2010 1-HOUR SULFUR DIOXIDE BOUNDARY RECOMMENDATION

And

Technical Support Document for Recommendation of Nonattainment and Unclassifiable Boundaries in Missouri for the 2010 SO_2 National Ambient Air Quality Standard

Prepared for the
Missouri Air Conservation Commission
(Adoption: May 26, 2011)

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Table of Contents

List of Figures

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1.0 Introduction

In June 2010, the U.S. Environmental Protection Agency (EPA) promulgated a revision to the National Ambient Air Quality Standard (NAAQS) for sulfur dioxide (SO_2), which establishes "a new 1-hour SO_2 standard at a level of 75 parts per billion (ppb), based on the 3-year average of the annual 99^{th} percentile of 1-hour daily maximum concentrations." This new standard replaces both the 24-hour and annual standards.

As provided under Clean Air Act Subparagraph 107(d)(1)(A), the governor of each state is required to submit to the EPA a recommendation regarding the attainment status of all areas within that state. This recommendation is due to EPA by June 2, 2011. Each area of the state shall be recommended for designation as:

- nonattainment for areas that do not meet the NAAQS or contain sources that contribute to nonattainment in a nearby area,
- attainment for areas that meet the NAAQS, or
- unclassifiable for areas that cannot be classified as attainment or nonattainment based on available information.

The purpose of this document is to provide the technical bases for the recommendations described in the 2010 1-Hour Sulfur Dioxide Boundary Recommendation.

The primary source of SO_2 emissions is the combustion of sulfur-bearing coal for power generation, either by utilities or by industries. As coal is burned, the elemental sulfur combines with oxygen to form gaseous SO_2. The sulfur content of coal varies widely, from less than one percent to over three-and-one-half percent. The life span of gaseous SO_2 is limited because it is quickly oxidized further into sulfate (SO_4^{2-}). The sulfate binds to atmospheric ammonium (NH_4^+) to form ammonium sulfate, one of the major constituents of another criteria pollutant-Fine Particulate Matter ($PM_{2.5}$). Other significant emission sources in Missouri include smelting of sulfur-bearing ores, such as lead sulfide.

In establishing the form and level of the new standard, the EPA referred to studies that "infer a causal relationship between respiratory morbidity and short-term exposure to SO_2." On the basis of these studies, EPA dramatically reduced the averaging time of the standard in addition to lowering the level of the standard.

EPA studies show that children, the elderly, and asthmatics are the most sensitive subpopulations to SO_2 exposure. For these subpopulations, decreased lung function, increased respiratory symptoms, and more hospital admissions and emergency room visits all characterize their exposure to SO_2. In particular, asthmatics exercising or playing while exposed to SO_2 represent a high-risk group as they may experience bronchoconstriction, respiratory symptoms, and rapid swallow breathing in response to this exposure. In typical asthmatics, SO_2 exposure enhances the effect of exercise, causing greater than usual increases in airway resistance and wheeze. This response occurs at concentrations only a fraction of those required to affect healthy people.

As mentioned previously, SO_2 can also react with other compounds in the atmosphere to create small particles, collectively known as $PM_{2.5}$. These particles can penetrate deeply into sensitive parts of the lungs and may cause or worsen respiratory diseases such as emphysema and bronchitis. They can also aggravate existing heart disease, leading to increased hospital admissions and premature death.

2.0 Method of Determining Attainment Status and Boundaries

The EPA has chosen to take a different approach to determine compliance with the 1-hour SO_2 NAAQS. Unlike other criteria pollutants, SO_2 is an almost exclusively point source emitted pollutant. A monitoring network large enough to adequately cover all large sources would be prohibitively expensive and an affordable network would leave large gaps in coverage. Therefore, EPA has decided to use a hybrid monitoring-modeling approach for SO_2. This hybrid approach involves a modest monitoring network and extensive use of refined air dispersion modeling.

- Nonattainment areas will be determined by either monitoring or modeling data which show a violation, or likely violation, of the standard.
- Both monitoring and modeling are required to show attainment.
- Areas without either monitoring or modeling data will be designated unclassifiable.

Since the final SO_2 rule states that modeling is not required for initial nonattainment determinations and EPA's modeling guidance was not available in time for the Department to take these recommendations through its public process and meet the June 2, 2011 deadline, at this time the boundary recommendations are based on factors other than modeling. Therefore, in this initial round of recommendations, no areas can be recommended as attainment; areas that monitor or that likely contribute to violations will be recommended as nonattainment; and all other areas of the state will be recommended as unclassifiable. As the SO_2 modeling guidance is released and finalized, the Department intends to conduct refined dispersion modeling of SO_2 sources in accordance with EPA's guidelines and provide additional technical justification as needed for recommended nonattainment area boundaries.

Because all areas of the state are evaluated without modeling at this time, only those areas with violating monitors and areas immediately surrounding them are addressed in this document. For 2007-2009, the four violating monitors are Troost in Kansas City, Main Street in Herculaneum, and James River & South Charleston in Springfield. Sources in these three counties (Greene, Jackson, and Jefferson) and surrounding areas (neighboring counties) were considered in the analysis to determine their likely impact on the violating monitors. If emissions from a particular area in Missouri are determined to have a substantial impact on the violating monitor, that area is included in the recommended nonattainment area.

As stated in the preamble of EPA's final SO_2 rule, county lines are the presumptive boundaries for SO_2 nonattainment areas. Therefore, county boundaries were the starting point for this analysis. The information contained in this document demonstrates why a smaller area (less than countywide) for nonattainment boundary recommendations is appropriate for all three counties containing monitors that do not meet the 1-hour SO_2 NAAQS.

EPA expects to issue final designations by June 2012. If the EPA intends to modify the state's recommendations or needs additional technical justification to support the designation, they will notify the Department 120 days prior to finalizing the designations. For the SO_2 standard, these "120-day" letters are expected to be released around February 2012. The Department will then be required to submit attainment state implementation plans (SIPs) for nonattainment areas to EPA by February 2014 outlining actions that will be taken to meet the standard.

The Department expects that some SO_2 emission sources located in the recommended unclassifiable areas may contribute to violations of the 1-hour SO_2 standard. These sources will be evaluated with refined modeling analyses when EPA provides official modeling guidance. Any sources contributing to SO_2 violations will be addressed in the Infrastructure SIP due June 2013.

As outlined in the final SO_2 rule, the Infrastructure State Implementation Plan (SIP) for the 1-hour SO_2 NAAQS will be similar to the conventional attainment SIP for nonattainment areas in that they must include emission inventories, enforceable emission limits, timetables for compliance, refined dispersion modeling demonstrating timely attainment (by 2017), and contingency measures. Since each state is required to submit an Infrastructure SIP for all areas not designated as nonattainment, Missouri intends to develop such an Infrastructure SIP as an enforceable tool to ensure all areas of the state, including unclassifiable areas, comply with 1-hour SO_2 NAAQS no later than August 2017. Missouri also expects the development and implementation of the Infrastructure SIP will eliminate the need to reclassify any additional areas as nonattainment, besides the initial boundary recommendations to be approved by EPA in June 2012, prior to the August 2017 deadline to demonstrate attainment.

On February 17, 2011, a preview of EPA's draft Boundary Recommendation guidance was released. In that document, EPA lists a number of different factors to be considered when establishing boundaries for nonattainment areas:

- Monitoring data
- Emissions, including growth, controls, and regional emission reductions
- Meteorology
- Topography
- Jurisdictional boundaries

Each of these factors is discussed in the following sections to determine the extent they play in contributing to the violations recorded at the violating monitors.

There is a limit to the influence an emission source has on downwind SO_2 concentrations. This limit is determined by several factors, the most important of which are the rate of SO_2 emissions, the conversion rate from SO_2 to SO_4^{2-}, stack height, and wind speed. Maximum emission rates are determined by a facility's construction or operating permit, or by the size of its boilers if there is no permit limit. Stack parameters, such as height, width, and exit gas temperature and velocity, can greatly affect SO_2 concentrations. Higher stack heights, temperatures, and exit velocities all lead to increased dispersion and lower concentrations. Higher wind speeds have the effect of diluting SO_2 concentrations by increasing the distance traveled from the source during the conversion process. Slower winds speeds have the opposite effect. These factors combine to determine the extent to which an emission source influences the SO_2 concentration at

nearby locations. All these considerations are also taken into account when determining the recommended boundaries.

3.0 Monitoring Data

Sulfur dioxide was monitored at nine locations in Missouri by state and local agencies and two additional sites operated by industry during recent years including most of 2010. Operation of five of these sites, all of which were well below the new NAAQS, was temporarily discontinued in September 2010 with the approval of US EPA Region VII. Figure 1 shows the locations of these sites as well as the location of the Blair Street site in St. Louis, where SO_2 monitoring began in January 2011. The final SO_2 rule included minimum monitoring requirements that are currently met for St. Louis, Kansas City, and Springfield. However, to better characterize the spatial distribution of SO_2 in the Kansas City area, the Department may add at least one additional site in the Kansas City area beginning in January 2013. Additional SO_2 monitors near emission sources may also be added depending on the result of modeling and other analysis. The locations of additional sites will be identified in Missouri's July 2012 air monitoring plan.

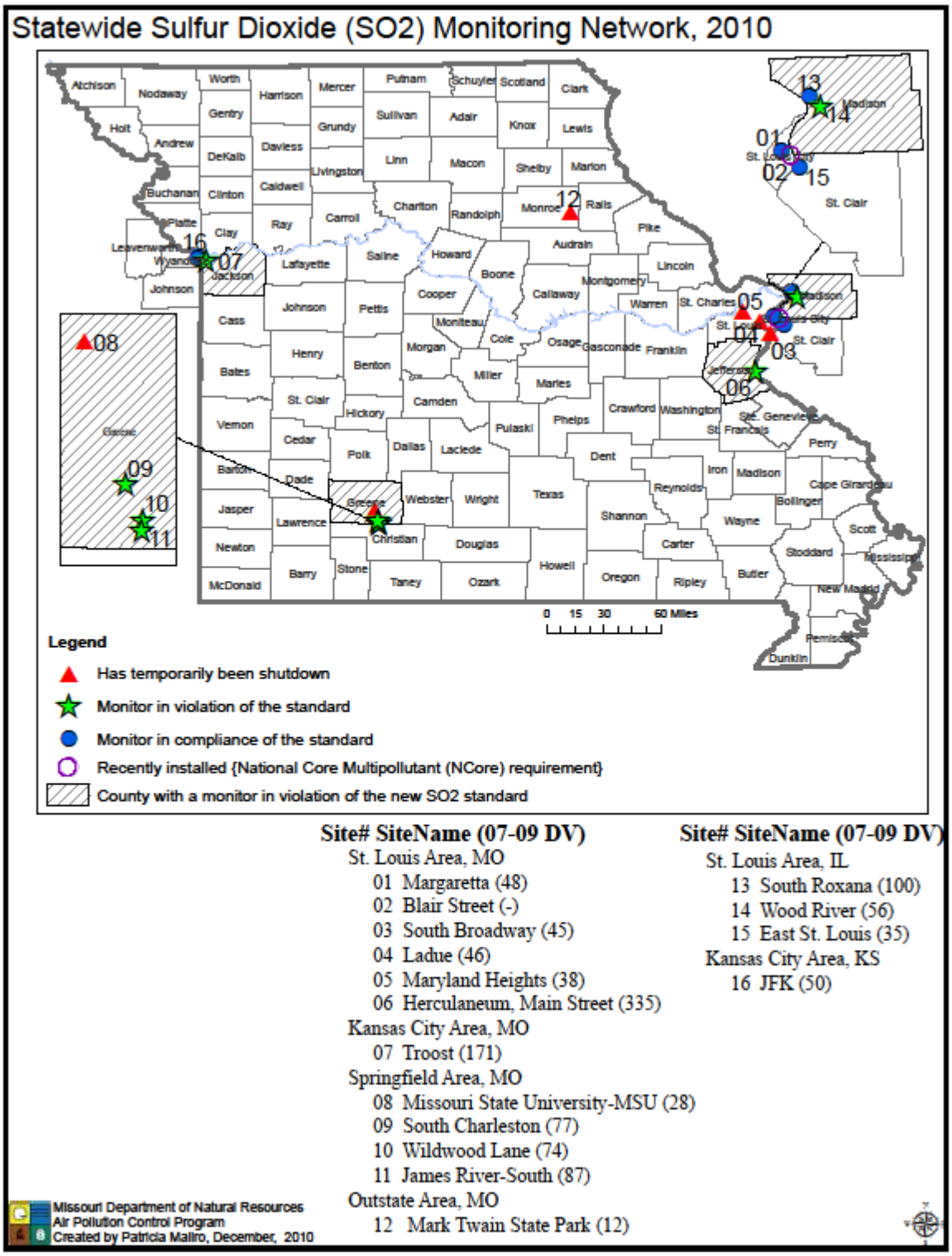
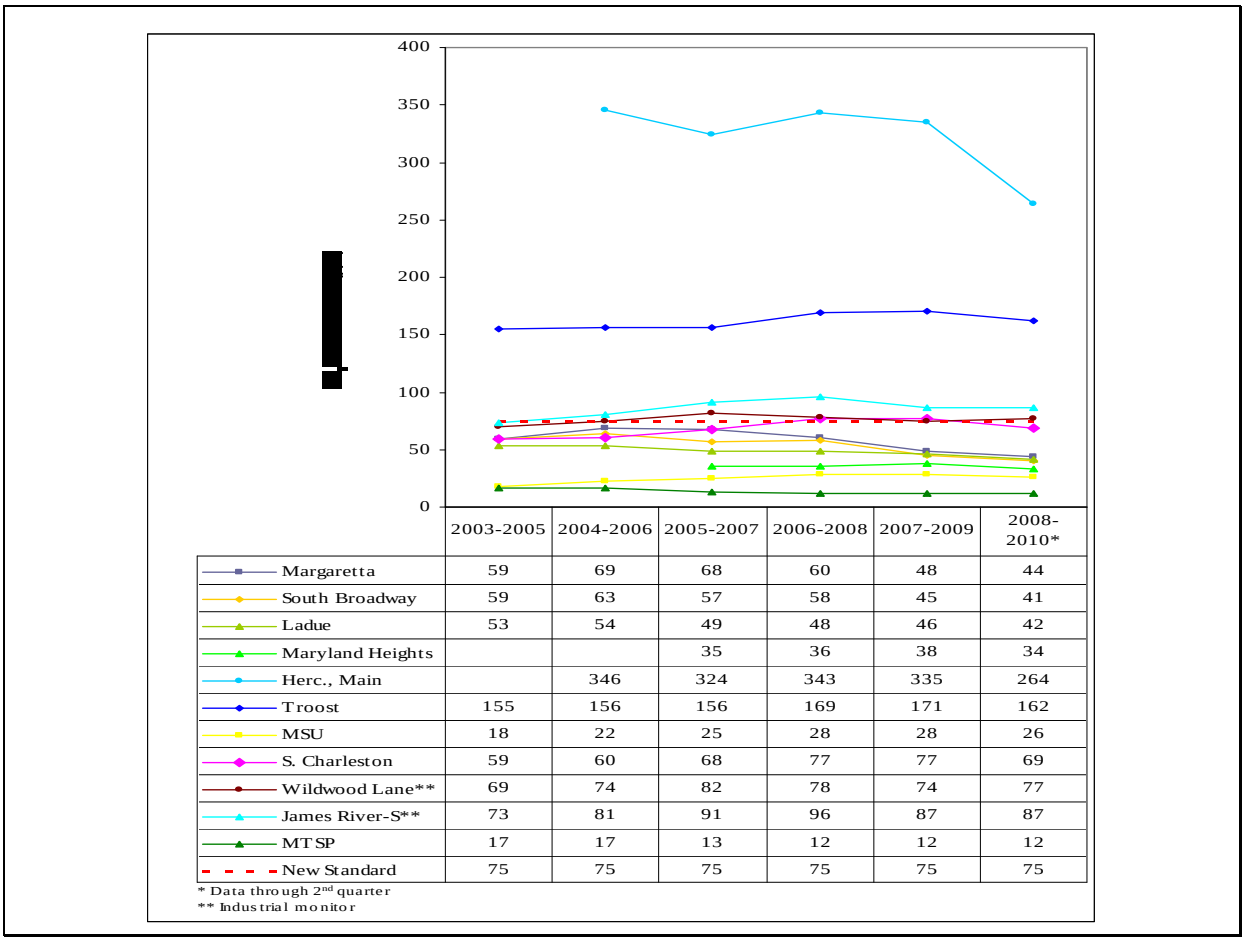


Figure 1. Missouri SO_2 monitoring network, 2010

Figure 2 and the embedded table show additional 1-hour SO_2 design values, which are determined by the three-year average of 99th percentile of daily maximum one-hour SO_2 concentrations. These design values were measured in recent years (2003-2010) at monitoring

sites in Missouri and are compared to the level of the 1-hour SO_2 NAAQS, 75 ppb. The Main Street site in Herculaneum, the Troost site in Kansas City, and the industry-operated Wildwood Lane and James River South sites in Springfield consistently show violation of the standard, though the Wildwood Lane 2007-2009 design value is 74 ppb. The South Charleston site in Springfield shows violation of the standard for the 2006-2008 and 2007-2009 periods. The SO_2 level at the Main Street site is about four times the standard. The SO_2 level at the Troost site is about twice the standard. The SO_2 levels at the Springfield sites are slightly above the standard. For areas with multiple violating monitors, the monitor with the highest design value is assigned as that area's official design value. For Springfield, the James River monitor is the area's design value monitor.



