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cc: RA/DRA

STATE OF MISSOURI
Mel Carnahan, Governor • Stephen M. Mahfood, Director
DEPARTMENT OF NATURAL RESOURCES
OFFICE OF THE DIRECTOR
P.O. Box 176 Jefferson City, MO 65102-0176

JUL 11 2000

Mr. Dennis Grams
Regional Administrator
U.S. EPA, Region VII
901 North Fifth Street
Kansas City, KS 66101

Dear Mr. Grams:

This letter is in response to the U.S. Environmental Protection Agency's (EPA) May 2, 2000, letter to Governor Carnahan. Your May 2, 2000, letter requested that the state of Missouri make recommendations regarding the classification of attainment/unclassifiable and nonattainment status of counties under the revised 8-hour national ambient air quality standards for ozone. Governor Carnahan has requested that I, as his designee, send this response.

The EPA has promulgated a new 8-hour ozone national ambient air quality standard and has advised states that it is obligated by the Clean Air Act and the Transportation Equity Act for the 21st Century to designate areas throughout the country as attainment/unclassifiable or nonattainment for the standard. Section 107(d)(1) of the Clean Air Act provides each state governor the opportunity to recommend designations including appropriate boundaries to the EPA. The EPA's guidance dated March 28, 2000, "Boundary Guidance on Air Quality Designations for the 8-Hour Ozone National Ambient Air Quality Standards" requests that all state governors submit their designation recommendations and supporting documentation to the EPA by June 30, 2000.

At this time, I am recommending that the counties of Clay, Platte, Jackson, Jefferson, Franklin, St. Charles, and St. Louis along with the City of St. Louis be designated as nonattainment. I recommend that the remainder of the state of Missouri be designated as attainment/unclassifiable. Enclosed with this letter is a table listing all 114 counties in Missouri along with their corresponding recommended classification. Also enclosed with this letter is a technical review of the factors requested in the aforementioned EPA guidance document.

RECYCLED PAPER

Thank you for this opportunity. Should you have any questions regarding this letter or the technical support document enclosed, pleases contact Roger D. Randolph, Director of the Air Pollution Control Program, at (573) 751-4817.

Sincerely,

DEPARTMENT OF NATURAL RESOURCES

Stephen Mahfood
Director

SM:rca

Enclosures

County	Recommended Classification
ADAIR	Attainment/unclassifiable
ANDREW	Attainment/unclassifiable
ATCHISON	Attainment/unclassifiable
AUDRAIN	Attainment/unclassifiable
BARRY	Attainment/unclassifiable
BARTON	Attainment/unclassifiable
BATES T	Attainment/unclassifiable
BENTON	Attainment/unclassifiable
BOLLINGER	Attainment/unclassifiable
BOONE	Attainment/unclassifiable
BUCHANAN	Attainment/unclassifiable
BUTLER	Attainment/unclassifiable
CALDWELL	Attainment/unclassifiable
CALLAWAY	Attainment/unclassifiable
CAMDEN	Attainment/unclassifiable
CAPE GIRARDEAU	Attainment/unclassifiable
CARROLL	Attainment/unclassifiable
CARTER	Attainment/unclassifiable
CASS	Attainment/unclassifiable
CEDAR	Attainment/unclassifiable
CHARITON	Attainment/unclassifiable
CHRISTIAN	Attainment/unclassifiable
CLARK	Attainment/unclassifiable
CLAY	Nonattainment
CLINTON	Attainment/unclassifiable
COLE	Attainment/unclassifiable
COOPER	Attainment/unclassifiable
CRAWFORD	Attainment/unclassifiable
DADE	Attainment/unclassifiable
DALLAS	Attainment/unclassifiable
DAVIESS	Attainment/unclassifiable
DeKALB	Attainment/unclassifiable
DENT	Attainment/unclassifiable
DOUGLAS	Attainment/unclassifiable
DUNKLIN	Attainment/unclassifiable
FRANKLIN	Nonattainment
GASCONADE	Attainment/unclassifiable
GENTRY	Attainment/unclassifiable
GREENE	Attainment/unclassifiable
GRUNDY	Attainment/unclassifiable
HARRISON	Attainment/unclassifiable
HENRY	Attainment/unclassifiable

HICKORY	Attainment/unclassifiable
HOLT	Attainment/unclassifiable
HOWARD	Attainment/unclassifiable
HOWELL	Attainment/unclassifiable
IRON	Attainment/unclassifiable
JACKSON	Nonattainment
JASPER	Attainment/unclassifiable
JEFFERSON	Nonattainment
JOHNSON	Attainment/unclassifiable
KNOX	Attainment/unclassifiable
LACLEDE	Attainment/unclassifiable
LAFAYETTE	Attainment/unclassifiable
LAWRENCE	Attainment/unclassifiable
LEWIS	Attainment/unclassifiable
LINCOLN	Attainment/unclassifiable
LINN T(14)	Attainment/unclassifiable
LIVINGSTON	Attainment/unclassifiable
McDONALD	Attainment/unclassifiable
MACON	Attainment/unclassifiable
MADISON	Attainment/unclassifiable
MARIES	Attainment/unclassifiable
MARION	Attainment/unclassifiable
MERCER	Attainment/unclassifiable
MILLER	Attainment/unclassifiable
MISSISSIPPI	Attainment/unclassifiable
MONITEAU	Attainment/unclassifiable
MONROE	Attainment/unclassifiable
MONTGOMERY	Attainment/unclassifiable
MORGAN	Attainment/unclassifiable
NEW MADRID	Attainment/unclassifiable
NEWTON	Attainment/unclassifiable
NODAWAY	Attainment/unclassifiable
OREGON	Attainment/unclassifiable
OSAGE	Attainment/unclassifiable
OZARK	Attainment/unclassifiable
PEMISCOT	Attainment/unclassifiable
PERRY	Attainment/unclassifiable
PETTIS	Attainment/unclassifiable
PHELPS	Attainment/unclassifiable
PIKE	Attainment/unclassifiable
PLATTE	Nonattainment
POLK	Attainment/unclassifiable
PULASKI	Attainment/unclassifiable
PUTNAM	Attainment/unclassifiable
RALLS	Attainment/unclassifiable

