program staff have recently enhanced their skills in developing NONROAD emissions inventories using the

EPA NONROAD 2008a model. Several MOVES and NONROAD modeling runs have been performed by the Air Program for the St. Louis area in recent years. Therefore, the Air Program has the technical resources and expertise to undertake future air toxics emissions inventory developments for mobile sources in the future.

4.2 Air Toxic Inventory Comparison

The Air Program examined air toxic ambient data collected at two different monitoring sites in St. Louis, Missouri. Specifically, staff compared and contrasted the annual arithmetic means of the chemicals of concern and the associated cancer risks identified in the St. Louis Community Air Project to the annual arithmetic means and the associated cancer risks of the chemicals of concern based on the ambient data collected at the National Air Toxics Trends Station from 2005 through 2010.

Overall, the comparison and contrast of the St. Louis CAP data analysis and the 2005 through 2010 NATTS data analyses indicated that with respect to air toxics, the ambient air quality measured at the St. Louis CAP monitoring site was similar to that measured at the NATTS monitoring site. Monitors at each site detected acetaldehyde, arsenic PM_{10}, benzene, and formaldehyde at ambient concentrations associated with excess cancer risks between one and six additional cases of cancer per an exposed population of 100,000. The largest number of excess cancers was associated with exposures to chemicals of concern of the "likely to be carcinogenic to humans" classification. Of these chemicals of concern, exposure to formaldehyde was the driver of this excess cancer risk. Though differences existed between the two data analyses due to the detection of chlorinated hydrocarbons; especially carbon tetrachloride and chloroform, acrolein, and acetonitrile, this difference may however be more of a reflection of the monitoring site's surroundings. The surroundings of the St. Louis CAP monitoring site were residential whereas those of the NATTS monitoring site are industrial.

This comparison and contrast therefore indicates that the spatial difference between the two monitoring sites, the current NATTS monitoring site is 4.2 miles to the northeast of the former St. Louis CAP monitoring site, has little effect on the ambient air quality with respect to air toxics within this narrow north-south corridor of the St. Louis City air-shed. Instead it is the combustion of coal and oil, the presence of petroleum products and the exhaust of mobile sources, and the occurrence of secondary formation that have a greater influence on making the ambient air quality of northern St. Louis City remarkably like that of southern St. Louis City. The full report generated through this review can be found in Appendix H of this final technical report.

This comparison gave insight to air toxics priorities and potential emission reduction targets. In absence of a fully developed working photochemical model, ambient air quality analysis and review of emissions inventory information can reveal areas with the potential for control. These candidate control measures can be fully evaluated and vetted through a multi-pollutant SIP development process in the future.

4.3 Air Toxic Emission Inventory Improvements

The Air Program's Emissions Inventory Unit continues to make efforts to improve its methods of collecting and quality assuring emissions inventory data. Over the past two years, a stronger focus has been placed on quality assuring all emissions inventory data (including air toxics data) that is submitted through MoEIS. In early 2009, the Air Program's emission inventory unit developed an initial scoping document for coding changes to be incorporated into MoEIS that would make it easier for sources to report their air toxics emissions, and easier for the Air Program to analyze and quality assure source specific air quality emission data. Unfortunately, due to budget and manpower constraints, this coding change was not approved. Despite not receiving the coding change upgrades, inventory staff have used tools at hand and their time and effort to expand HAP quality assurance in the last four years.

For 2008, fifteen facilities statewide were selected for further review because of an absence of HAP data when HAP data was expected or because the HAPs reported as VOC or PM_{10} were incompatible with VOC and PM_{10} emissions. For the 2009 reporting year, a thorough comparison was made between expected and actual HAP emissions. Emission factors were obtained from EPA's WebFIRE to calculate expected emissions. The resulting expected values were compared to actual reported emissions for the 3,900 HAP processes of the 2009 inventory.

For the 2010 reporting year, several different QA checks were done to identify potential errors including comparing MoEIS data to Toxic Release Inventory data, checking for identical HAPs in years 2009 and 2010, looking for missing HAP data, and finding sites with abnormally large year to year changes in HAP emissions. This allowed for a higher priority to be placed in areas where there were likely errors in the data, allowing for a more efficient use of resources during the QA process.