	2003-2005	2004-2006	2005-2007	2006-2008	2007-2009	2008-2010*
Margaretta	59	69	68	60	48	44
South Broadway	59	63	57	58	45	41
Ladue	53	54	49	48	46	42
Maryland Heights			35	36	38	34
Herc., Main		346	324	343	335	264
Troost	155	156	156	169	171	162
MSU	18	22	25	28	28	26
S. Charleston	59	60	68	77	77	69
Wildwood Lane**	69	74	82	78	74	77
James River-S**	73	81	91	96	87	87
MTSP	17	17	13	12	12	12
New Standard	75	75	75	75	75	75

* Data through 2nd quarter
** Industrial monitor

Figure 2. Three-year averages for SO_2 concentrations.

Measurement results at the Springfield monitoring sites give some indication of the limited spatial extent of elevated SO_2 concentrations. The Wildwood Lane and James River monitoring sites operated by City Utilities are 0.5 and 0.6 kilometers respectively from the James River Plant. These two sites have been fairly consistent in recent years in measuring SO_2 concentrations above the level of the standard. The South Charleston monitoring site, 2.2 kilometers north-northwest of the James River Plant, has measured SO_2 concentrations near the standard, sometimes above and sometimes below. The more distant Missouri State University (MSU) monitoring site, located 10.6 kilometers north-northwest of the James River Plant, has consistently measured SO_2 concentrations below the level of the standard.

In addition to Missouri monitoring sites, the state of Kansas operates one SO_2 monitor in Kansas City, KS, at their JFK site. The JFK site's 2007-2009 design value is 46 ppb. This site is located approximately five kilometers west of the Troost site. The state of Illinois operates three SO_2 monitoring sites in the St. Louis metropolitan statistical area, including the South Roxana site with a 2007-2009 design value of 100 ppb. The South Roxana site is located approximately 70 kilometers north-northeast of the Herculaneum, Main Street monitoring site.

4.0 Emissions Data

Although SO_2 emission sources are distributed throughout the state, the most and largest sources are along the Mississippi and Missouri Rivers. These include both electric generating and industrial facilities. A list of all sources in the state with emissions greater than 10 tons per year (tpy) is in Appendix 1.

The rate of SO_2 emissions from a source is the single most important factor in the SO_2 concentration surrounding the source.

4.1 Emissions

Greene County – City Utilities of Springfield operates two coal-fired power plants in Greene County: James River Plant to the south and Southwest Plant to the southwest. A second large coal-fired boiler at the Southwest Plant began operating in late 2010. Boiler 2 more than doubles the location's production of electricity; however, SO_2 emissions (as well as other emissions) from boiler 2 are well controlled. Boiler 2 utilizes flue gas desulfurization (FGD) technology to control SO_2, a baghouse to control particulate matter (PM), and selective catalytic reduction to control nitrogen oxides (NOx), all with corresponding emission limits. The existing boiler 1 at Southwest Plant utilizes low sulfur coal to control SO_2. Overall City Utilities' SO_2 emissions were down about 14% in 2009 compared to 2007 (see table below). This was due mainly to reductions in electricity demand during a mild summer.

Minor SO_2 sources are scattered throughout the city limits of Springfield, but are less than 10 tpy. There are few sources in Greene County outside of Springfield city limits (see Figure 3). A list of all sources greater than or equal to 10 tpy is found in Appendix 1.

SO_2 emissions (tpy)

Facility	**2007**	**2008**	**2009**
City Utilities – James River	4,702	5,288	3,780
City Utilities – Southwest	4,229	3,301	3,780
Total	**8,931**	**8,590**	**7,561**

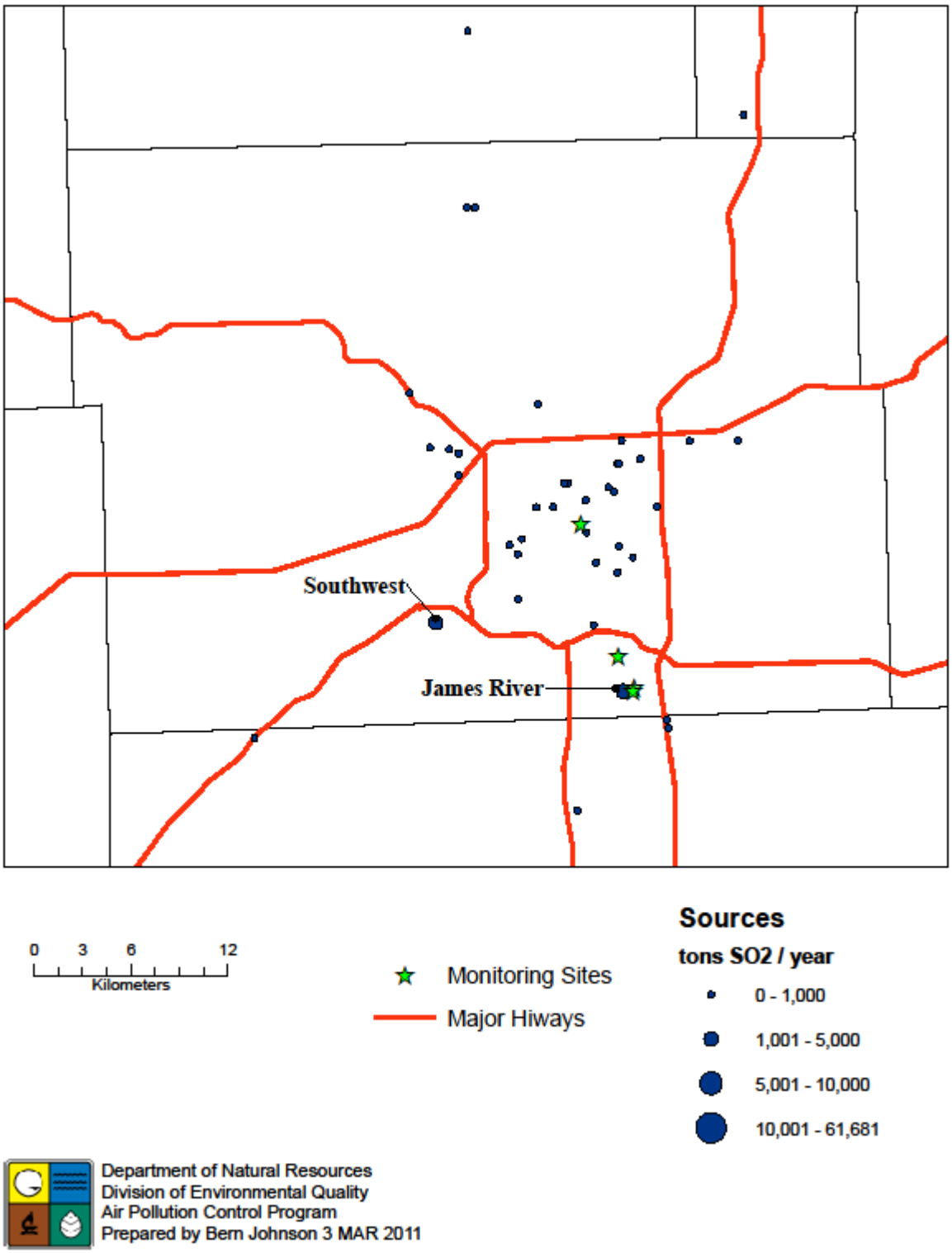


Figure 3. Emission Sources and Monitoring Sites in Greene County

Jackson County – All but one of the significant SO_2 sources in Jackson County are located along the Missouri River. Overall SO_2 emissions were down about 35% from 2007. This was primarily due to scrubber controls installed at Kansas City Power & Light's (KCP&L) Iatan Plant and also related to reductions in electricity demand during a mild summer (see table below). The KCP&L Hawthorn plant has installed a scrubber. There are two large sources in nearby Wyandotte County, KS: Nearman and Quindaro. There are minor sources scattered throughout the city limits of Kansas City and Independence, but most have emissions below 10 tpy (see Figure 4). A list of all sources greater than or equal to 10 tpy is found in Appendix 1.

SO_2 emissions (tpy)

Facility	**2007**	**2008**	**2009**
Jackson County, MO			
KCP&L – Sibley	11,796	9,181	11,787
Veolia – Grand Avenue	6,077	6,295	7,201
IP&L – Blue Valley	9,185	10,658	6,177
KCP&L – Hawthorn	1,923	1,725	2,017
Platte County, MO			
KCP&L – Iatan	14,290	15,077	1,923
Clay County, MO			
IP&L – Missouri City	5,040	2,592	920
Total	**48,311**	**45,528**	**30,025**
Wyandotte County, KS			
Public Utilities – Nearman	na	na	5,932
Public Utilities – Quindaro	na	na	3,612
Grand Total			**39,569**

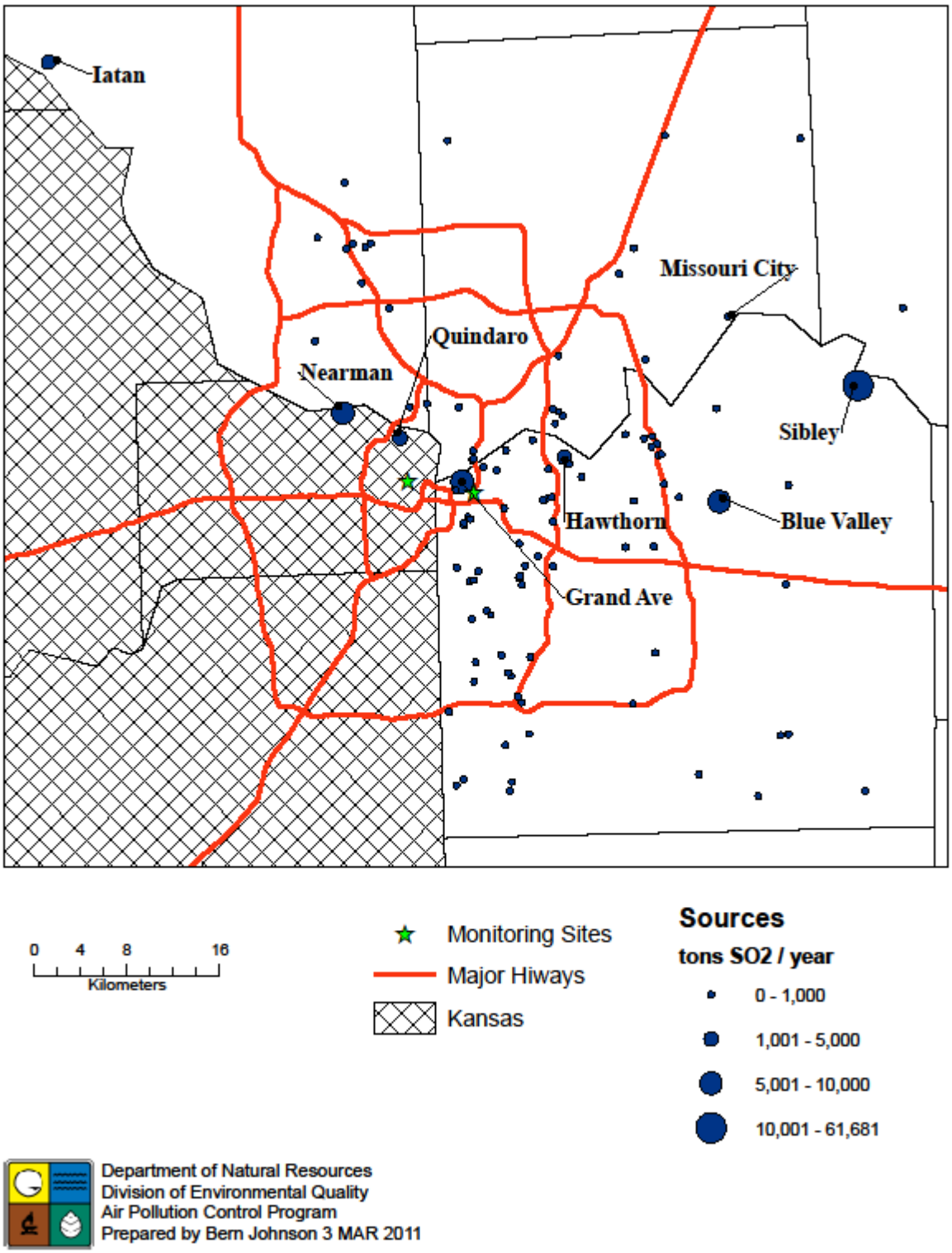


Figure 4. Emission Sources and Monitoring sites in Jackson County

Jefferson County – All major SO_2 sources in Jefferson County are located along the Mississippi River. Overall SO_2 emissions were down about 24% from 2007-08. This was due to a new, more accurate method of measurement at the Doe Run's Herculaneum smelter which resulted in a correction of almost minus 50% and reductions in electricity demand due to the recession and a mild summer. There are few sources west of Interstate 55 (see Figure 5). A list of all sources greater than or equal to 10 tpy is found in Appendix 1.

SO_2 emissions (tpy)

Facility	**2007**	**2008**	**2009**
Jefferson County			
Ameren Missouri – Rush Island	22,058	29,593	28,327
Doe Run – Herculaneum	32,904	35,998	18,842
River Cement – Selma	3,018	2,758	1,069
Total	**57,980**	**68,349**	**48,238**
St. Louis County			
Ameren Missouri - Meramec	22,769	20,827	16,856
Grand Total	**80,749**	**89,176**	**65,094**

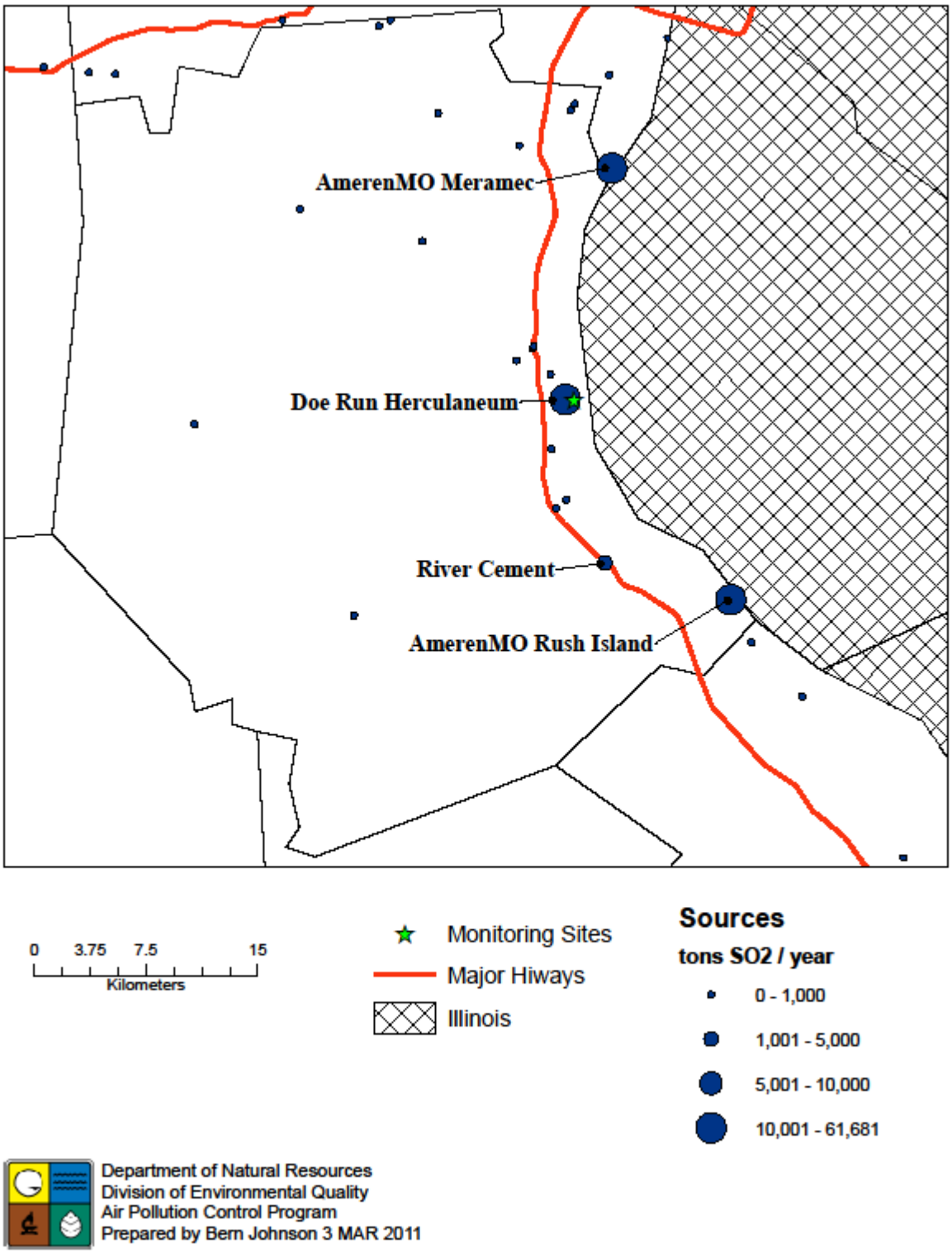


Figure 5. Emission Sources and Monitoring sites in Jefferson County

4.2 Emission Controls

One of the best emission controls for SO_2 is the use of low-sulfur bearing coal, mainly from the western U.S. Operating permits often include SO_2 emission limits, often expressed in pounds (mass) SO_2 per million British thermal units (mmBtu) - a measure of the potential heat content of the coal burned that varies with coal type and mine location.