RANDOLPH	Attainment/unclassifiable
RAY	Attainment/unclassifiable
REYNOLDS	Attainment/unclassifiable
RIPLEY	Attainment/unclassifiable
ST. CHARLES	Nonattainment
ST. CLAIR	Attainment/unclassifiable
ST. FRANCOIS	Attainment/unclassifiable
STE. GENEVIEVE	Attainment/unclassifiable
ST. LOUIS	Nonattainment
SALINE	Attainment/unclassifiable
SCHUYLER	Attainment/unclassifiable
SCOTLAND	Attainment/unclassifiable
SCOTT	Attainment/unclassifiable
SHANNON	Attainment/unclassifiable
SHELBY	Attainment/unclassifiable
STODDARD	Attainment/unclassifiable
STONE	Attainment/unclassifiable
SULLIVAN	Attainment/unclassifiable
TANEY	Attainment/unclassifiable
TEXAS	Attainment/unclassifiable
VERNON	Attainment/unclassifiable
WARREN	Attainment/unclassifiable
WASHINGTON	Attainment/unclassifiable
WAYNE	Attainment/unclassifiable
WEBSTER	Attainment/unclassifiable
WORTH	Attainment/unclassifiable
WRIGHT	Attainment/unclassifiable
ST. LOUIS CITY	Nonattainment

Technical Information for Determination of Nonattainment Boundaries in Missouri for the 8-hour Ozone National Ambient Air Quality Standard

In July 1997, the U.S. Environmental Protection Agency (EPA) published a revision to the ozone national ambient air quality standard (NAAQS). This revision changed the level and averaging time for the standard: old – 0.12 ppm and 1 hour, new – 0.08 ppm and 8-hour. In May 1999, the U.S. Court of Appeals for the D.C. circuit remanded the 8-hour ozone standard while reaffirming EPA's ability to make designations. Nevertheless, EPA has a Clean Air Act deadline of July 2000 to promulgate designations for the new 8-hour NAAQS. These designations are usually recommended by the governor of each state and acted on by EPA. In these recommendations, areas can be classified as nonattainment (does not meet the NAAQS, or it contributes to a nearby area that does not meet the NAAQS), attainment (meets the NAAQS), or unclassifiable (cannot be classified on available data). EPA's action can be approval of the recommendations or promulgation of new designations that differ from the governor's recommendation. EPA has asked for recommendations from the states by June 30, 2000. This document provides the technical basis for this recommendation by the state of Missouri.

In the March 28, 2000, guidance on establishing nonattainment boundaries for the 8-hour ozone NAAQS, EPA suggested that "the Metropolitan Statistical Area (MSA) or Consolidated Metropolitan Statistical Area (CMSA) serve as the presumptive boundary for 8-hour NAAQS nonattainment areas." Therefore, the analysis provided in this document will focus on current Missouri MSAs that have counties that violate the current level of the 8-hour NAAQS from 1997-99. However, some additional counties will be addressed in order to provide sufficient information to distinguish trends regarding emission, population, and air quality trends within the immediate area around the MSA.

EPA has also stated that states may recommend areas larger than the current MSA if additional counties contain sources, population, commuting patterns or other factors that contribute to the nonattainment problem. Conversely, states may request smaller nonattainment areas where counties or portions of counties do not contribute to the problem area and can be considered rural in nature. In an area where the 1-hour NAAQS still applies (St. Louis), EPA suggested that the designated 8-hour nonattainment area boundary be the same as or larger than the existing 1-hour nonattainment area boundary. The guidance spells out eleven additional criteria for evaluation of the boundaries. These include:

- Emission and air quality in adjacent areas (including adjacent C/MSAs)
- Population density and degree of urbanization including commercial development (significant difference from surrounding areas)
- Monitoring data representing ozone concentrations in local area and larger area (urban or regional scale)
- Location of emission sources (emission sources and nearby receptors should generally be included in the same nonattainment area)
- Traffic and commuting patterns
- Expected growth (including extent, pattern, and rate of growth)
- Meteorology (weather/transport patterns)
- Geography/topography (mountain ranges or other air basin boundaries)

- Jurisdictional boundaries (e.g. counties, air districts, existing 1-hour nonattainment areas, Reservations, etc.)
- Regional emission reductions (e.g. Oxides of Nitrogen (NOx) State Implementation Plan (SIP) call or other enforceable regional strategies)

All these factors will be presented in this analysis.