Quality assurance of 2011 HAP emissions will consist of the following checks:

- Determining if the HAP worksheets were updated at each facility
- Comparing data reported to the emissions inventory to data reported to the TRI
- Comparing the quantity of HAPs reported as VOC or PM_{10} to the VOC and PM_{10} emissions
- Comparing the amount of HAPs on the worksheets to the amount reported for the emission process
- Identifying any facility reporting HAPs with no detailed HAP worksheets

These steps will be modified, refined, and improved as needed for the quality assurance of future emissions inventories. Any facility with possible errors will be prioritized based on the likely magnitude of the error. Sites added to the high priority list will be contacted to resolve any identified issues. These improvements have allowed the Air Program to perform a much more efficient emission inventory QA process, specifically regarding HAP emissions, and have resulted in a much higher confidence in the quality of the HAP emissions data that the Air Program collects. The improvements to the air toxics emissions inventory will allow the Air Program to develop higher quality emission modeling inputs in future air toxics exposure studies that can be used for public outreach and education and also in determining air toxics co-benefits for future control strategy analyses.

Chapter 5 – Moving Forward/Lessons Learned

Ozone continues to be an issue in the St. Louis area. During the summer of 2012, the state of Missouri experienced unprecedentedly high temperatures, low wind speed, and low amounts of precipitation. Many areas of the state experienced some of the worst drought conditions seen in decades. Eight-hour average ozone concentration levels were higher in 2012 than those recorded in the last 5 – 10 years. Though the St. Louis region had achieved clean data for the 1997 ozone NAAQS for consecutive three-year periods from 2007-2011 and the Air Program was in the process of redesignating the area to attainment, one monitor in the area recorded a 4th highest 8-hour average ozone concentration high enough to violate this standard. This occurrence shows that future planning and modeling demonstrations based on more extreme weather pattern possibilities would be beneficial as opposed to solely using meteorological data representative for the area in a "typical" year. The Air Program continues to coordinate with EPA to understand the impacts of this violation of the 1997 ozone NAAQS.

In addition to ozone, other air quality planning priorities are emerging for the state and the St. Louis area. In December 2012, the EPA revised the national ambient air quality standard for $PM_{2.5}$. The Air Program is currently reviewing emissions and monitoring data in St. Louis and other areas of the state in developing the boundary designation recommendations. At the time of this writing, two monitors on the Illinois side of the greater St. Louis metropolitan area are violating the 2012 annual $PM_{2.5}$ NAAQS. Should the St. Louis area ultimately be designated nonattainment under the 2012 annual $PM_{2.5}$ NAAQS, this could provide for another opportunity to implement the framework established through the AQMP in St. Louis. Other air quality issues include the 2010 SO_2 NAAQS, the 2010 NO_2 NAAQS, and a potentially lower ozone NAAQS resulting from the next scheduled review.

The AQMP document developed for the St. Louis area establishes the framework for future air quality planning efforts. The framework, as well as improvements to multi-pollutant emissions datasets made through the AQMP process, is expected to greatly improve the quality, transparency, and efficiency of future SIP development efforts. While obstacles to developing multi-pollutant SIPs are still prevalent, the Air Program believes that multi-pollutant planning will be an efficient and cost effective planning strategy in the future, especially as NAAQS continue to be tightened as a result of new scientific evidence.

5.1 AQMP Accomplishments

- **Development of the Air Quality Management Plan**
  The AQMP completed in May 2010 (Appendix D) establishes the overall goals, processes, and public outreach tasks necessary for the successful implementation of multi-pollutant planning efforts in the St. Louis area. It also allows for consideration of smart growth, greenhouse gas reductions, environmental justice, and air toxics exposure in the traditional SIP-based air quality planning process. This document can be shared with regions around the country as a template for areas wishing to develop mulit-pollutant air quality management plans.