Sulfur is a naturally occurring element in coal that also varies considerably with coal type and geographic region of the coal mine. Coal delivered for use in Missouri typically has a sulfur content ranging from approximately 0.2% sulfur to 5% sulfur. Low sulfur coal is more expensive because of demand and increased transportation costs to Missouri, while high sulfur coal is typically less expensive and often originates from nearby states. Many facilities mix coal from different sources to achieve their required emission limits at the lowest possible cost.

The most common post-combustion control for SO_2 is flue gas desulfurization (FGD), also known as a scrubber. FGD control requirements are included in a facility's construction or operating permit. Scrubbers operate by spraying a stream of lime-containing solution across the stack through which the exhaust gas passes. The gaseous SO_2 is absorbed by the alkaline (lime/limestone) slurry. The sulfuric acid produced is neutralized by the lime in the slurry. The control efficiency is typically 90% or greater.

An alternate means of reducing sulfur emissions is switching to natural gas as a primary or secondary fuel. Natural gas contains virtually no sulfur. Several plants in Missouri, including the Independence Power & Light – Blue Valley Plant in Jackson County, the Kansas City Power & Light – Lake Road Plant in Buchanan County, and both the James River and Southwest Plants operated by City Utilities of Springfield in Greene County, are able to use both coal and natural gas to fuel one or more of their boilers. There are also many small, natural gas-fired power plants throughout the state that operate only when needed.

4.3 Regional Emission Reductions

<u>Federal Rules with sulfur and/or sulfur dioxide restrictions</u>

Significant regional emission reductions are envisioned in the proposed Transport Rule (75 FR 45210, August 2, 2010). Its primary purpose is to reduce emissions of SO_2 and NO_x that contribute to $PM_{2.5}$ and ozone. The Transport Rule applies to any stationary, fossil-fuel-fired boiler or stationary, fossil-fuel-fired combustion turbine serving a generator with a nameplate capacity of more than 25 megawatts producing energy for sale. Proposed emissions reductions are to take effect beginning in 2012 with additional reductions scheduled for 2014 lowering nationwide NO_x emissions by 52 percent from 2005 levels and SO_2 emissions by 71 percent. To comply with the Transport Rule and other regulations, at least six Missouri units have already installed (prior to January 2011) FGD control devices. FGD control devices have been installed on two units at both the Ameren Missouri – Sioux Plant and Kansas City Power & Light – Iatan Plant, as well as one unit each at Kansas City Power & Light – Hawthorn Plant and City Utilities of Springfield – Southwest Plant. A final Transport rule is expected to be presented in summer 2011.

EPA is also currently in the process of promulgating three new Maximum Achievable Control Technology (MACT) regulations that could lead to direct SO_2 reductions and co-benefit reductions.

On March 21, 2011, EPA published final rules in the Federal Register that will reduce emissions of air pollutants from existing and new boilers. Compliance is required for existing boilers in 2014. One of the two boiler rules reduces emissions from existing and new industrial, commercial, and institutional boilers located at area source facilities. This Generally Available Control Technology (GACT) reduces a number of air pollutants including mainly mercury, metals, and dioxins. The second boiler rule reduces emissions from new and existing industrial, commercial and institutional boilers and process heaters residing at major source facilities that burn natural gas, fuel oil, coal, biomass, refinery gas and other gas to produce steam. The intent of this MACT is to reduce mainly mercury, metals, and organic toxins. The co-benefits of reducing mercury and other air pollutants from the Boiler GACT & MACT also lower SO_2 emissions.

The proposed Utility MACT (signed by the EPA Administrator on March 16, 2011) targets emissions of hazardous air pollutants (HAPs) [including mercury, arsenic, acid gases, toxic metals & other toxics] from new and existing coal- and oil-fired electric generating units (EGUs). Per a settlement deadline, EPA is required to sign a notice of final rulemaking establishing MACT standards for EGUs no later than November 16, 2011. Mercury reductions can be achieved through SO_2, NO_x, and/or particulate matter (PM) controls. The effectiveness of these controls depend on the characterization of coal or oil burned and the configuration of the power plant, as controls for SO_2 serve as a co-benefit to reduce mercury. As proposed, once the final rule is issued, existing sources have up to four years to comply with these standards; all existing sources must comply in three years, but individual sources can obtain an additional year if technology cannot otherwise be installed in time.

On February 21, 2011, EPA finalized revisions to the New Source Performance Standards (NSPS) and emission guidelines for new and existing commercial and industrial solid waste incineration units as well as for new and existing sewage sludge incineration units. Both of these NSPS standards establish emission limits for nine pollutants emitted from the regulated units, including sulfur dioxide and mercury emissions.

Other federal regulations that restrict SO_2 emissions include NSPS, 40 CFR 60 subpart D (Standards of Performance for Fossil-Fuel-Fired Steam Generators for Which Construction is Commenced after August 17, 1971), subpart Da (Standards of Performance for Electric Utility Steam Generating Units for Which Construction is Commenced after September 18, 1978), subpart Db (Standards of Performance for Industrial-Commercial-Institutional Steam Generating Units), and subpart Dc (Standards of Performance for Small Industrial-Commercial-Institutional Steam Generating Units).

<u>State Rules with sulfur and/or sulfur dioxide restrictions</u>

10 CSR 10-5.130, Certain Coals to be Washed

This rule provides that specified coals be cleaned by washing prior to their sale or use. Coal may not be used at facilities located in the St. Louis metropolitan area that is in excess of 2 percent sulfur, or 12 percent ash, unless the coal has been cleaned and provides no more than 12 percent ash on a dry basis. Any facility that emits SO_2 at a rate of 2.3 pounds / mmBtu or less is the exception to this rule.

10 CSR 10-5.240, Additional Air Quality Control Measure May be Required When Sources Are Clustered in a Small Land Area

This rule provides that more restrictive air quality control requirements may be prescribed for areas in which the sum of particulate matter and/or SO_2 emissions from existing and proposed sources exceed specified limits.

10 CSR 10-5.570, Control of Sulfur Emissions from Stationary Sources
This rule limits SO_2 emissions from industrial boilers in the St. Louis $PM_{2.5}$ nonattainment area. By reducing SO_2 emissions released into the atmosphere, emissions of $PM_{2.5}$ are reduced. This rule is intended to curb emissions in the St. Louis nonattainment area in compliance with the federal Clean Air Fine Particle Implementation Rule to reduce the risk of $PM_{2.5}$ violations. The rule applies to industrial, commercial, or institutional boilers or process heaters greater than 55 mmBtu per hour with compliance beginning January 1, 2011. Breweries are limited to 3,050 tons SO_2 per year and other installations limited to 1.0 lb SO_2/ mmBtu of actual heat input.

10 CSR 10-6.060, Construction Permits Required
This rule defines sources which are required to obtain permits to construct. The rule also establishes that certain requirements be met before modification or construction of a facility. This rule includes maximum allowable increases to ambient air concentrations for Class I, II, and III areas, significant monitoring concentrations, and significant SO_2 air quality impact levels.

10 CSR 10-6.260, Restriction of Emission of Sulfur Compounds
This rule establishes sulfur limits for indirect heating, lead smelting and refineries, and all other new and existing sources. Indirect heating sources outside the St. Louis metropolitan area may not exceed 8 lbs of SO_2/ mmBtu with additional limits to the various utility units. Indirect heating sources located in the St. Louis metropolitan area and greater than 2,000 mmBtu /hour may not exceed 2.3 lbs SO_2/ mmBtu with one utility limit of 4.8 lbs SO_2/ mmBtu. Sources in this area which are less than 2,000 mmBtu /hour must have an emission rate of 2.3 lbs SO_2/ mmBtu or lower, or may only burn 2 percent or less sulfur coal from October through March and 4 percent or less from April through September. Lead smelters and refinery SO_2 emissions are limited by a table outlined in the rule. An update to this table not yet incorporated into the rule is an EPA proposed consent decree for the Doe Run Herculaneum smelter which establishes a shutdown date of December 31, 2013. All other existing sources may not exceed SO_2 limits of 2,000 parts per million volume (ppmv) or 70 milligrams (mg) per cubic meter (m^3) of sulfuric acid or sulfur trioxide. All other new sources may not exceed 500 ppmv or 35 mg/m^3.

10 CSR 10-6.270, Acid Rain Source Permits Required
This rule establishes certain general provisions and operating permit program requirements for affected sources and affected units under the federal Acid Rain Program (ARP). This program pertains to existing utility units serving generators with a nameplate capacity greater than 25 megawatts and all new utility units. Missouri required affected units to participate in the EPA administered ARP cap and trade program. Phase I of the program reduced SO_2 emissions by approximately 50 percent, and Phase II reductions by 67 percent from 1980 levels.

4.4 Growth

Despite projections of increased electricity demand of 1.0% per year, the U.S. Department of Energy projects a substantial decrease in nationwide SO_2 emissions to 2035 due to increased controls required by a variety of new regulations (see http://www.eia.gov/forecasts/aeo/early_elecgen.cfm).

5.0 Meteorology

In general, winds in Missouri come from two directions: southeast and northwest. During the months from late spring to early fall, southeast winds predominate with sizable fractions coming from the southwest quadrant. During the late fall to late winter months, the winds shift significantly to the northwest, though there is still a considerable southern component. Winds from the northeast are negligible throughout the year. There is some variation between the major metropolitan areas. The majority of winds have speeds between 8 and 20 miles per hour (7 to 17 knots). Wind roses for each quarter for the three major metropolitan areas are shown in Appendix 2.

Wind direction plays a critical role in the location and concentration of SO_2 in ambient air. Areas located downwind of large sources will have higher concentrations than those located upwind. However, the changing direction of the wind means that downwind areas can be either north or south of major sources. Areas to the east or west of major sources are less likely to have high SO_2 concentrations. Wind speed also plays a significant role in ambient SO_2 concentrations. Days with still or low wind speeds are more likely to have high concentrations than days with moderate to high winds.

Kansas City area – the greatest deviation from the statewide pattern is during the third quarter, when the predominant wind direction is from the southwest.

St. Louis area, including Jefferson County – the greatest deviation from the statewide pattern is during the second quarter, when winds are almost equally distributed throughout the southeast to northwest (112.5 degrees to 315 degrees).

Springfield area – the Springfield area is the closest to the statewide pattern of all the major metropolitan areas. The greatest deviation from this pattern is during the fourth quarter, when the single largest component remains from the southeast.

5.1 Back Trajectories

Back trajectories use a computer model called HYSPLIT (Hybrid Single Particle Lagrangian Integrated Trajectory) to determine the path a parcel of air travels during the previous twenty-four hours to arrive at the selected time and location. For this document, this information is used to help determine the sources that contribute to the four highest annual concentration days during 2007-9 at Missouri's three violating monitor sites. These dates correspond to the values used in calculating the design value for each site. The back trajectory maps are located in Appendix 3.

Greene County – of the twelve trajectories, four each come from the west and south, and the remaining four are scattered from the northwest to the northeast. These results are not unexpected, considering that the monitor is located east of the City Utilities of Springfield – James River Plant. Only the four trajectories from the west are from the direction of the Southwest Plant, indicating that, while emissions from City Utilities of Springfield – Southwest Plant may influence the James River monitor occasionally; more often than not the winds are blowing the Southwest Plant's emissions away from the monitor.

Jackson County – of the twelve trajectories, eight come from the northwest, the direction of the nearest large source – Veolia's Grand Avenue facility – and to a lesser extent from the two power plants in Kansas – Nearman and Quindaro. The other trajectories were scattered from east to west. These trajectories show that, on days which have SO_2 concentrations above the standard, the winds are overwhelming from the direction of the nearest source. This indicates that other large sources to the east are unlikely to contribute to the violating monitor.

Jefferson County – of the twelve trajectories, eleven come to the monitor from the south, up the Mississippi River valley. The twelfth comes from the west. These trajectories indicate that the area likely to contribute to the violating monitor is limited to the area south of Herculaneum along the Mississippi River Valley.

6.0 Topography

In the context of this document, topography refers to the presence of air basin boundaries, such as mountain ranges, or other features that affect the movement of the air on a large scale. It does not include micro effects such as building downwash. In general, the northern part of Missouri is open plain and contains no features that impede or channel air speed or direction. The southern part of Missouri is dominated by the Ozark Mountains, which are not tall enough to create large effects, but may lead to local channeling through small valleys. The remaining major features are the two great rivers, the Mississippi and Missouri, and their valleys. On a small scale, the two river valleys seem to have the effect of increasing the north-south or east-west wind direction. This effect may not affect the concentration at any one particular monitor, but may limit the number of sources that impact that monitor.

7.0 Jurisdictional Boundaries

Nonattainment boundaries are typically defined by easily definable features such as county, municipal, or township boundaries. Large, immovable features such as rivers or highways can also be used. The following considerations are taken into account when considering which features to use as boundaries:

- contains a violating monitor
- contains sources that likely contribute to a violating monitor
- is easily recognizable by public

8.0 Recommended Nonattainment Boundaries

Due to the hybrid monitoring/modeling approach to SO_2 boundary determination selected by EPA and the lack of timely modeling guidance prior to the boundary designation deadline, no areas of the state, even those with valid monitoring data below the standard, may be classified as attainment. This approach also dictates that areas with neither monitoring nor modeling must be labeled unclassifiable. Most of Missouri falls into this category. The remaining areas are only those that are determined to either contain or impact one of the four monitors that violate the standard.

The Department is recommending three nonattainment areas for the state of Missouri, each of which contains a violating monitor(s) and the surrounding area determined by the Department to likely contribute to that violation. As noted in the Section 2.0, the four violating monitors are in Greene County (Springfield), Jackson County (Kansas City), and Jefferson County (Herculaneum).

8.1 Greene County

For 2007-2009, Greene County has two monitors that violate the 1-hour SO_2 NAAQS. The recommended nonattainment area includes the area bounded by U.S. 65 on the east, U.S. 60 on the north, U.S. 160 (South Campbell Ave) on the west, and the county line on the south (see Figure 7). The boundaries of the recommended nonattainment area include the two violating monitors and the City Utilities of Springfield - James River Plant. The fact that there is a third nearby site in Springfield that is well below the standard demonstrates the limited range of influence of the James River Plant emissions. As seen in Figure 6, there is a linear relationship between the SO_2 concentration at a site and its distance from the James River Plant. The line crosses the new standard at approximately 2.6 km. This radius of influence justifies the small boundaries. In late 2010, City Utilities of Springfield – Southwest Plant began operating a new coal-fired boiler that utilizes significant emission controls including FGD technology to control SO_2, a baghouse to control particulate matter and selective catalytic reduction to control NOx, all with corresponding emission limits. The existing boiler 1 at Southwest Plant utilizes low Sulfur coal to control SO_2. Since the Southwest Plant has roughly the same total emissions, it should have a similarly small radius of SO_2 impact (similar to the James River Plant). The Southwest Plant is approximately 13 km from the James River monitor. At that distance, its impact on the James River monitor is negligible based on the conducted analysis.