Kansas City MSA

CURRENT AIR QUALITY

The current and recent past air quality information for 8-hour ozone in the Kansas City MSA is shown in Table 1. The design value for 8-hour ozone in any area is based on the highest average of the 4th highest values at all monitors. Figure 1 denotes the locations of the monitors within the current Kansas City ozone network.

TABLE 1

Monitor	4th High 8-hour Ozone Values (ppb)					95-97	96-98	97-99
	1995	1996	1997	1998	1999	Average	Average	Average
Liberty	99	87	98	95	82	**94**	**93**	**91**
Watkins Mill	96	83	95	91	84	**91**	**89**	**90**
KCI	90	80	90	90	76	**86**	**86**	**85**
Worlds of Fun	88	72	82	86	82	80	80	83
Richards Gebaur	77	71	72	73	81	73	72	75
Wyandotte Co. (KS)	89	86	81	87	78	**85**	84	82
El Dorado Springs (upwind)				87	84			
Mine Creek (KS-upwind)				80	82			

BOLD denotes monitors that exceed the 85 parts per billion (ppb) cutoff

The Kansas City area does not meet the 8-hour standard based on the 1997-99 ozone design values. The design value for Kansas City is 91 ppb (measured at the Liberty monitor). Three monitors have design values over the 8-hour ozone NAAQS and it should be noted that these three monitors have recorded most of the 1-hour ozone exceedances in the recent past. The violating counties in the Kansas City MSA are Clay and Platte. Also, the El Dorado Springs monitor in Cedar County would exceed based on the average of the two-year data set.

KANSAS CITY AREA POINT SOURCE EMISSION, POPULATION, AND TRAFFIC INFORMATION

Table 2 illustrates the precursor emissions and population data for the counties in and surrounding the Kansas City MSA. This data illustrates that the five counties in the 1-hour maintenance area account for the vast majority of point source volatile organic compound (VOC) and NOx emissions within the MSA for Kansas City (94% VOC and NOx). Among the remaining counties in the MSA, Miami County has the most emissions from point sources of VOC and NOx. Figures 2, 3, and 4 illustrate the location of the point sources in these counties. Figure 2 contains all sources of VOC and NOx in the area. Figure 3 provides information about sources greater than 25 tons per year (TPY) of VOC emissions. Figure 4 has information concerning NOx sources with emissions greater than 25 TPY. These figures illustrate the same

pattern as the tables with some exceptions (most of the emission sources in the MSA are in the existing maintenance area). The surrounding counties in Missouri that have greater than 5% of the MSA total of either NOx or VOC point source emissions are Buchanan, Pettis, and Henry. Douglas and Linn counties in Kansas also meet this criteria.

The population data for 1999 in Table 2 shows that there are seven of the eleven MSA counties that exceed 70,000 people. These counties include the five maintenance area counties and Leavenworth and Cass counties. The population growth information from 1990-99 is also of interest for several of these counties. Johnson (KS) and Cass counties have the highest population growth rates for the area. The surrounding counties with "high" populations include Buchanan and Douglas (Douglas also has a 20% population growth rate). Figure 5 provides 1990 population density information for many of the counties in the area. Figure 6 provides 2004 population density information for counties in Missouri. These illustrate the strong signal of high population and urbanization within the maintenance area with some areas of high density in Douglas, Cass, and Buchanan counties. One of the uses for the population data will be as a surrogate for area source emissions in this analysis. Figure 7 illustrates the urban areas near Kansas City. This map shows that the counties outside the five-county maintenance area are less urban than the five-county area. Special note should be taken of northern Platte (rural), eastern Leavenworth, and extreme northern Cass counties as exceptions to the previous statement.

The vehicle miles traveled (VMT), traffic count, and commuter pattern information for this analysis has been provided by the Mid-America Regional Council (MARC), the Missouri Department of Transportation (MoDOT), the Kansas Department of Transportation, and the U.S. Census Bureau. The VMT information demonstrates the typical pattern of high urban core VMT with major highways (I-29, 35, 70, and 435) contributing the majority of that VMT. Figure 8, 9, and 10 show the traffic patterns based on MoDOT data (Figure 8), the MARC traffic network (Figure 9), and the whole region (Figure 10). The VMT data, as shown in Table 4, illustrates a consistently higher density and volume of VMT in the urban core counties with the major highways contributing in the outlying counties of the MSA.

METEOROLOGY OF OZONE FORMATION IN KANSAS CITY

The meteorology of ozone formation in the Kansas City area is fairly typical of many cities in the eastern United States. The meteorological conditions for high 1-hour ozone concentrations include maximum temperature greater than 85°F, minimum temperature greater than 57°F, strong sunshine, no precipitation, and light surface and upper level winds. NOTE: Conducive days for 1-hour ozone are also conducive for high 8-hour ozone concentrations. However, with these conducive conditions Kansas City has some very specific wind direction features. Wind roses from the Kansas City International Airport (KCI) are provided in Figures 11, 12, and 13 that provide days with these meteorological conditions. Figure 11 shows all hours of days with the above conditions met. This figure shows the strong southerly component to these days and especially with winds from the due south. Figure 12 gives the wind rose for 7-10 AM CST (early morning traffic emissions and hours before strong solar radiation). This information again shows the strong southerly component with the due south and southwest as the most predominant directions. Figure 13 represents the early afternoon hours (1-4 PM CST) on these same ozone-conducive days. This wind rose shows a similar southerly dominance but also has a strong

easterly component. When viewing all this information, the conclusion is that winds with a strong southerly component are predominant on ozone conducive days.