- **Development of the Ozone, $PM_{2.5}$, and Air Toxics Modeling Protocol**
  The modeling protocol developed by Environ and the Air Program details the steps needed to develop a multi-pollutant photochemical modeling construct for the St.

Louis area. The methods for selection of various preprocessor/postprocessor models, selection of modeling domains and receptor grid sizes, sources of base year emission inventory data, model performance evaluation techniques, and the development of future year control strategy modeling are described in detail. These methods and approaches can be shared with regions around the country wishing to develop photochemical modeling capabilities that address multiple pollutants.

- **Improved/Acquired Technical Modeling Skills for Air Program Staff**
  Through the creation of multi-pollutant SMOKE input files and review of the modeling protocol, emission inventory data, and modeling inputs submitted by Environ through the AQMP, Air Program modeling staff have gained a better understanding of the development of photochemical modeling constructs to address multiple pollutants. Additionally, through exercises necessary for emission inventory development, Air Program staff continue to enhance their skills with mobile emission models such as MOVES and NONROAD. These skills will certainly improve future SIP development efforts that the Air Program undertakes and will conserve resources for the state perhaps allowing for multiple pollutants to be included in future modeling exercises.

- **Improved QA Processes for Emission Inventory Submissions**
  Through the AQMP process, the state has improved its quality assurance methods for inventory data submitted to the Department. This includes inventory data for criteria air pollutants as well as air toxics. These improved methods have allowed the state to conserve resources during the quality assurance process by taking steps that have the greatest chance of discovering erroneous data but require the least amount of resources. These improvements will allow for higher confidence in future emissions inventory data to be used in future modeling exercises for both Missouri and other areas of the country that may use Missouri's emissions inventory data in future efforts.

- **Increased Understanding of Air Toxics Concentrations in the St. Louis Area**
  The review of the air toxics data obtained through the St. Louis Community Air Project and the National Air Toxics Trend Station in St. Louis have led to a greater understanding of the air toxics concentrations in the St. Louis area. The comparison study also helps validate and increase confidence in each of these studies. Having a more thorough understanding of air toxics concentrations, associated cancer risks, and the source types contributing to air toxics concentrations, future $PM_{2.5}$ or ozone control strategies can target these areas in order to achieve the greatest public health co-benefits when addressing future NAAQS requirements.

5.2 Multi-Pollutant Planning Obstacles

- **NAAQS Uncertainty and Shifting Air Quality Planning Priorities**
  - NAAQS Revisions:
    The Clean Air Act requires each NAAQS be reviewed every five years and revised as necessary to assure protection of public health. In addition, the Clean Air Act establishes rigid deadlines for NAAQS to be addressed once they are

revised. For this reason, unless two pollutants are on the exact same NAAQS review cycle, a multi-pollutant planning approach may not allow states to submit SIPs by the required deadlines, which could put them at risk of receiving a finding of failure to submit from EPA. Further complicating planning efforts is the increasing prevalence of litigation surrounding NAAQS revisions, which can delay implementation and adds uncertainty to the air quality planning process.

- Boundary Designations and Classifications:
  For nonattainment areas, the deadlines for attainment SIP submittals prescribed in the Clean Air Act are based on when the area was designated nonattainment. Additionally, if air quality improves in an area after it has been designated nonattainment then certain SIP elements can become suspended. Both of these issues can drive air quality planning priorities for states throughout the country and can also cause those priorities to shift rapidly.

- **Diminishing State Resources**
  - Core state funding mechanisms:
    Many states have faced budget cuts over the last four or five years. These cuts have caused technical positions to be eliminated, vacancies to go unfilled for extended periods of time, and other cost saving measures to be implemented such as extending equipment attrition schedules and traveling restrictions. For state air quality agencies, funding levels are often based on emission fees. As emissions continue to decline based on federal and state control measures, this improves air quality; however, it also decreases funding levels for core activities of air quality agencies. Furthermore, state air quality agencies depend largely on federal grants received for core activities. If these grants are eliminated or reduced in years to come this further limits the resources that state agencies have to accomplish their core activities.
  - Increasing Air Quality Agency Responsibilities:
    As NAAQS are revised based on the Clean Air Act required five year reviews of new scientific evidence, this can result in new nonattainment areas as well as new monitoring requirements for state air quality agencies. These changing requirements and priorities can prompt shifts in resources in order to address the issue at hand.