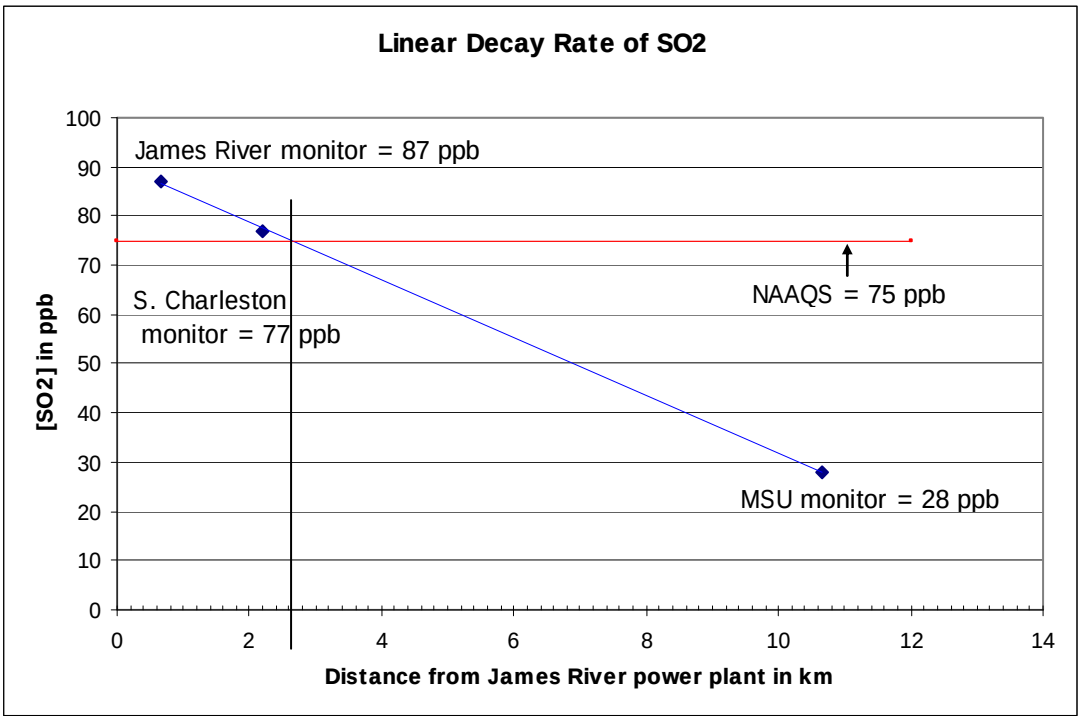


Figure 6. Radius of impact from James River Plant

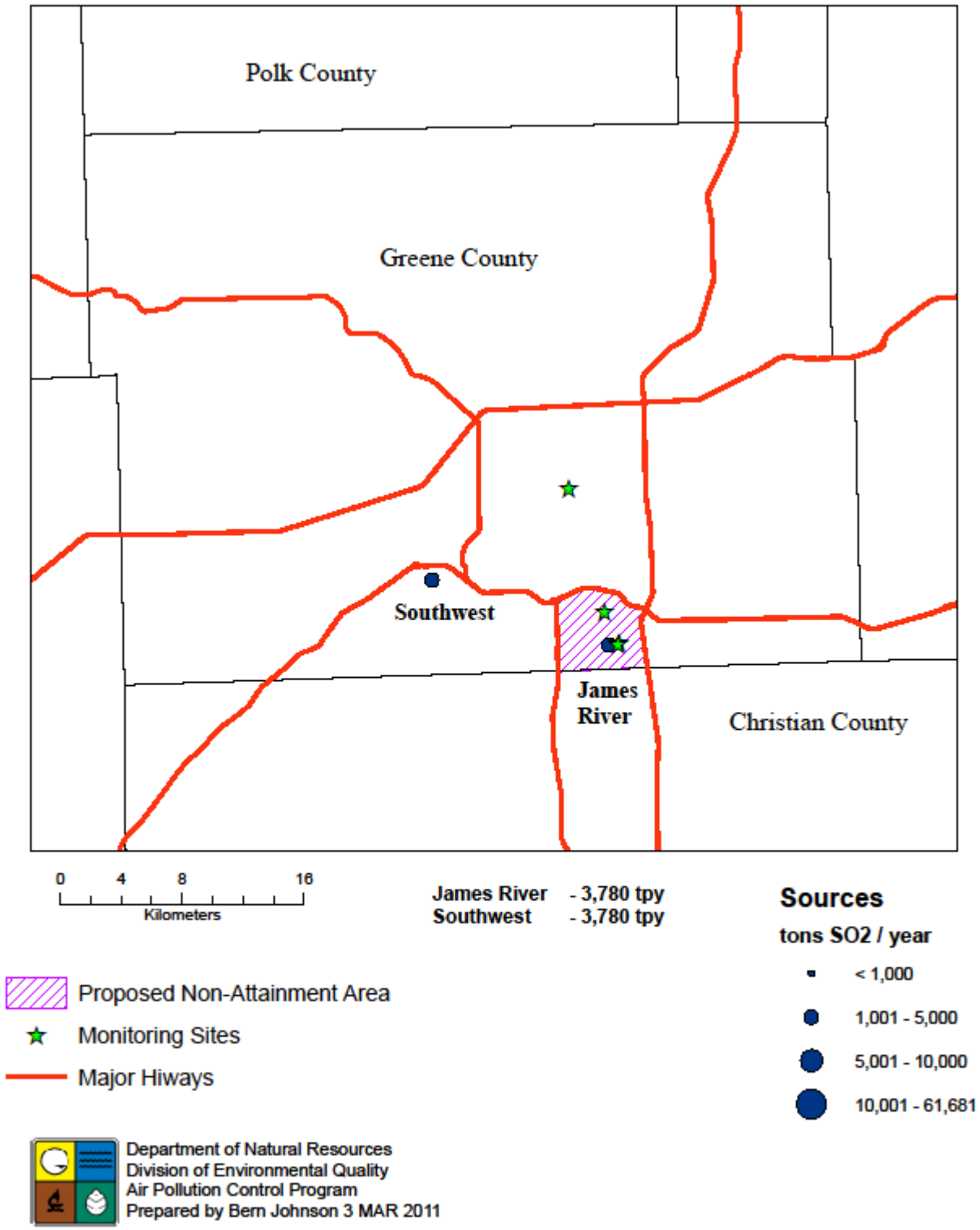


Figure 7. Recommended NAA for Greene County

8.2 Jackson County

Jackson County has one monitor that violates the 1-hour SO_2 NAAQS. The recommended nonattainment area includes the portion of Jackson County north of I-70/I-670and west of I-435. (see Figure 8). The boundaries of the nonattainment area contain the violating monitor in downtown Kansas City and the nearest large source – Veolia's Grand Avenue facility. The predominance of back trajectories on high exceedance days from the northwest indicates that the sources in eastern Jackson County are unlikely to impact the Troost monitor. The rapid conversion of SO_2 to SO_4^2- and the presence of a non-violating monitor in Wyandotte County, KS, indicate that the SO_2 contributions from the two Public Utility power plants, Nearman and Quindaro, likely do not have a significant impact on the violating Troost monitor. As mentioned in Section 4.1, the KCP&L - Hawthorn Plant has a scrubber installed which provides 80% control of SO_2 emissions. This fact, in combination with the back trajectories, led to the recommendation of I-435 as the eastern boundary.

The southern portion of Jackson County contains no large sources and therefore has minimal impact the violating monitor. The same is true for southern Clay and Platte counties. Interstate 70 was selected as the southern boundary because it is an easily recognizable, permanent feature and encompasses the major source affecting the Troost monitor. Interstate 435 was selected as the eastern border for the same reasons: it is an easily recognizable, permanent feature; includes the Troost monitor; and excludes the sources to the east that have been determined to likely have little impact on the violating monitor. Given the rapid conversion of SO_2 to SO_4^{2-} and the back trajectories on the highest exceedance days, the Department determined that the KCP&L – Iatan Plant in northern Platte County is not likely a significant contributor to the violation at Troost. KCP&L also installed significant SO_2 controls (specifically FGD) at Iatan when building a second boiler there.

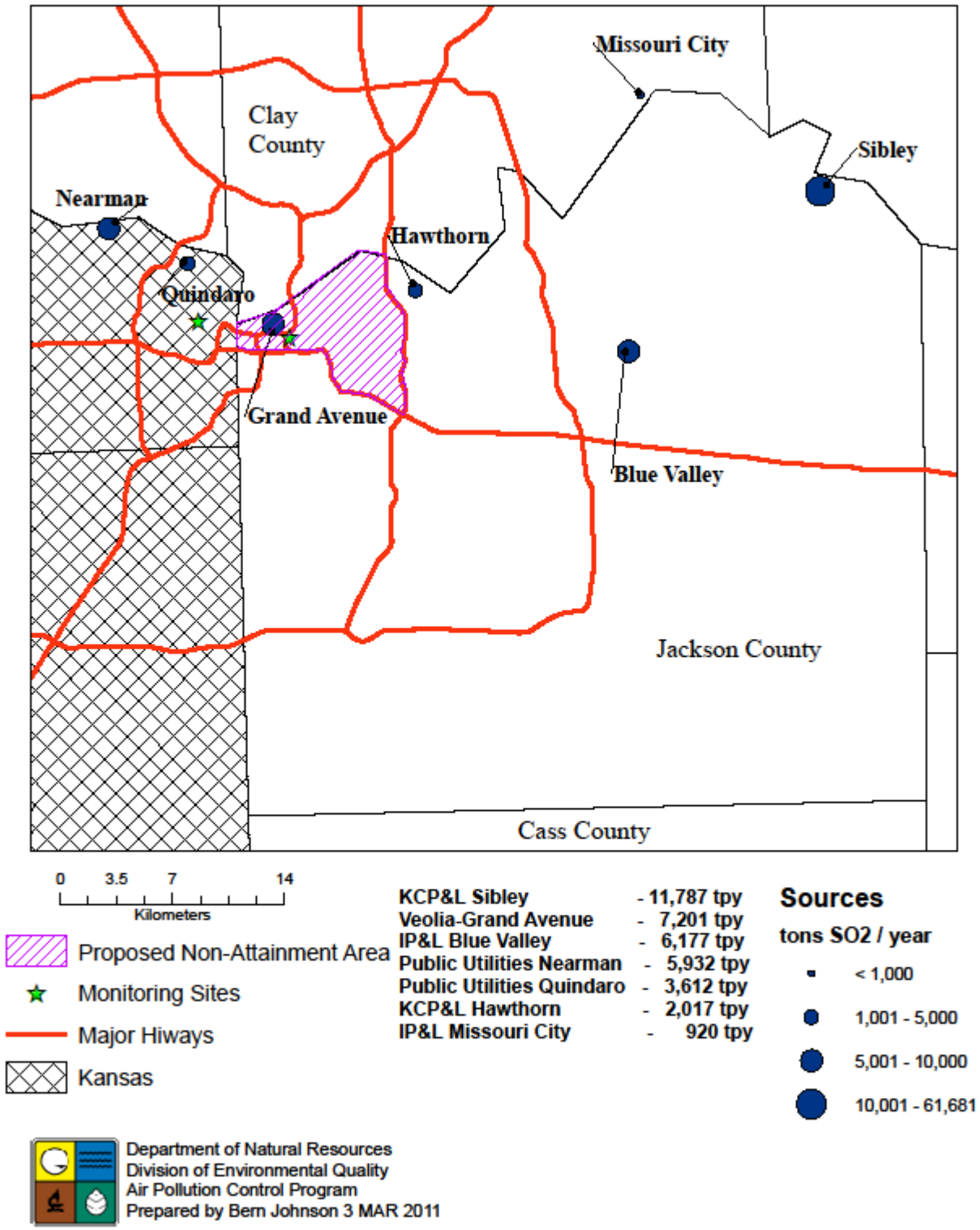


Figure 8. Recommended NAA for Jackson County

8.3 Jefferson County

Jefferson County has one monitor that violates the 1-hour SO_2 NAAQS. The recommended nonattainment area includes both Herculaneum and Festus townships in Jefferson County as well as the portions of Valmeyer and Selma townships in Jefferson County, Missouri (see Figure 9). The boundaries of the recommended nonattainment area include both large sources in Jefferson County: the Doe Run lead smelter in Herculaneum and the Ameren Missouri – Rush Island Plant. The wind direction roses and back trajectories all indicate that emissions from these plants are transported north along the Mississippi River valley. That fact, combined with the lack of sources in the western portion of the county, indicate that the remainder of the county does not contribute to the violation at the Main Street monitor and justify the exclusion of the remainder of the county. Townships were selected for the boundaries due to the lack of any other significant north-south feature, such as a highway, that would include all sources. Interstate 55 was judged to be too close (in proximity) to establish an appropriate western boundary. The Ameren Missouri – Meramec Plant in southern St. Louis County was determined to not contribute to the violation at the Main Street monitor because of its location to the north of the monitor and the fact that the back trajectories indicate that the highest concentration days occur when the winds are from the south, not the north.

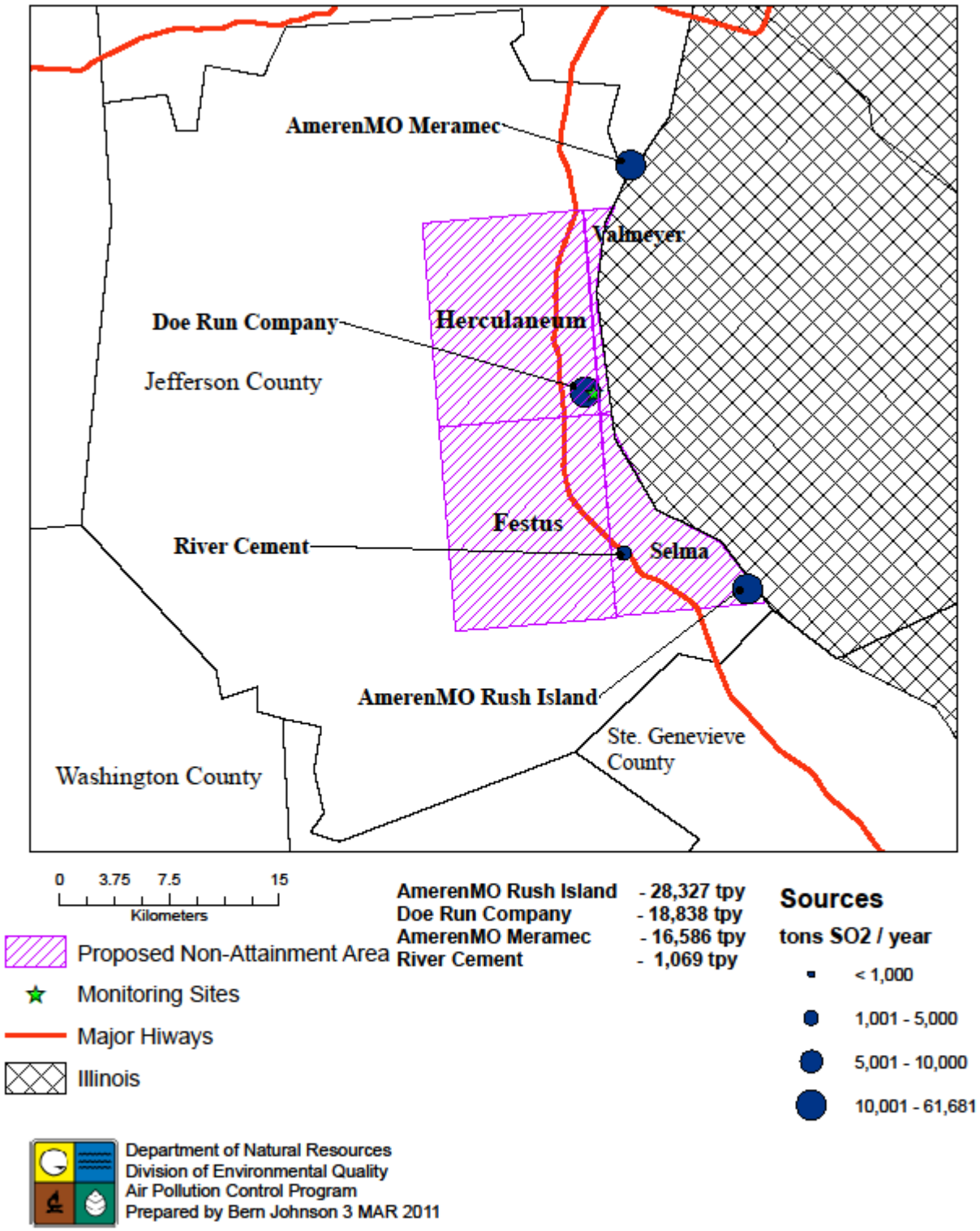


Figure 9. Recommended NAA for Jefferson County

9.0 Summary

After reviewing the available monitoring, emission, and meteorological data, the Department has recommended three areas, one each in Greene, Jackson, and Jefferson counties, for designation as nonattainment for the 2010 1-Hour SO_2 NAAQS. The recommended nonattainment area boundaries were selected based on fixed, easily recognizable features and include the violating monitor(s) and those nearby sources determined to likely impact the violating monitor.