In addition, forward trajectories have been developed from the NOAA-Hysplit trajectory model for many of the 8-hour exceedance days in Kansas City during 1996-99. These plots are included in the attachment to this document. The purpose of these diagrams is to show where the plume that originates near the centroid of emissions for Kansas City (area near the Missouri River between Wyandotte and Jackson counties) travels over a 6, 12, 18, and 24-hour period. This information illustrates that on most days the air at this location travels toward the monitors that record high 8-hour ozone concentrations. However, the wind data is collected at National Weather Service stations and interpolated over the entire country. This data has a tendency to show higher wind speeds and more regional flow than local meteorological data. Therefore, the likelihood is that the trajectory is showing too much movement from the centroid on many days when compared to the actual plume.

The trajectory analysis suggests that easterly/southeasterly winds show higher concentrations at the Wyandotte County and KCI monitors. Consistent southwesterly winds show higher concentrations at the Liberty and Watkins Mill monitors. Also, lower wind speed conditions and the same southwesterly influence cause higher concentrations at the Worlds of Fun monitor. On two days in 1999 (August 4th and 25th), the Richards Gebaur monitor had 8-hour ozone concentrations of 105 and 87, respectively. The winds on these days were from the north and suggested contributions from the same area as the other sites. The conclusion of this analysis is the resultant direction and ozone data suggest the influence of the emissions in this area is strong in determining the actual concentrations at the monitor.

An additional analysis was performed to understand the origin of the plumes at the monitoring sites at the time of maximum 1-hour concentration. For each 8-hour exceedance day (with available meteorological data), the air parcel containing the maximum 1-hour concentration was projected back to its location at 7 AM CDT. This back trajectory exercise, shown in Figure 14, was conducted with the KCI meteorological data for exceedance days at the four Missouri sites with exceedances between 1996 and 1998. Again, this data will likely overestimate the transport distance because of the higher wind speeds and regional flow characterization. However, the pattern of transport is very clear for all these sites. The area around eastern Jackson and western Wyandotte and Johnson (KS) counties is the area where the plumes travel on these days. These correspond to southeasterly and southwesterly directions from the centroid area. Figures 15 and 16 illustrate the location of "large" VOC and NOx sources with this back trajectory analysis. No transport from Buchanan or Clinton counties was seen on any of these days. Very limited transport was seen from Ray, Johnson (MO), Lafayette, Bates, Leavenworth, Douglas, and Franklin counties. The remaining counties not in the five-county maintenance area include Miami, Linn, and Cass. NOTE: The ozone monitoring network for Kansas City is currently under revision and is not well suited to characterize the extent of the 8-hour problem areas.

One final set of meteorological analysis was conducted. The "upwind" monitors located at Mine Creek (KS) and El Dorado Springs were analyzed with back trajectory analysis on some exceedance days during 1998-99 to determine the origin of the high concentrations for this two sites. The trajectory analysis was conducted using the NOAA-Hysplit model for 24 hours.

There were six days that recorded greater than 85-ppb ozone at these sites (six at El Dorado Springs and four at Mine Creek). The results show that nine of the ten trajectories are from the southwest, south, or southeast. This would not indicate significant transport away from Kansas City on these days. In addition, the one trajectory "from" Kansas City was the Mine Creek exceedance on September 4, 1999. The trajectory for El Dorado Springs on that day showed a trajectory from the southwest. This could be an interpolation problem with the Hysplit model on this particular day for the Mine Creek site. Nonetheless, the predominant trajectory for these sites as well as the metropolitan monitoring sites is from the southeast, south, or southwest.

OTHER INFORMATION REQUESTED IN THE EPA GUIDANCE

There are no significant geographic or topographic features in the Kansas City area. One jurisdictional boundary of interest is the current five-county maintenance area. The Metropolitan Planning Organization (MPO) boundary is also of interest because of its urban nature and higher expected growth rates for Kansas City (VMT, population, etc.). The state of Missouri has submitted a SIP with utility control in the western two-thirds of the state at 0.35 lb NOx/MMBTU heat input. The nearby, upwind MSAs of interest are Springfield, MO; Joplin, MO; Tulsa, OK; Wichita, KS; and Lawrence, KS. The Springfield MSA has 1996-98 and 1997-99 design values of 73 ppb. The Wichita MSA has a 1996-98 design value of 78 ppb and a 1997-99 design value of 80 ppb. The Tulsa MSA has a 1997-99 design value of 88 ppb. No ozone monitoring data exists for Lawrence, KS, or Joplin, MO.

As seen in Table 2, population growth above 15% has occurred in the following counties between 1990-1999: Cass, Clinton, Jackson, and Platte in Missouri and Douglas, Miami, and Johnson in Kansas. Additional growth information for some of the counties is presented in Table 3. This information includes population and employment projections until 2020. Additional growth is expected to occur within all the Kansas City area except population within Wyandotte County. The highest growth is expected to continue to occur with Johnson (KS), Platte, and Cass.