- **High Cost of Photochemical Modeling Development**
  - Pollutants such as ozone and $PM_{2.5}$ are impacted significantly by regional emissions. In order to develop a working photochemical model for $PM_{2.5}$ and ozone, emissions inventories from across the country and even parts of Mexico and Canada need to be collected. The higher the quality of the emissions inventory, the higher the quality of the model to predict pollution concentrations. Developing a quality emissions inventory for such a large geographic area is resource intensive, especially for individual states. While many states continue to develop their technical skills for generating inputs for photochemical modeling, this is still an area of expertise that many states are lacking. If photochemical modeling is needed by states with nonattainment $PM_{2.5}$ or ozone areas, many elect to contract the work out to environmental consultants at significant costs to the

state. Furthermore, once photochemical modeling constructs are developed, their usefulness is limited to a small range of years based on the changing nature of emissions inventories that are critical to provide confidence in the predicted concentrations produced by the model.

5.3 Moving Forward and Suggestions

- **Aligning NAAQS Revisions for Regionally Impacted Pollutants**
  Missouri suggests that to aid agencies in developing multi-pollutant plans for $PM_{2.5}$ and ozone, EPA could attempt to align the NAAQS revision dates for these two criteria pollutants as was done in 1997 when the ozone and $PM_{2.5}$ NAAQS were both revised in the same year. For these pollutants, which are impacted significantly at the regional level, this would create a strong incentive to develop multi-pollutant SIP development that result in control strategy analyses that investigate and consider the co-benefits that ozone control measures will have on $PM_{2.5}$ concentrations and vice versa, especially in areas that are designated nonattainment for both pollutants.

- **Coordinate SIP-Quality Emissions Inventory Data Nationally**
  Missouri suggests that EPA contemplate recommending a preferred base year for all $PM_{2.5}$ and ozone nonattainment areas to use prior to the start of planning efforts by the states. Then a nationally coordinated emissions inventory could be developed and formatted into emission model ready input files that could be used by all states that need to perform photochemical modeling as part of an attainment demonstration. This would allow for the larger modeling domains (36km and 12km) in the photochemical model to be developed much more easily and quickly. Without such a nationally coordinated inventory, the data collection and quality assurance of such data is resource intensive for individual states to undertake the task by themselves. A national effort would also relieve a number of the regional planning organizations from having to develop these types of inventories in house.

  Emissions inventory collection and evaluation tools continue to improve. Missouri has implemented a number of improvements and efficiencies in its emissions inventory reporting and quality assurance systems. These types of improvements should occur not only in Missouri, but also at the national level. Data sharing techniques should improve as well so that emissions data can be shared between states and other agencies easily and efficiently. National coordination and EPA guidance for preferred emissions data collection and quality assurance mechanisms, particularly for air toxics which are not currently required to be reported to the National Emissions Inventory, would greatly improve the consistency and quality of emissions data across the country.

- **Future Uses for Air Toxics Exposure Studies**
  Incorporating knowledge from air toxics exposure studies into future SIP developments can provide increased public health benefits. As air toxics emissions inventory data in Missouri continues to improve, air toxics exposure levels and air

toxics co-benefits of ozone and $PM_{2.5}$ related control strategies can be considered in the selection of control measures included in future SIPs.

- **Micro-Scale Multi-Pollutant Analyses**
  Although significant roadblocks exist for regional multi-pollutant model development, micro-scale multi-pollutant models are a possibility that could be researched further. These models could be used to analyze the ambient concentrations of air pollutants of concern that tend to be more localized, and that do not tend to travel at regional levels once emitted. Examples include carbon monoxide, lead, SO_2, NO_2, and air toxics. Such models could be developed with fewer resources because these types of pollutants are not impacted as greatly by regional emissions, which would reduce the need for quality emissions inventory data at the regional or national level. These models could potentially be used to site future near-road monitors that measure multiple pollutants, or could also be used in micro-scale environments where unique sets of sources are clustered together in a small area. The same principles of the AQMP could be incorporated into these exercises where multi-pollutant co-benefits can be investigated and used to select control strategy options that generate the biggest public health benefits for the dollars spent.