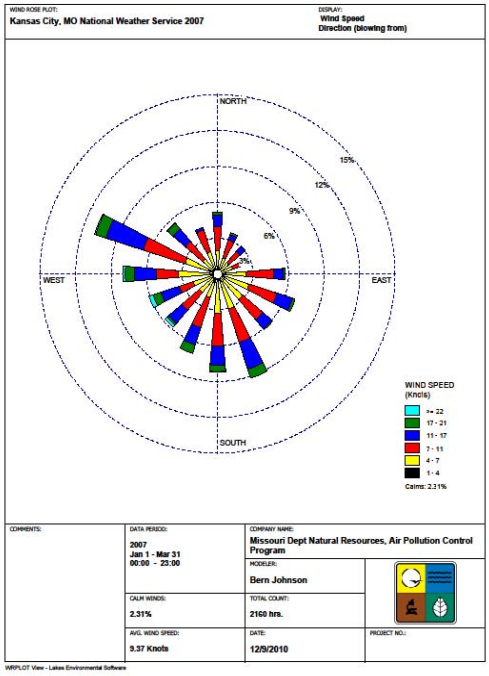
Appendix 1 – SO_2 Emission Data (from 2009 Missouri Emission Inventory System)

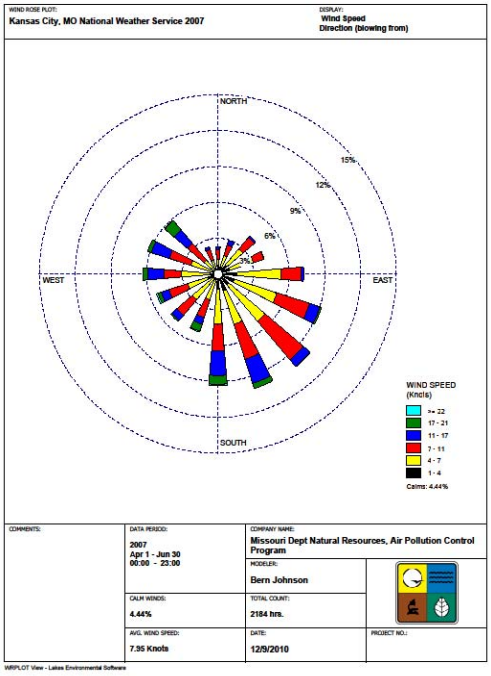
County	Plant #	Parent Company (* - non electric generating unit)	Site Name	2009 Total SO_2 Emissions (tons/yr)
Franklin	0003	AMEREN MISSOURI	LABADIE PLANT	**61,681**
St. Charles	0001	AMEREN MISSOURI	SIOUX PLANT	**46,456**
Jefferson	0016	AMEREN MISSOURI	RUSH ISLAND PLANT	**28,327**
Jefferson	0003	*DOE RUN COMPANY	HERCULANEUM SMELTER	**18,838**
St. Louis	0010	AMEREN MISSOURI	MERAMEC PLANT	**16,856**
Randolph	0001	THOMAS HILL ENERGY CENTER	THOMAS HILL	**16,628**
New Madrid	0004	NEW MADRID POWER PLANT	MARSTON	**14,480**
Henry	0001	KANSAS CITY POWER & LIGHT CO	MONTROSE STATION	**12,791**
Jackson	0031	KANSAS CITY POWER & LIGHT CO	SIBLEY STATION	**11,787**
Jasper	0001	EMPIRE DISTRICT ELECTRIC CO	ASBURY PLANT	**11,007**
Boone	0004	UNIVERSITY OF MISSOURI	POWER PLANT	**7,459**
Jackson	0021	*VEOLIA ENERGY	GRAND AVENUE STATION	**7,201**
Jackson	0050	INDEPENDENCE POWER AND LIGHT	BLUE VALLEY STATION	**6,177**
Scott	0017	SIKESTON POWER STATION	SIKESTON POWER STATION	**6,023**
St. Louis City	0003	*ANHEUSER-BUSCH INC	ST. LOUIS	**4,991**
Pike	0002	*ASHLAND INC	MISSOURI CHEMICAL WORKS	**4,890**
Ste. Genevieve	0001	*MISSISSIPPI LIME COMPANY	STE. GENEVIEVE	**4,419**
Greene	0005	CITY UTILITIES OF SPRINGFIELD	JAMES RIVER POWER PLANT	**3,780**
Greene	0039	CITY UTILITIES OF SPRINGFIELD	SOUTHWEST POWER PLANT	**3,780**
New Madrid	0008	*NORANDA ALUMINUM INC	NEW MADRID	**2,885**
Osage	0002	CENTRAL ELECTRIC POWER COOPERATIVE	CHAMOIS PLANT	**2,728**
Iron	0009	*DOE RUN COMPANY	BUICK SMELTER	**2,583**
Buchanan	0004	KANSAS CITY POWER & LIGHT CO	LAKE ROAD PLANT	**2,401**

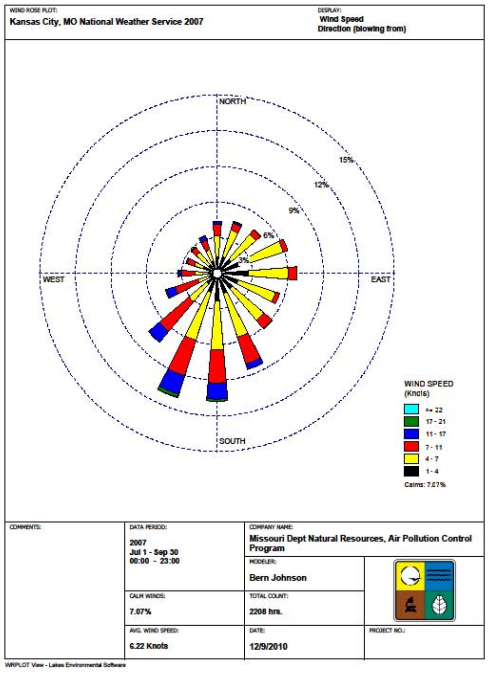
Marion	0001	*BASF CORPORATION	HANNIBAL PLANT	**2,371**
Jackson	0022	KANSAS CITY POWER & LIGHT CO	HAWTHORN STATION	**2,016**
Platte	0007	KANSAS CITY POWER & LIGHT CO	IATAN GENERATING STATION	**1,923**
Pike	0001	*HOLCIM (US) INC	CLARKSVILLE	**1,843**
Saline	0010	MARSHALL MUNICIPAL UTILITIES	MARSHALL MUNICIPAL UTILITIES	**1,400**
Jefferson	0002	*RIVER CEMENT CO. DBA BUZZI UNICEM USA	SELMA PLANT	**1,053**
Clay	0096	INDEPENDENCE POWER AND LIGHT	MISSOURI CITY STATION	**919**
Boone	0002	CITY OF COLUMBIA	MUNICIPAL POWER PLANT	**908**
Phelps	0006	MISSOURI UNIV. OF SCIENCE AND TECHNOLOGY	POWER PLANT	**465**
Cape Girardeau	0010	SOUTHEAST MISSOURI STATE UNIVERSITY	POWER PLANT	**373**
St. Charles	0076	*GENERAL MOTORS LLC	WENTZVILLE CENTER	**314**
Montgomery	0008	*CHRISTY MINERALS, LLC	HIGH HILL	**313**
Jefferson	0068	*SAINT-GOBAIN CONTAINERS INC	PEVELY	**229**
Jackson	0030	*LAFARGE NORTH AMERICA INC	SUGAR CREEK PLANT	**192**
Pettis	0009	*PITTSBURGH-CORNING CORP	SEDALIA	**168**
St. Louis City	0017	*MALLINCKRODT INC	N SECOND	**133**
Holt	0001	*EXIDE TECHNOLOGIES	CANON HOLLOW	**80**
Ralls	0001	*CONTINENTAL CEMENT COMPANY LLC	ILASCO PLANT	**75**
Ste. Genevieve	0035	*CHEMICAL LIME COMPANY	STE. GENEVIEVE	**46**
Jasper	0094	*TAMKO BUILDING PRODUCTS INC	RANGELINE PLANT	**38**
Jackson	0017	*FOLGERS COFFEE CO	BROADWAY	**38**
Ste. Genevieve	0044	*HOLCIM (US) INC	STE. GENEVIEVE PLANT	**33**
Callaway	0001	*HARBISON-WALKER REFRACTORIES	WESTMINSTER AVE	**29**
Cape Girardeau	0060	*Q. C. CORPORATION	Q. C. CORPORATION	**28**

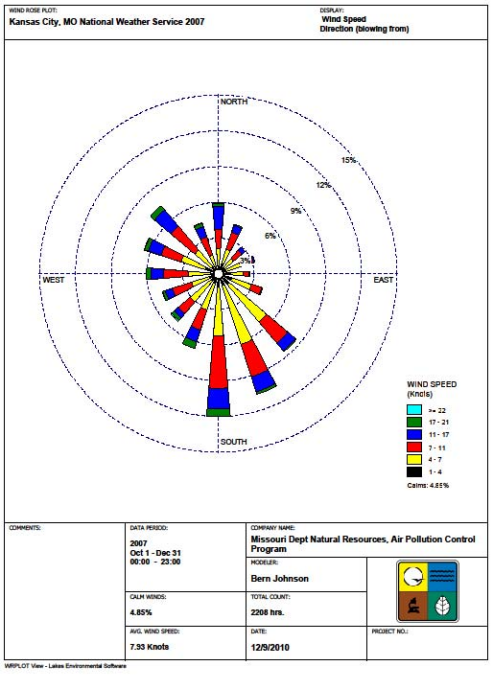
Pulaski	0004	*FT LEONARD WOOD	INSTALLATION MANAGEMENT	**28**
Cape Girardeau	0021	*BUZZI UNICEM USA	CAPE GIRARDEAU	**26**
Perry	0020	*ATLAS EPS	PERRYVILLE	**20**
St. Louis	1521	*PACE CONSTRUCTION CO	FLORISSANT	**13**
Clay	0002	*NATIONAL STARCH LLC	NORTH KANSAS CITY	**13**
St. Francois	0017	*FLAT RIVER GLASS CO	PARK HILLS	**12**
Barry	0021	*SCHREIBER FOODS INC	SCHREIBER FOODS INC - MONETT	**12**
Maries	0001	*KINGSFORD MANUFACTURING CO	BRIQUETTING PLANT	**10**

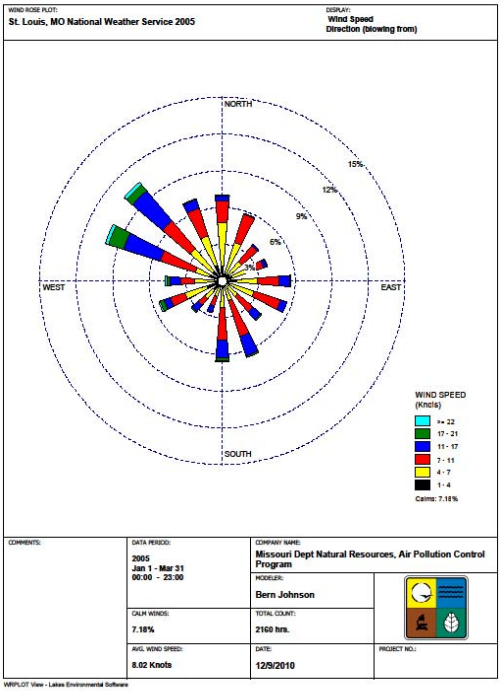
Appendix 2 – Wind Roses










WIND ROSE PLOT:
St. Louis, MO National Weather Service 2005
DISPLAY:
Wind Speed
Direction (blowing from)
NORTH
EAST
SOUTH
WEST
15%
12%
9%
6%
WIND SPEED
(Knots)
>= 22
17 - 21
11 - 17
7 - 11
4 - 7
1 - 4
Calms: 7.18%
COMMENTS:
DATA PERIOD:
2005
Jan 1 - Mar 31
00:00 - 23:00
COMPANY NAME:
Missouri Dept Natural Resources, Air Pollution Control Program
MODELER:
Bern Johnson
CALM WINDS:
7.18%
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AVG. WIND SPEED:
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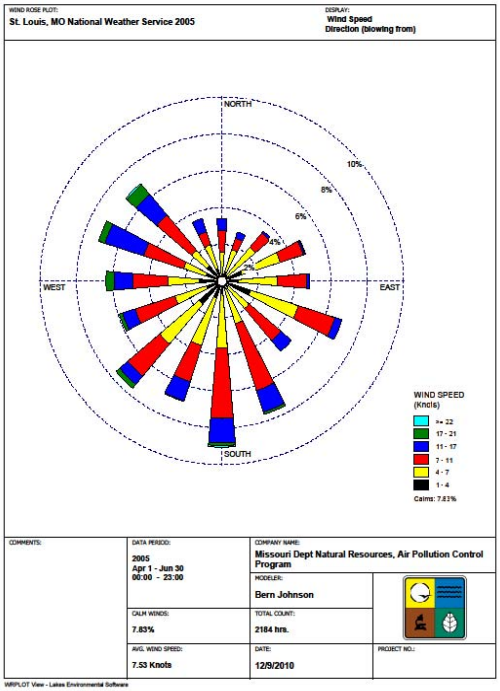
DATE:
12/9/2010
PROJECT NO.:
WRPLOT View - Lakes Environmental Software


WIND ROSE PLOT:
St. Louis, MO National Weather Service 2005
DISPLAY:
Wind Speed
Direction (blowing from)
NORTH
EAST
SOUTH
WEST
10%
8%
6%
4%
WIND SPEED
(Knots)
>= 22
17 - 21
11 - 17
7 - 11
4 - 7
1 - 4
Calms: 7.83%
COMMENTS:
DATA PERIOD:
2005
Apr 1 - Jun 30
00:00 - 23:00
COMPANY NAME:
Missouri Dept Natural Resources, Air Pollution Control Program
MODELER:
Bern Johnson
CALM WINDS:
7.83%
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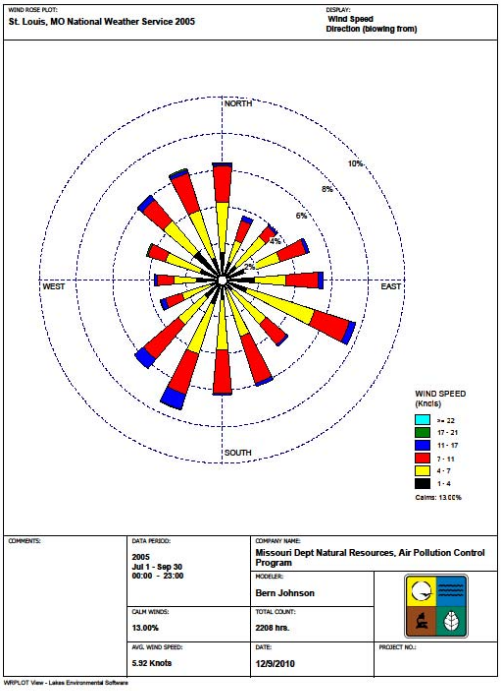
DATE:
12/9/2010
PROJECT NO.:
WRPLOT View - Lakes Environmental Software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St. Louis, MO National Weather Service 2005
DISPLAY:
Wind Speed
Direction (blowing from)
NORTH
EAST
SOUTH
WEST
10%
8%
6%
4%
WIND SPEED
(Knots)
>= 22
17 - 21
11 - 17
7 - 11
4 - 7
1 - 4
Calms: 13.00%
COMMENTS:
DATA PERIOD:
2005
Jul 1 - Sep 30
00:00 - 23:00
COMPANY NAME:
Missouri Dept Natural Resources, Air Pollution Control Program
MODELER:
Bern Johnson
CALM WINDS:
13.00%
TOTAL COUNT:
2208 hrs.
AVG. WIND SPEED:
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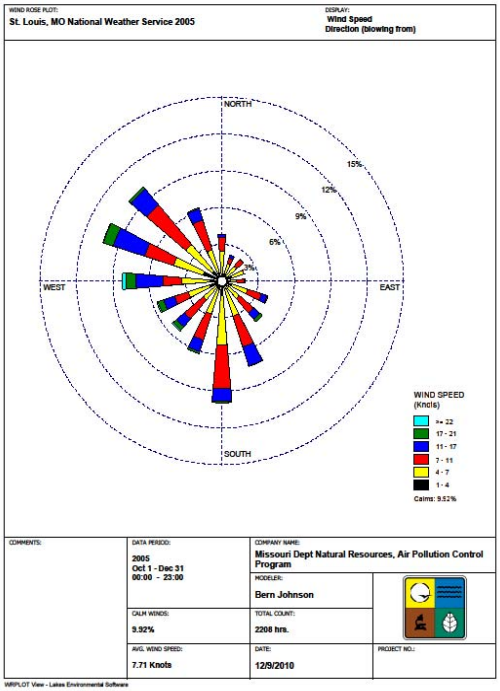
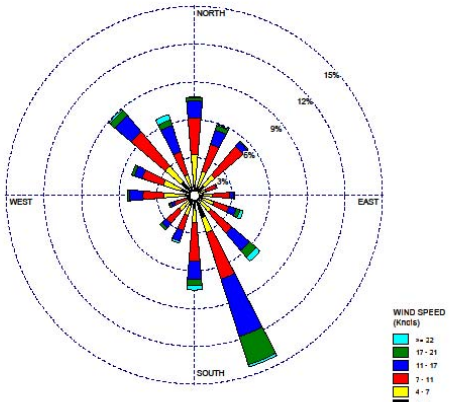
DATE:
12/9/2010
PROJECT NO.:
WRPLOT View - Lakes Environmental Software