SUMMARY

The following table is a condensed summary of 8-hour ozone designation factors. This table can be used as a guide for selecting counties with greater opportunity to contribute to 8-hour ozone significantly in the Kansas City area.

Table 4: Summary of 8-Hour Designation Factors

County	1-Hr. Maint Area	Pt. Source VOC % (TPY)	Pt. Source NOx % (TPY)	1999 Pop. % (1000)	1998 Daily VMT % (1000)	1999 Population Density	Total Non-Met Summary
Jackson	Yes	19.9 (2038)	27.4 (26196)	32.2 (654)	29.0 (16217)	16.9	125.5
Wyandotte	Yes	26.8 (2740)	9.4 (9034)	7.5 (151)	8.2 (4565)	15.6	67.5
Johnson (KS)	Yes	4.5 (462)	1.6 (1516)	21.7 (440)	21.2 (11846)	14.4	63.4
Clay	Yes	26.9 (2750)	0.3 (242)	8.9 (180)	10.7 (5981)	7.1	53.8
Linn	No	2.1 (213)	**28.8** (27531)	0.5 (9)	0.6 (321)	0.2	32.1

Buchanan	No	6.2 (638)	7.2 (6893)	4.0 (82)	4.2 (2352)	3.1	24.8
Platte	Yes	2.6 (262)	7.2 (6838)	3.5 (72)	5.6 (3109)	2.4	21.5
Douglas	No	1.2 (120)	7.9 (7554)	4.8 (98)	4.2 (2325)	3.4	21.4
Cass	No	0.1 (14)	0.2 (149)	4.1 (83)	4.4 (2461)	1.9	10.7
Leavenworth	No	0.9 (95)	0.3 (330)	3.5 (72)	2.5 (1399)	2.4	9.7
Henry	No	0.7 (70)	**7.1** (6816)	1.1 (21)	N/A	0.5	9.3
Miami	No	1.6 (164)	2.3 (2171)	1.3 (27)	1.8 (1030)	0.7	7.8
Lafayette	No	1.5 (151)	0.0 (17)	1.6 (32)	2.8 (1549)	0.8	6.7
Johnson (MO)	No	0.6 (65)	0.0 (26)	2.4 (48)	2.3 (1303)	0.9	6.3
Atchison	No	3.6 (366)	0.4 (353)	0.8 (17)	N/A	0.6	5.4
Clinton	No	0.8 (77)	0.0 (0)	1.0 (20)	1.5 (811)	0.7	3.9
Ray	No	0.1 (7)	0.0 (12)	1.2 (23)	1.0 (582)	0.7	2.9

The population density metric is based on population/total county acreage * 10. This metric delivers a degree of urbanization to the summary. Based on this information, the following counties will receive no additional detailed analysis: Ray, Clinton, Atchison, Johnson (MO), and Lafayette. Henry County will, also, not receive additional analysis because the factor that contributes most to the summary is NOx emissions. The emissions from the Kansas City Power & Light (KCPL)-Montrose power plant (vast majority of NOx emissions in Henry) will be controlled to 0.35 lb/MMBTU under the current Missouri rule for utilities.

The meteorology of ozone formation in Kansas City should be factored into this summary in, at least, a qualitative fashion. As discussed above, the wind conditions associated with high ozone concentrations are easterly to southwesterly flows. This suggests less consideration should be given to Buchanan and Leavenworth counties. However, since no ozone monitoring has been conducted north of the KCI monitor, it could be that exceedances are also occurring in the northern portion of Platte, Leavenworth, or Buchanan counties. In addition, Buchanan County is somewhat distant and isolated from the metropolitan area.

Cass, Douglas, Miami, and Linn are the remaining counties to the south and southwest of the metropolitan area. These counties must be given close consideration due to the transport direction for Kansas City. It should be noted that Douglas County does not represent a significant transport direction in the back trajectory analysis discussed above and is likely too distant from the metropolitan area to contribute frequently to high ozone concentrations. However, there is reason to believe that Douglas County can contribute to high ozone. The size of the NOx emissions from the La Cygne power plant in Linn County are a concern for ozone formation in the Kansas City area. These emissions are on the order of 75 tons per day (TPD) and are located directly south of the metropolitan area (an ideal transport location). While Linn County does not have significant population, VMT, and is likely rural in nature, the size of this source must be accounted for in this analysis.

Miami County does not have any large contributing factors and is very rural in nature. The reason for consideration given to this county would be the 2,171 TPY of NOx emissions. In addition, it is part of the MSA and is "upwind" of the area. However, the majority of the technical evidence supports the fact that Miami does not contribute frequently and significantly to 8-hour ozone exceedances in the Kansas City MSA. Cass County is also upwind of the area

and is part of the MSA. The point source emissions from Cass are insignificant and do not support significant contribution to the Kansas City area ozone problems. However, the VMT, population, and growth of northern Cass County are more supportive of this type of contribution in the future. There is a significant decline in urbanization near the MPO boundary as well as a decline in population density and VMT. Also, the commuting patterns are such that Cass County residents commute to Jackson County for work. In the same manner as Linn County, Cass County (at least very northern Cass) should be considered as a possible significant contributor to 8-hour ozone formation in Kansas City.

Conversely, northern Platte County is very rural and does not have back trajectory analysis showing contributions to 8-hour exceedances. However, Platte County does exceed the current 8-hour ozone standard and has significant point source NOx emissions in the northern half of the county. Nonetheless, Platte County contributes the least to ozone in the current 1-hour maintenance area. It is possible that northern Platte County could be excluded from this new 8-hour designation.