- **Voluntary Emission Reduction Strategies**
  Voluntary approaches may be beneficial for educating business and industry groups, citizens, and communities on steps they can take to reduce air emissions. Particularly for states such as Missouri that have state statutes prohibiting actions stricter or sooner than federal requirements, voluntary efforts can be an effective component of a multi-pollutant strategy to address air toxics within a SIP framework. The Air Program continues to support local organizations and EPA efforts to encourage voluntary emission reduction strategies throughout the country. Areas that implement voluntary Clean Air Action Plans have the potential to improve their air quality levels and could avoid mandatory control regulations.

- **Continued Public Outreach Improvement**
  Public outreach and education are an integral part of the AQMP process. East West Gateway's Air Quality Advisory Committee (AQAC) holds meetings about 7 – 10 times per year. These meetings are open to the public and numerous stakeholders such as public interest groups, environmental groups, and regulatory agencies attend these meetings regularly. These meetings provide an ideal opportunity for public outreach and education. The AQAC meetings typically include updates from the state air agencies, presentations about air quality topics of interest, updates on air quality concentrations, upcoming and recently promulgated rules, air quality studies, and other regional planning activities.

  Both East West Gateway and the Department maintain websites dedicated to providing updated information to the public regarding air quality issues in the St. Louis area. Presentations given at AQAC meetings along with minutes from past meetings are posted on East West Gateway's website.

The Department also has its own air program advisory forum, where industry and other interested parties meet to discuss recent and upcoming regulatory activities. This provides all stakeholders with an open forum to discuss the implications of state and federal rulemakings.

Finally, in addition to the AQAC and the air program advisory forum meetings, the Department also schedules regional outreach meetings when specific air quality priorities arise, such as NAAQS revisions, boundary designations, and SIP development. All of these outreach and education activities take place on a continual basis, and provide a means for informing the public and other stakeholders of the air quality planning activities and priorities affecting the St. Louis area. These types of public outreach efforts in the St. Louis area are also used in other areas of the state and can be used as a model in regions across the country. These public outreach practices are expected to continue and also expected to be built and improved upon in the future to ensure public and stakeholder involvement throughout future air quality planning efforts.

Chapter 6 – Conclusion

Multi-pollutant planning is expected to be an efficient and cost-effective planning strategy in the future, especially as NAAQS continue to be tightened as a result of new scientific evidence. However, in order to expedite the transition to multi-pollutant planning, improvements must continue to be made to emissions inventory data collection mechanisms at the national level, more detailed and early guidance regarding SIP requirements and base year selections for regional criteria pollutant NAAQS revisions should be issued by EPA. Most importantly, implementation schedules and deadlines for planning obligations for PM2.5 and ozone NAAQS should be harmonized to the greatest extent possible.

Public outreach efforts need to continue and multi-pollutant planning can help inform the public of the benefits associated with these efforts. Improvements also must continue to be made to better understand air toxics exposure levels. In addition, air agencies should consider the use of micro-scale multi-pollutant planning efforts in the near future when applicable. The AQMP framework, modeling protocol, and improvements to public outreach and technical modeling skills are tools that can be used in the future to develop cost-effective air quality plans with the greatest impact on public health.

Appendices

Appendix A	- Summary of the Current Status of St. Louis Air Quality and Air Quality Management
Appendix B	- St. Louis AQMP Conceptual Model
Appendix C	- Draft Quality Assurance Project Plan (QAPP) for the AQMP
Appendix D	- St. Louis Air Quality Management Plan
Appendix E	- MDNR/Environ Contract
Appendix F	- MDNR/Environ Modeling Protocol
Appendix G	- St. Louis Missouri/Illinois Point Source Air Toxics Inventory
Appendix H	- Comparison of Air Toxics Data Collected - St. Louis Community Air Project and the National Air Toxics Trends Station