WIND ROSE PLOT:
St. Louis, MO National Weather Service 2005
DISPLAY:
Wind Speed
Direction (blowing from)
NORTH
EAST
SOUTH
WEST
15%
12%
9%
6%
WIND SPEED
(Knots)
>= 22
17 - 21
11 - 17
7 - 11
4 - 7
1 - 4
Calms: 9.92%
COMMENTS:
DATA PERIOD:
2005
Oct 1 - Dec 31
00:00 - 23:00
COMPANY NAME:
Missouri Dept Natural Resources, Air Pollution Control Program
MODELER:
Bern Johnson
CALM WINDS:
9.92%
TOTAL COUNT:
2208 hrs.
AVG. WIND SPEED:
7.71 Knots
DATE:
12/9/2010
PROJECT NO.:
WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:
Springfield, MO National Weather Service 2005

DISPLAY:
Wind Speed
Direction (blowing from)



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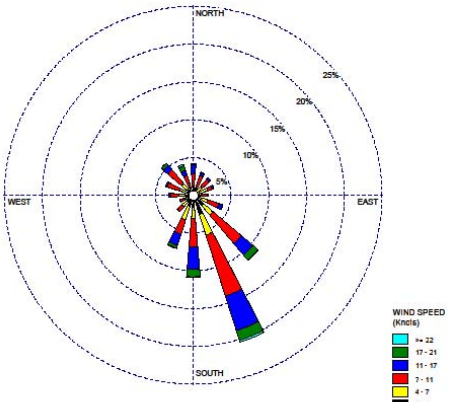
	AVG. WIND SPEED: 9.22 Knots	DATE: 12/9/2010
		PROJECT NO.:

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:
Springfield, MO National Weather Service 2005

DISPLAY:
Wind Speed
Direction (blowing from)



COMMENTS:	DATA PERIOD: 2005 Apr 1 - Jun 30 00:00 - 23:00	COMPANY NAME: Missouri Dept Natural Resources, Air Pollution Control Program
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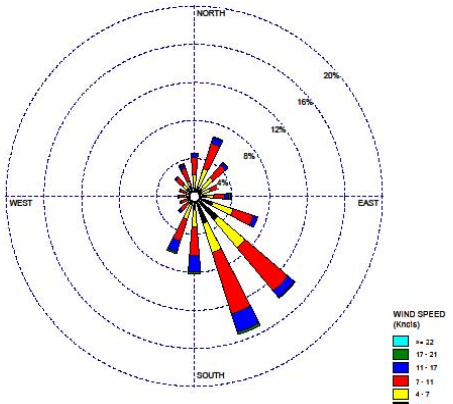
	CALM WINDS: 5.11%	TOTAL COUNT: 2184 hrs.
	AVG. WIND SPEED: 8.45 Knots	DATE: 12/9/2010
		PROJECT NO.:

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:
Springfield, MO National Weather Service 2005

DISPLAY:
Wind Speed
Direction (blowing from)



COMMENTS:	DATA PERIOD: 2005 Jul 1 - Sep 30 00:00 - 23:00	COMPANY NAME: Missouri Dept Natural Resources, Air Pollution Control Program
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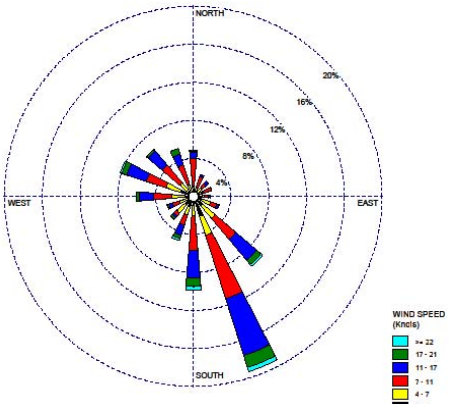
	AVG. WIND SPEED: 6.89 Knots	DATE: 12/9/2010
		PROJECT NO.:

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:
Springfield, MO National Weather Service 2005

DISPLAY:
Wind Speed
Direction (blowing from)



COMMENTS:	DATA PERIOD: 2005 Oct 1 - Dec 31 00:00 - 23:00	COMPANY NAME: Missouri Dept Natural Resources, Air Pollution Control Program
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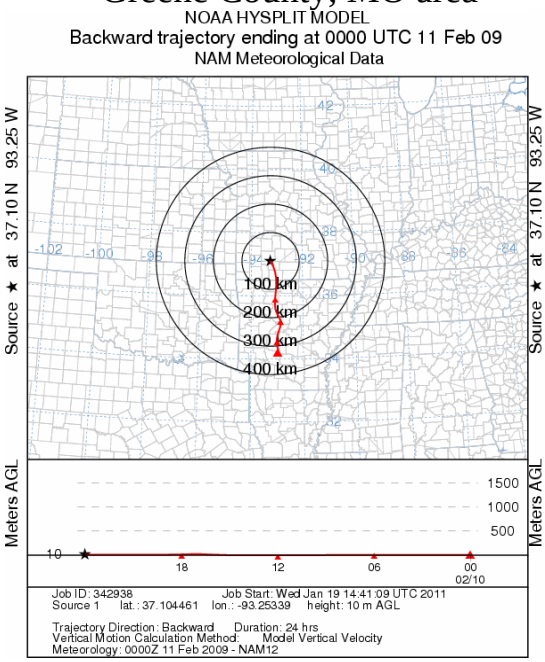
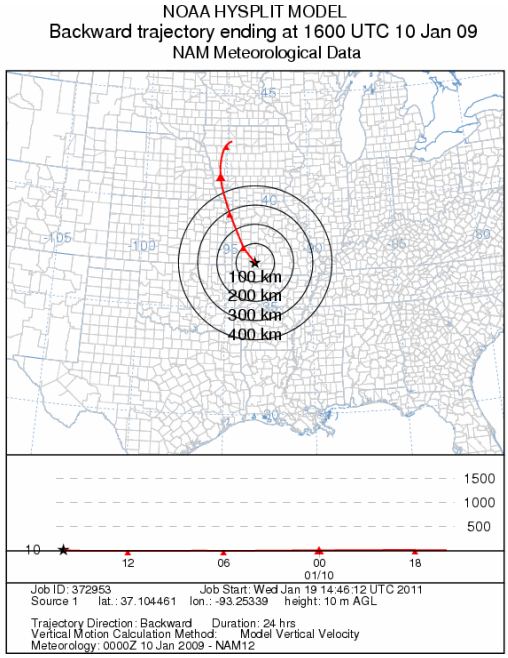
		PROJECT NO.:

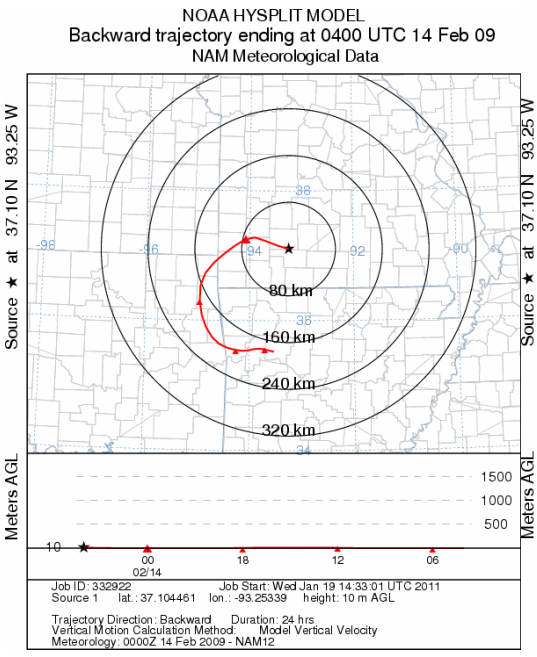
WRPLOT View - Lakes Environmental Software