Based on Table 4, there are several conclusions that can be drawn from the data. Jackson, Wyandotte, Johnson (KS), and Clay counties contribute the most to ozone in Kansas City. Then, there is a significant drop-off in potential contribution to Linn, Buchanan, Platte, and Douglas counties. These counties are less likely to contribute frequently and significantly to ozone in Kansas City. Meteorological conditions indicated that Buchanan and Douglas counties are far less likely than the other two. Other counties of interest include Cass and Linn due to "upwind" status and significant VMT, population, and/or emissions.

COUNTY BY COUNTY SUMMARY

The following is a county by county summary of factors that suggest frequent and significant contribution to the 8-hour ozone problem in Kansas City and factors that do not suggest such a contribution. In addition, if special consideration should be given to some additional factors, this is, also, presented.

Jackson County
Supportive of contribution
1) Located in current 1-hour maintenance area and MSA
2) Large point source emissions of NOx (26,196 TPY) and VOC (2,038 TPY)
3) Largest population in the area (654,484)
4) Largest VMT in the area (16,217,771)
5) Greatest population density in the area
6) Back trajectory analysis is supportive of contribution

Not supportive of contribution
None

Wyandotte County
Supportive of contribution
1) Located in current 1-hour maintenance area and MSA

2) Large point source emissions of NOx (9,034 TPY) and VOC (2,740 TPY)
3) Large population (151,379)
4) Large VMT (4,565,794)
5) Second highest population density in the area
6) Back trajectory analysis is supportive of contribution

Not supportive of contribution
None

Johnson County (KS)
Supportive of contribution
1) Located in the current 1-hour maintenance area and MSA
2) Large point source emissions of NOx (1,516 TPY) and VOC (462 TPY)
3) Large population (440,198)
4) Large VMT (11,846,793)
5) Third highest population density in the area
6) Significant population and employment growth expected
7) Back trajectory analysis is supportive of contribution

Not supportive of contribution
None

Clay County
Supportive of contribution
1) Located in the current 1-hour maintenance area and MSA
2) Currently monitoring 8-hour violation
3) Large point source emissions of VOC (2,750 TPY)
4) Large population (180,111)
5) Large VMT (5,981,477)
6) Fourth highest population density (however, less than 1 person per acre)
7) Back trajectory analysis is supportive of contribution

Not supportive of contribution
1) Point source NOx emissions (242 TPY, about 1 TPD)

Linn County (KS)
Supportive of contribution
1) Very large point source NOx emissions (27,531)
2) Back trajectory analysis is somewhat supportive of contribution

Not supportive of contribution
1) Not located in the current 1-hour maintenance area or MSA
2) Point source VOC emissions (213 TPY)
3) Small population (9,296)
4) Smallest VMT in the area (320,516)
5) Smallest population density in the area

Buchanan County
Supportive of contribution
1) Large point source emissions of NOx (6,893 TPY) and VOC emissions (638 TPY)
2) Medium population (81,635)
3) Medium VMT (2,352,917)

Not supportive of contribution
1) Not located in the current 1-hour maintenance area or MSA
2) Less than 0.4 people per acre (population density)
3) Back trajectory analysis is NOT supportive of contribution

Platte County
Supportive of contribution
1) Located in the current 1-hour maintenance area and MSA
2) Currently monitoring 8-hour violation
3) Large point source NOx emissions (6,838 TPY)
4) Medium population (71,688)
5) Medium VMT (3,108,803)
6) Southern portion is part of the contiguous metropolitan area
7) Population growth will continue (largely in the southern portion)

Not supportive of contribution
1) Population density (0.2 people per acre)
2) Back trajectory analysis offers limited support to contribution

Douglas County
Supportive of contribution
1) Large point source NOx emissions (7,554 TPY)
2) Medium population (98,343)
3) Medium VMT (2,325,018)
4) "Upwind" county
5) Considerable growth (employment and population) expected

Not supportive of contribution
1) Not located in current 1-hour maintenance area or MSA
2) Small point source VOC emissions (120 TPY)
3) Population density (0.3 people per acre)
4) Back trajectory analysis not supportive of contribution

Cass County
Supportive of contribution
1) Located in the MSA, not the current 1-hour maintenance area
2) Medium population (83,099)*
3) Medium VMT (2,460,933)*
4) Northern portion of county is part of the contiguous metropolitan area

5) Reasonable growth (employment and population) expected*
6) Back trajectory analysis is somewhat supportive of contribution

Not supportive of contribution
1) Very limited point source VOC (14 TPY) and small NOx (149 TPY) emissions
2) Population density (0.2 people per acre)
3) Richards-Gebaur monitoring site (southern Jackson County) monitors lowest of any sites in the network and is directly "downwind" of Cass

*Much of the growth, population, and VMT is in northern Cass County.