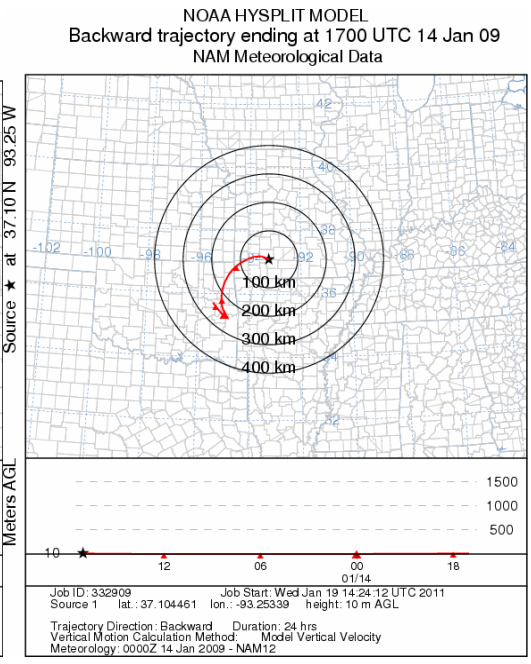
Appendix 3 – Back Trajectories

Greene County, MO area

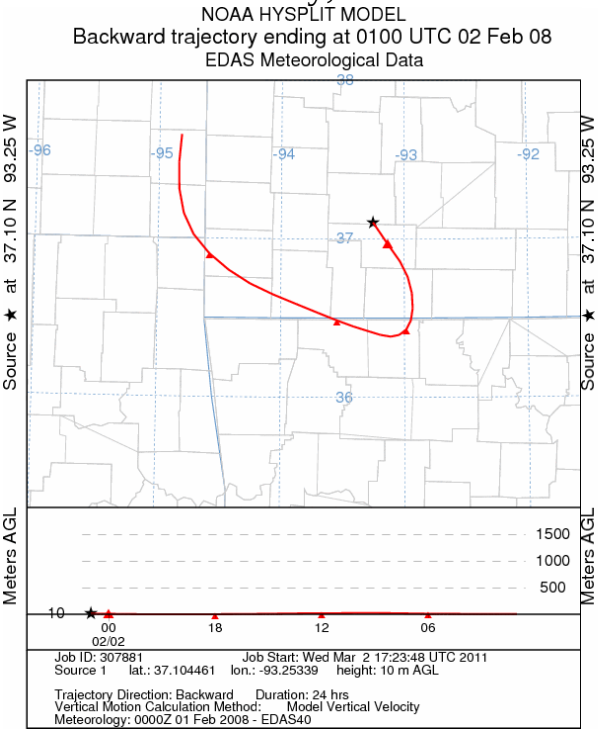


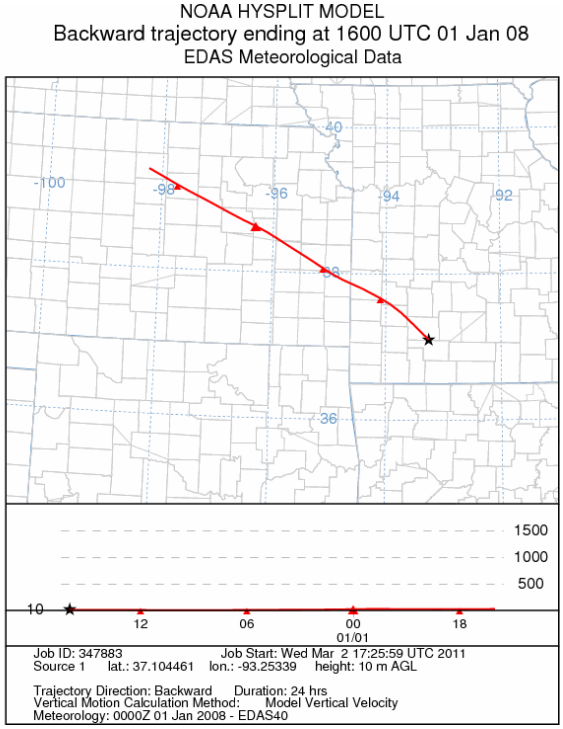


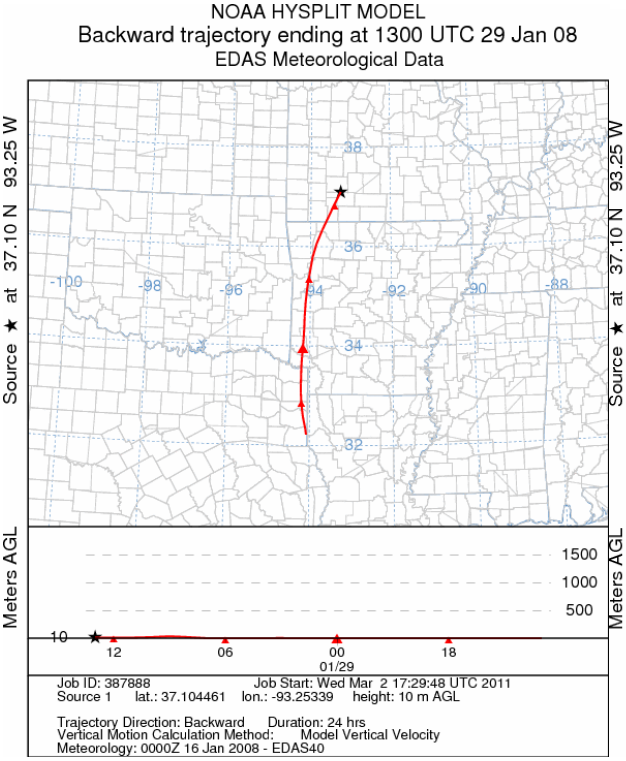


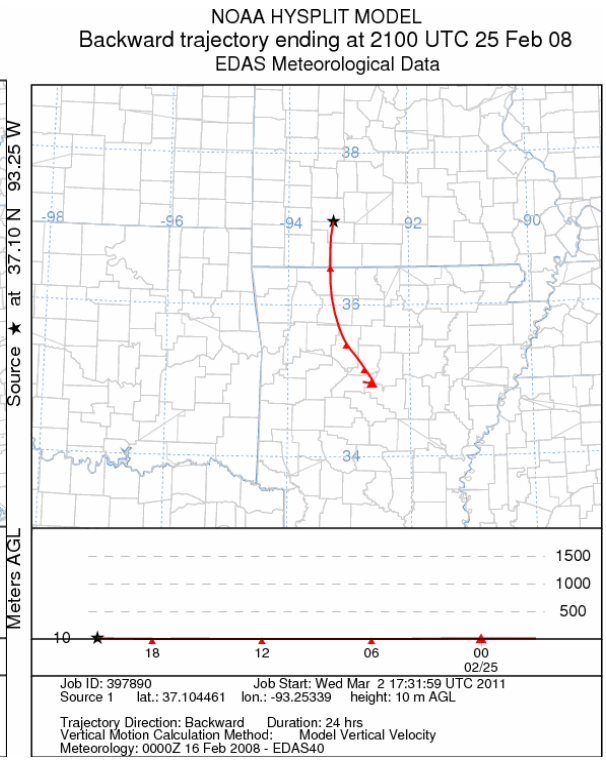


Greene County, MO area

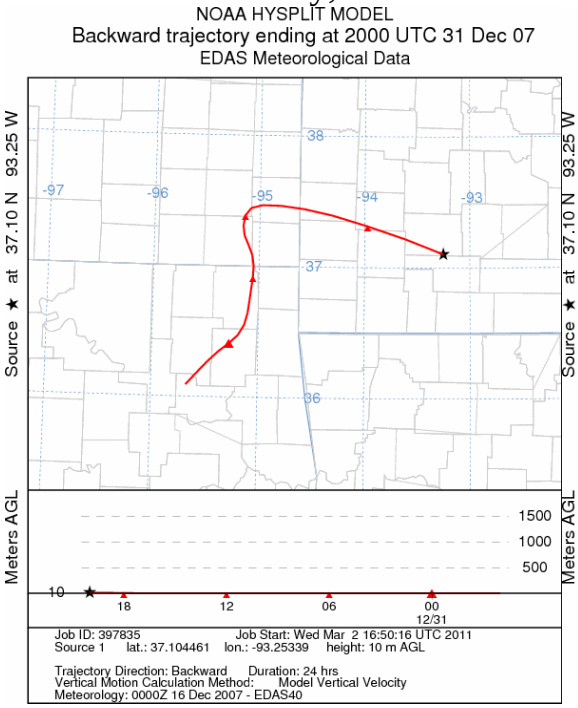


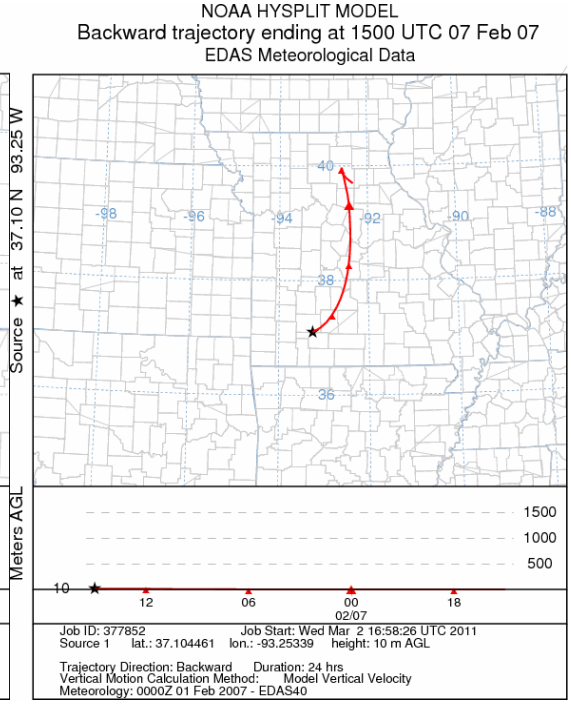


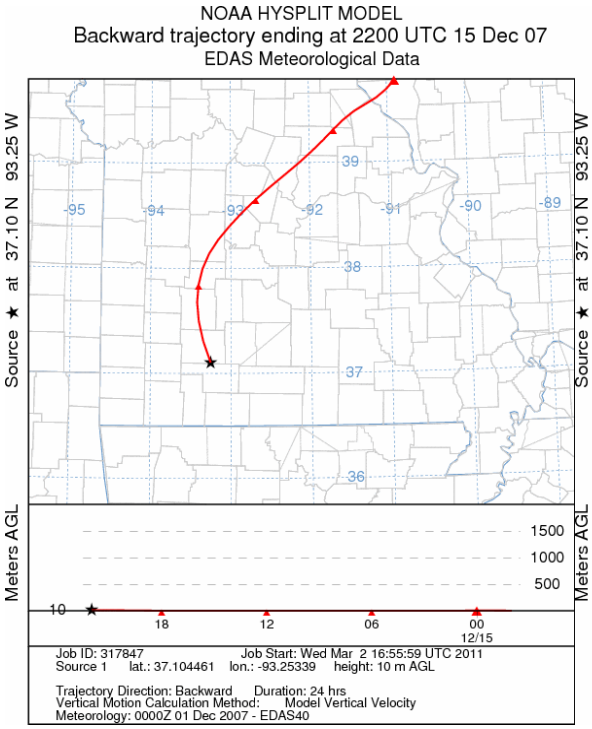


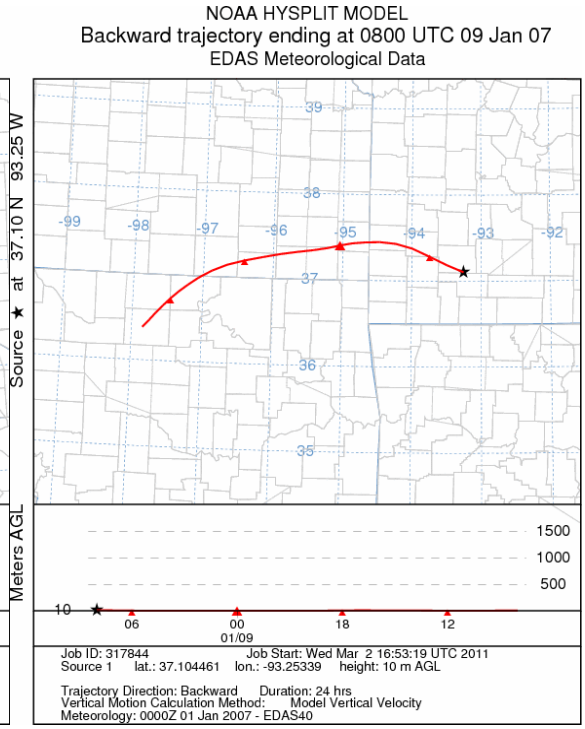


Greene County, MO area

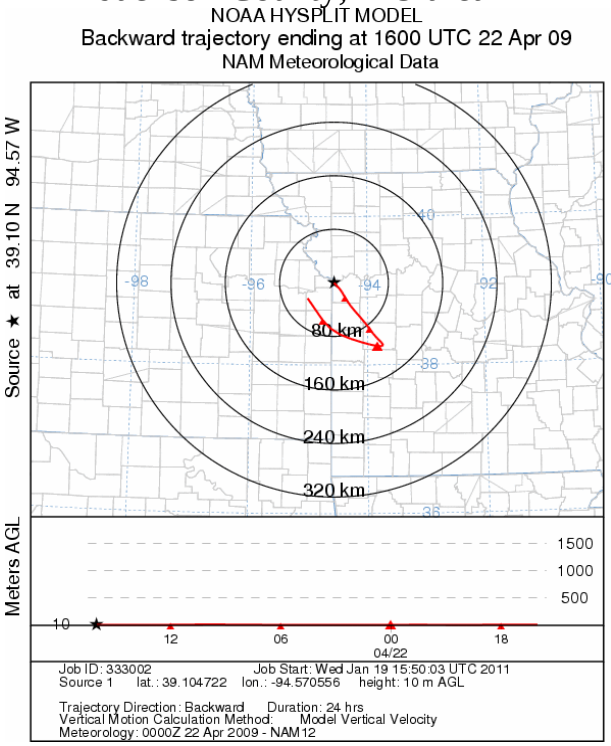


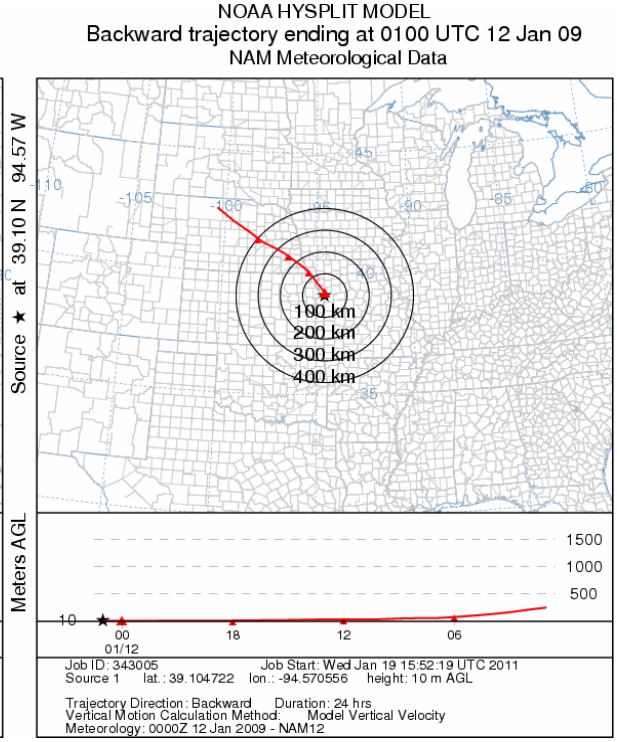


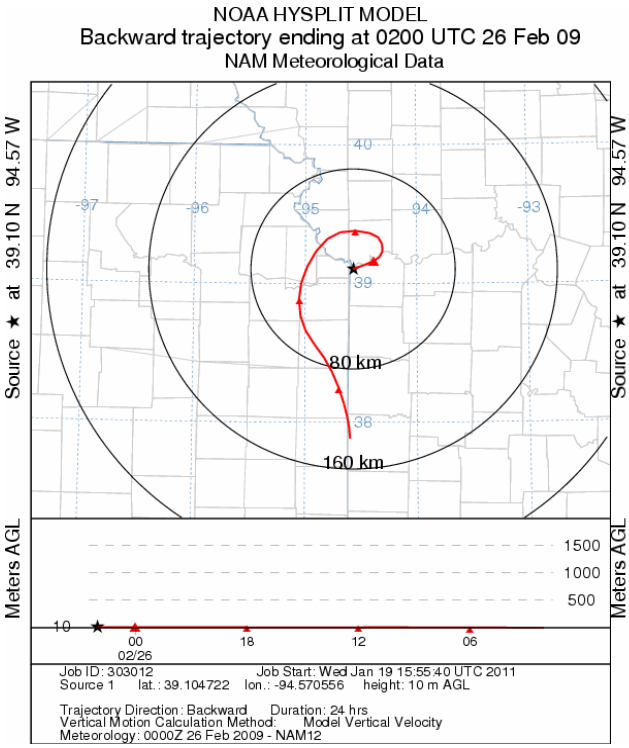


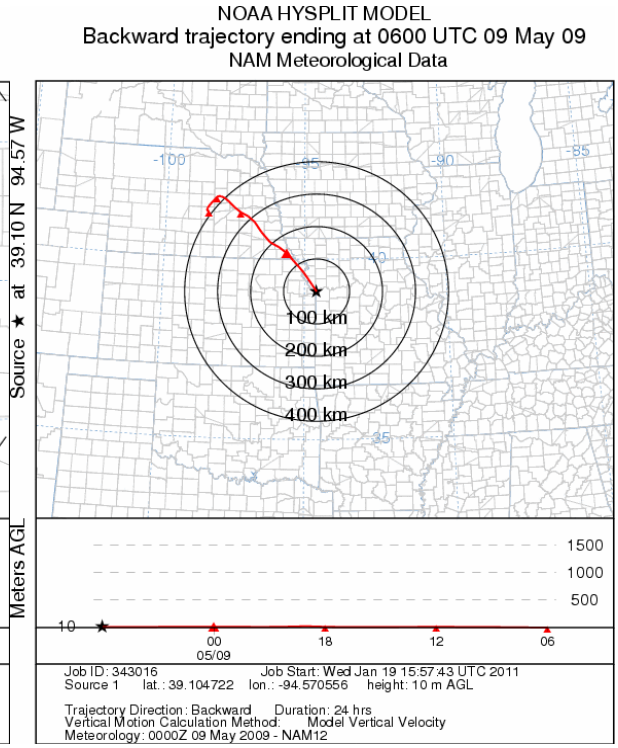


Jackson County, MO area

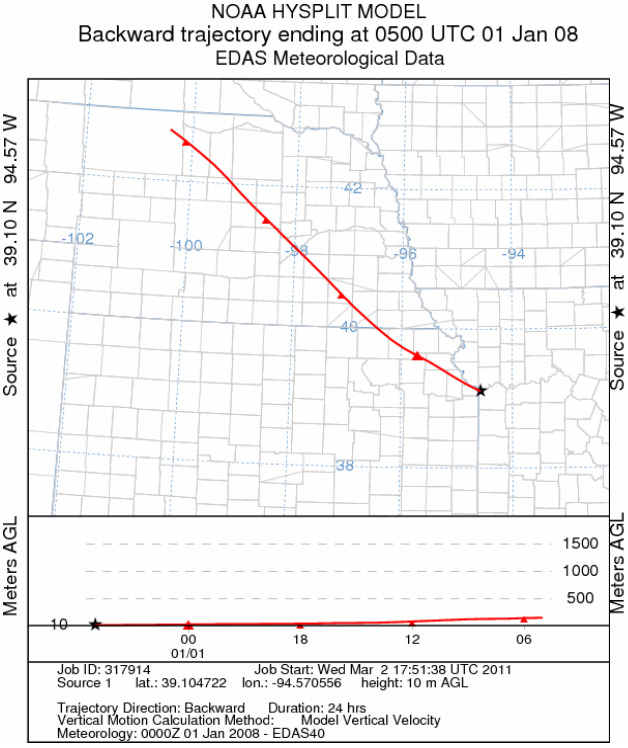


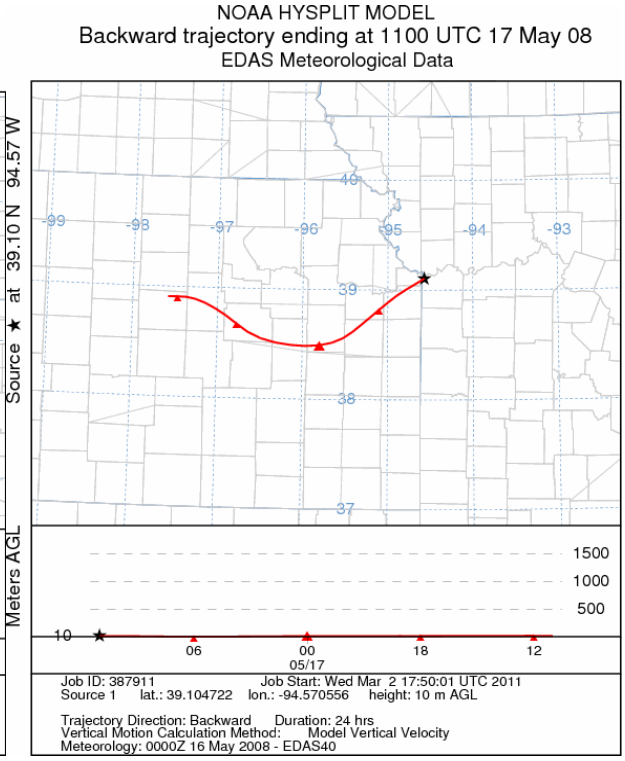


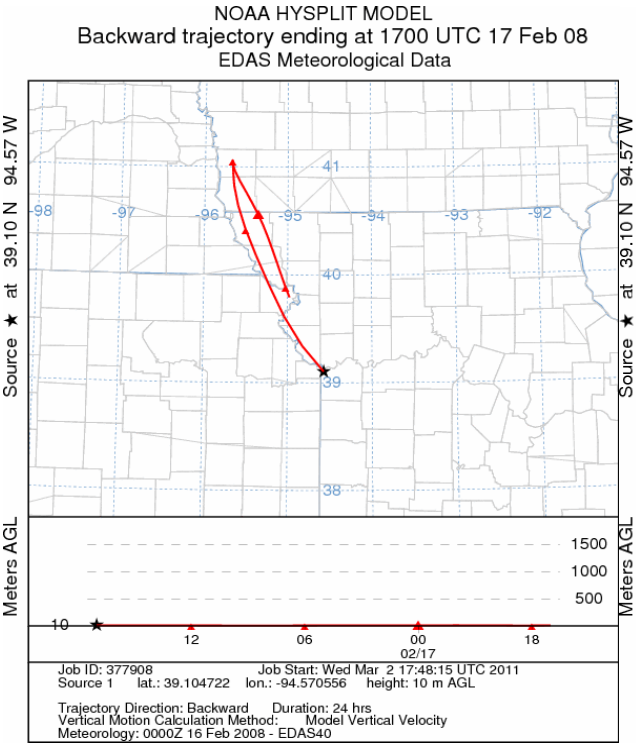


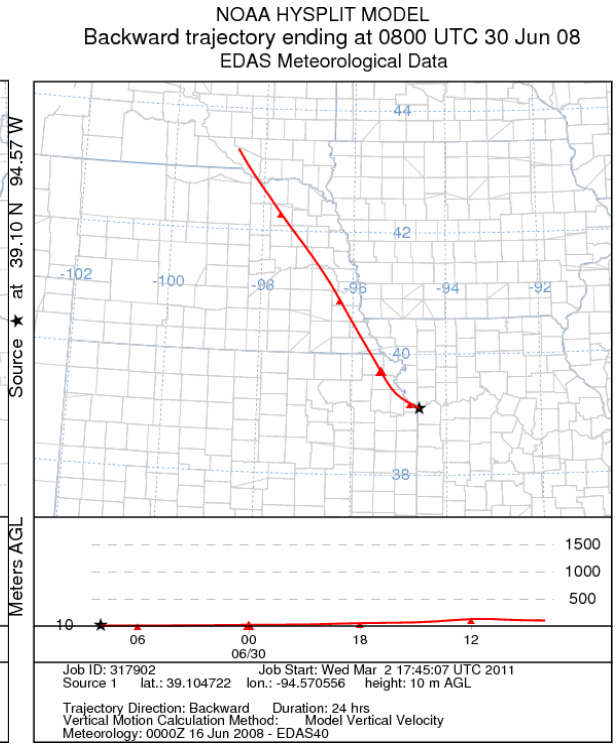


Jackson County, MO area

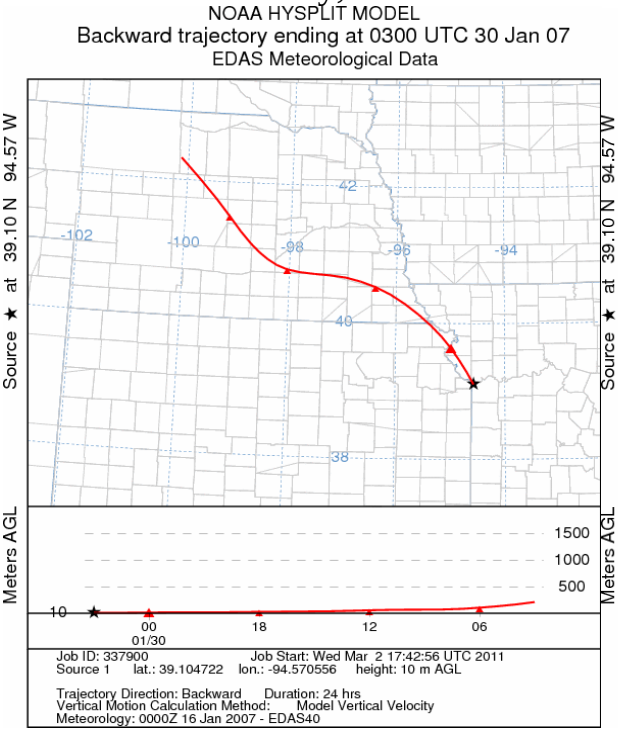


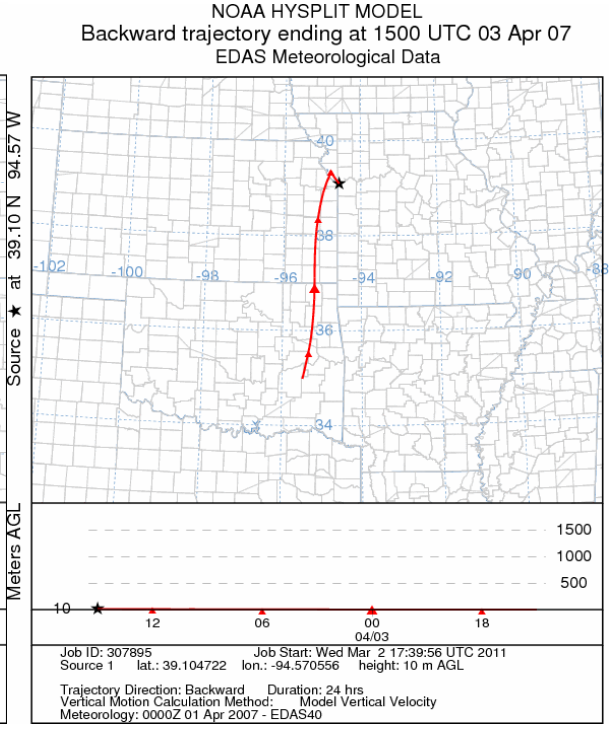


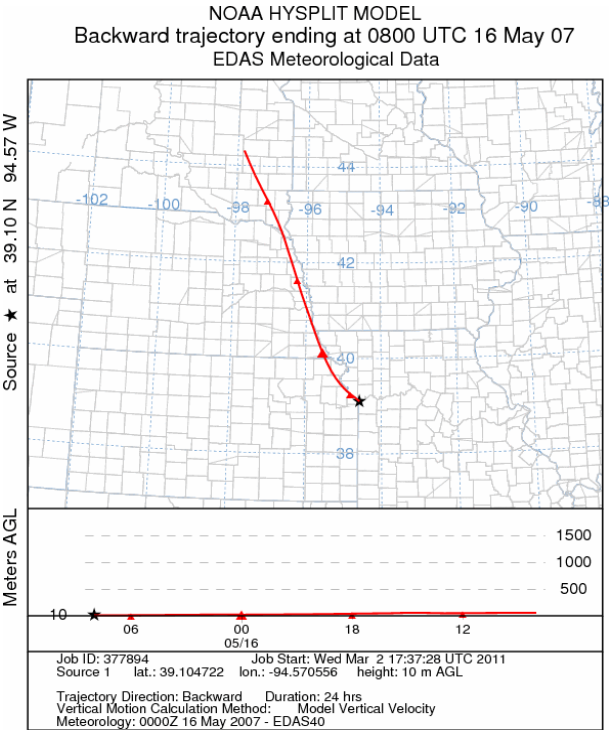


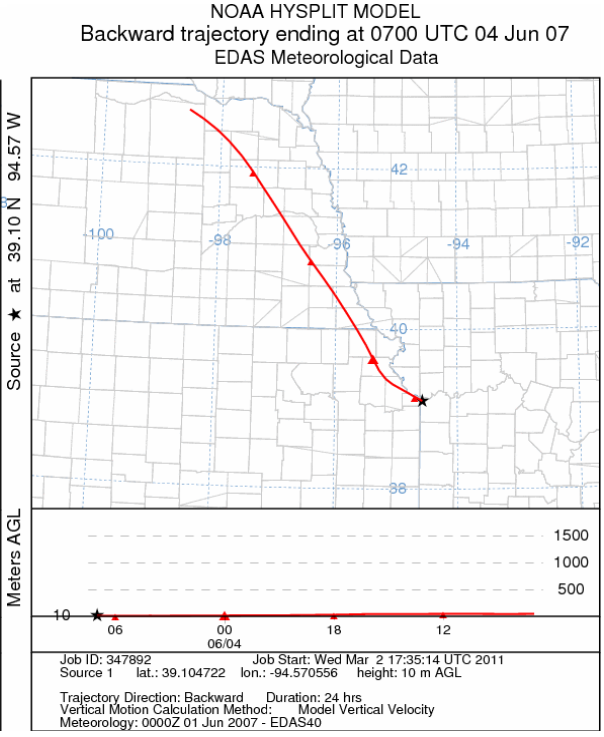


Jackson County, MO area

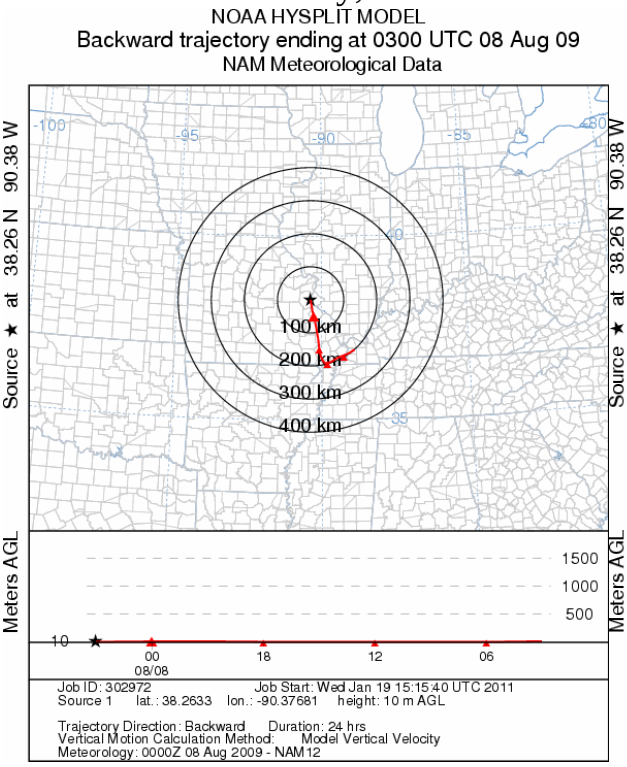


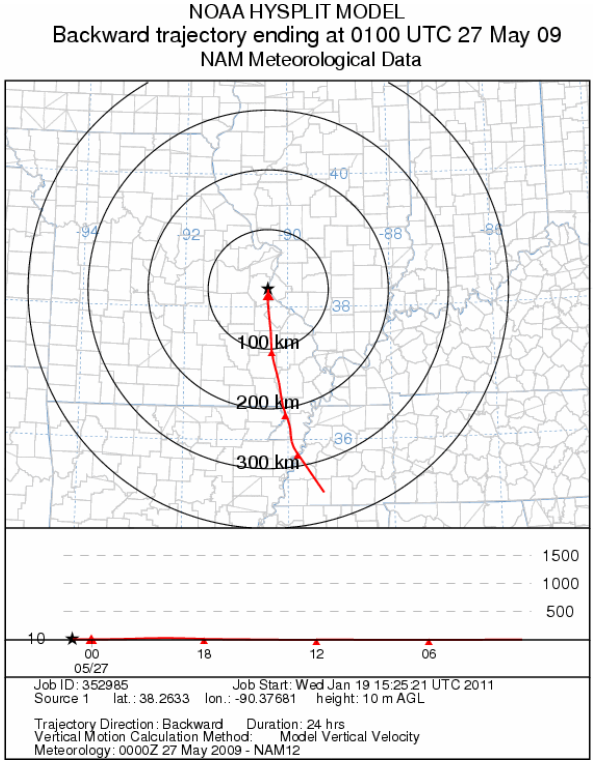


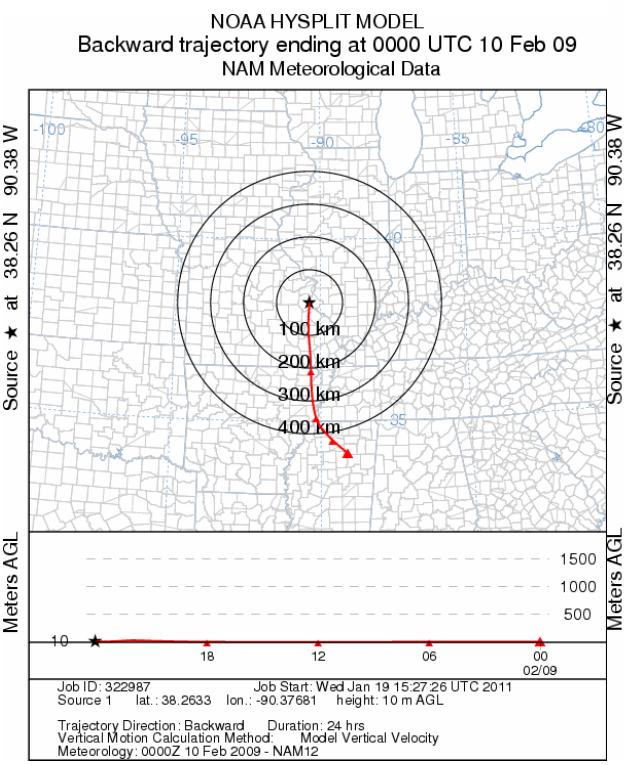


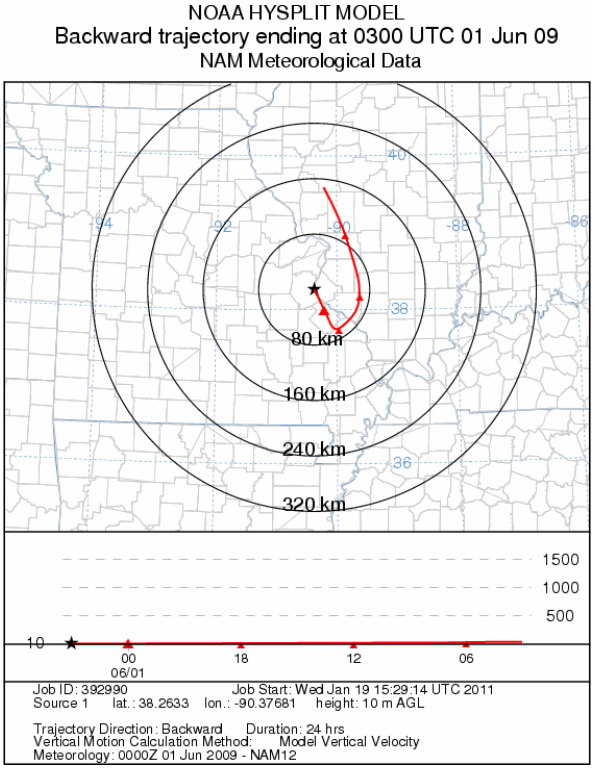


Jefferson County, MO area

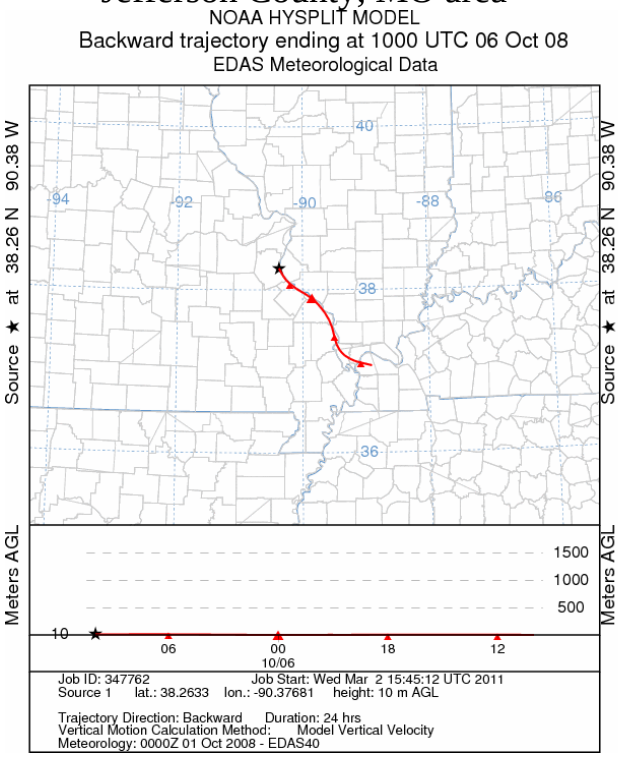


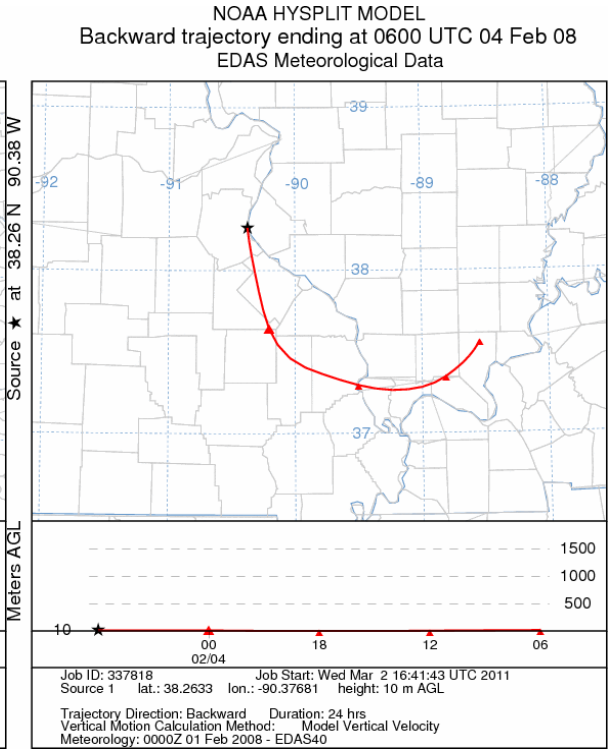


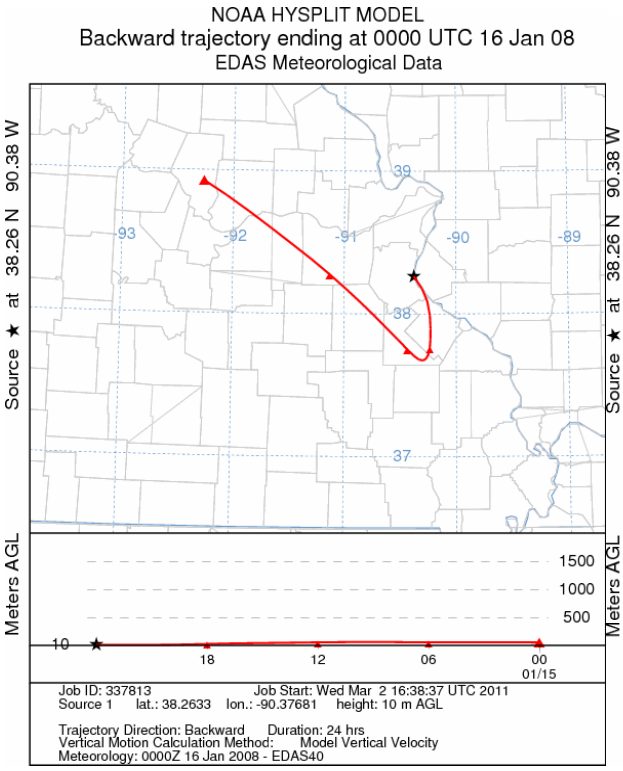


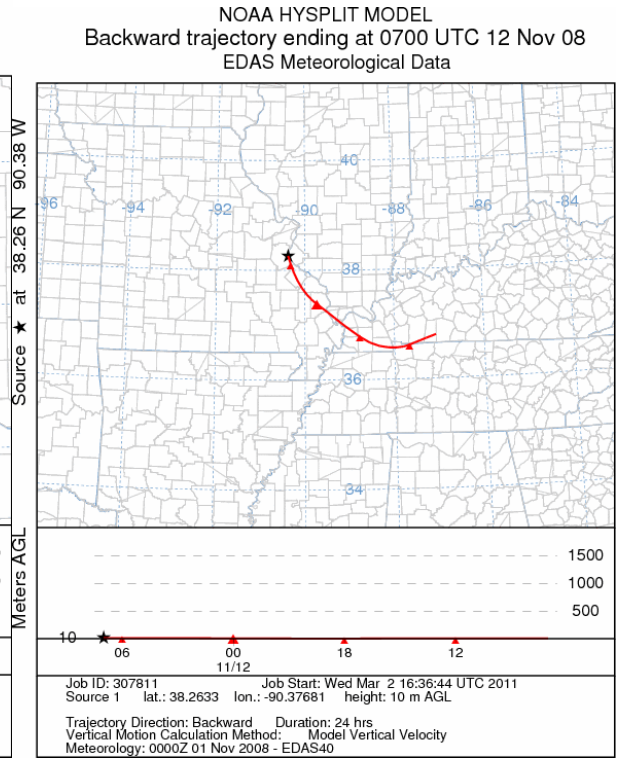


Jefferson County, MO area









Jefferson County, MO area