Leavenworth County (KS)
Supportive of contribution
1) Located in the MSA and MPO, not the current 1-hour maintenance area
2) Medium population (71,766)
3) Reasonable growth expected
4) High population density and employment in the eastern portion of the county

Not supportive of contribution
1) Small point source VOC (95 TPY) and NOx (330 TPY) emissions
2) Small VMT (1,399,471)
3) Population density (0.2 people per acre)
4) Back trajectory analysis not supportive of contribution

Henry County
Supportive of contribution
1) Large point source NOx emissions (6,816 TPY)

Not supportive of contribution
1) Not located in the current 1-hour maintenance area or MSA
2) Small point source VOC emissions (70 TPY)
3) Small population (21,288)
4) Population density (0.05 people per acre)
5) Back trajectory analysis is not supportive of contribution
6) Utility NOx rule

Miami County (KS)
Supportive of contribution
1) Located in MSA, not in current 1-hour maintenance area
2) Large point source NOx emissions (2,171 TPY)
3) Back trajectory analysis is somewhat supportive of contribution

Not supportive of contribution
1) Small point source VOC emissions (164 TPY)
2) Small population (27,083)
3) Small VMT (1,030,401)

4) Population density (0.07 people per acre)

Lafayette County
Supportive of contribution
1) Located in MSA, not in current 1-hour maintenance area
2) Medium VMT (1,548,985) I-70 traffic

Not supportive of contribution
1) Small point source VOC emissions (151 TPY) and NOx emission (17 TPY)
2) Small population (32,810)
3) Population density (0.08 people per acre)
4) Back trajectory analysis is not supportive of contribution

Johnson (MO) and Atchison (KS) Counties
Supportive of contribution
None

Not supportive of contribution
1) Not located in current 1-hour maintenance area or MSA
2) Small point source emissions
3) Small populations
4) Small VMT
5) Population density (0.09 and 0.06 people per acre)
6) Back trajectory analysis is not supportive of contribution

Clinton and Ray Counties
Supportive of contribution
1) Located in MSA, not in the current 1-hour maintenance area

Not supportive of contribution
1) Very small point source emissions
2) Small populations
3) Small VMT
4) Population density (0.07 people per acre)
5) Back trajectory analysis is not supportive of contribution

St. Louis MSA

CURRENT AIR QUALITY

The current and recent past air quality information for 8-hour ozone in the St. Louis MSA is presented in Table 5. Figure 17 denotes the locations of the monitors within the St. Louis ozone network.

TABLE 5

Monitor	4th High 8-hour Ozone Values (ppb)					95-97	96-98	97-99
	1995	1996	1997	1998	1999	Average	Average	Average
West Alton	112	98	90	97	99	**100**	**95**	**95**
Arnold	100	88	83	91	102	**90**	**87**	**92**
Orchard Farm	98	96	84	92	98	**93**	**90**	**91**
Jerseyville (IL)	88	83	82	91	100	84	**85**	**91**
S. Lindbergh	89	81	80	92	95	83	84	**89**
Ferguson	92	86	87	89	93	**88**	**87**	**89**
Bonne Terre (upwind)		95	80	90	95		**88**	**88**
Edwardsville (IL)	96	88	82	88	92	**88**	**86**	**87**
St. Ann	93	80	82	92	88	**85**	84	**87**
Alton (IL)	99	89	91	79	90	**93**	**86**	**86**
Maryville (IL)	87	90	88	84	85	**88**	**87**	**85**
Wood River (IL)	90	89	88	84	84	**89**	**87**	**85**
Queeny Park	88	82	75	89	93	81	82	**85**
Newstead	86	81	84	79	87	83	81	83
Clayton - Hunter	89	83	78	84	85	83	81	82
E. St. Louis (IL)	84	71	80	78	84	78	76	80
Nilwood - IL (downwind)	85	88	76	79	85	83	81	80
S. Broadway	82	88	76	74	88	82	79	79
Clark & Tucker	67	73	77	76	81	72	75	78
Houston - IL (upwind)	81	81	72	82	82	78	78	78

BOLD denotes monitors that exceed the 85-ppb cutoff

The St. Louis area does not meet the 8-hour standard based on the 1997-99 ozone design values. The design value for St. Louis is 95 ppb (measured at the West Alton monitor). Eleven monitors in the current 1-hour nonattainment area have design values over the 8-hour ozone NAAQS. In addition, two monitors just outside the current nonattainment area (Jerseyville - IL and Bonne Terre) exceed the 8-hour ozone NAAQS. The violating counties in the St. Louis MSA are St. Charles, St. Louis, Jefferson, Madison, and Jersey.

ST. LOUIS AREA EMISSION, POPULATION, AND TRAFFIC INFORMATION

Table 6 denotes the 1996 NOx and VOC emissions by source sector for Missouri and Illinois (MSA) counties in the St. Louis area. This information is based on the recent submittal of the 1-hour attainment demonstration for the St. Louis area. Table 7 illustrates the total emission and population data for the counties in the St. Louis area. The vast majority of emissions in the MSA are located in the current 1-hour nonattainment area (90% VOC and 95% NOx). Jersey (5.2% VOC) and Clinton (4.1% NOx) counties have the most emissions in the MSA outside the 1-hour nonattainment area. Figures 18-22 show the density of emissions within the current modeling (4 km grid size) application for low-level point VOC, area VOC, mobile VOC, total low-level NOx, and elevated point NOx emissions, respectively. These emission plots illustrate the urban nature of these emissions and the highest density of emissions is seen in eastern St. Louis County near St. Louis City.

The population data for 1999 in Table 7 shows six of the twelve MSA counties exceed 70,000 people. These counties include the seven 1-hour nonattainment counties minus Monroe (IL). The population growth rates for many of the counties are of interest. St. Charles, Lincoln, Warren, Franklin, Jefferson, and Monroe have growth rates between 1990-99 above 15%. There are no surrounding counties in Missouri with high population. Figure 23 provides 1990 population density information for many of the counties in the St. Louis area. Figure 24 provides 2004 population density information (projected) for area counties in Missouri. Both figures show an urban population base that includes most of St. Louis City and County, northern Jefferson, and a portion of St. Charles County. Pockets of higher population density are located in Franklin and St. Francois counties. Figure 25 provides information regarding urban areas in the St. Louis region. This data supports the same conclusion as the population density figures. Much of the urbanization has occurred in the area contiguous to St. Louis City with St. Charles as a notable exception.

Figure 26 illustrates the VMT patterns in the St. Louis area based on data provided by MoDOT. These patterns suggest a typical pattern of high urban core VMT with the major interstate highways (70, 435, 44, and 55) contributing the majority of that VMT. The interstate highways outside the "urban" area contribute the majority of the VMT in those particular counties. St. Francois County is a notable exception to this statement with no interstate highways and higher VMT than many of the other surrounding counties.

METEOROLOGY OF OZONE FORMATION IN ST. LOUIS

The Air Pollution Control Program has conducted numerous modeling studies of ozone formation in St. Louis including the recent 1-hour attainment demonstration. The episodes for 1-hour ozone in St. Louis have had similar characteristics. Southwest, south, southeast, and east wind flows are the predominant directions for high 1-hour ozone. Northerly winds will produce exceedances at the Arnold monitoring location but are less frequent than the other flows listed above. The episodes in the current 1-hour attainment demonstration have southerly and southeasterly flow patterns. Wind flows from the south are the most common for high ozone in St. Louis.

Wind roses from one of the monitoring stations in the area were created for ozone conducive days in a similar fashion as the KCI wind roses. The monitoring site chosen was the Maryville, IL, station. The wind roses from the Lambert Airport are consistently dominated by southerly and, to a lesser degree, northerly winds with some winds from the east. These particular wind roses are similar to that pattern of wind direction. Figures 27-29 represent the Maryville wind rose for all hours, 7 - 10 AM, and 1 - 4 PM, respectively. Since this stations is located at a monitoring site and not Lambert, it is subjected to microclimatological and terrain effects in the area. Therefore, the patterns will likely be influenced and not representative of flow on a regional basis. However, similar data was gathered at this site as previously seen (all hours - strong southerly component with southwest and east components as well). The meteorological data used was from 1995-1998 for this analysis.

Forward trajectories from the centroid of emissions in St. Louis have been included for all 8-hour exceedance days in 1998 and 1999. Many of these trajectories illustrate a pattern of transport from the centroid (downtown) area to the monitors of interest. However, the Bonne Terre monitor is not influenced by the St. Louis plume on a number of exceedance days. The plume on these days appears to be coming from the south and southeast of the monitor based on the trajectory analysis. This would indicate transport from the Memphis, southern Illinois, and western Kentucky region. Conversely, the Bonne Terre site does have influence from the St. Louis plume on the remainder of the exceedance days.

OTHER INFORMATION REQUESTED IN THE EPA GUIDANCE

There are no significant geographic or topographic features in the St. Louis area. One jurisdictional boundary of interest is the current 8-county 1-hour nonattainment area. The state of Missouri has submitted a SIP with utility control in the eastern third of the state at 0.25 lb NOx/MMBTU heat input. The state of Illinois has also submitted a SIP with utility control at 0.25 lb/MMBTU. In addition, both areas are included in the NOx SIP call area. One of the nearby, upwind MSAs of interest not discussed for Kansas City is Memphis, TN. The Memphis MSA design value is 95 ppb for 1996-98.

As seen in Table 7, population growth above 15% has occurred in the following counties between 1990-1999: Franklin, Jefferson, St. Charles, Lincoln, Warren, Crawford, and Monroe in Illinois. Additional population growth information for some of the counties is presented in Table 8. The 2000-2020 population growth data provides the same counties for growth above 15% as the 1990-99 information. However, Lincoln and Warren counties are still less than 60,000 people in 2020 with the population growth included. The highest growth rate is in St. Charles (40.4%) and St. Louis City has the largest population reduction (-21.1%).

SUMMARY

The following table is a condensed summary of 8-hour ozone designation factors. This table can be used as a guide for selecting counties with greater opportunity to contribute to 8-hour ozone significantly in the St. Louis area.

Table 9: Summary of 8-Hour Designation Factors

County	1-Hr. Nonatt Area	Total VOC % (TPD)	Total NOx % (TPD)	1999 Pop. % (1000)	1999 Population Density	Total Non-Met Summary
St. Louis City	Yes	13.4 (71.5)	8.2 (60.9)	12.2 (397)	84.3	118.1
St. Louis	Yes	24.4 (130.3)	17.8 (131.7)	36.5 (996)	30.7	109.3
Madison (IL)	Yes	14.3 (76.5)	16.5 (122.5)	9.5 (259)	5.5	45.8
St. Charles	Yes	6.7 (35.8)	14.0 (103.8)	10.3 (280)	7.8	38.8
St. Clair (IL)	Yes	12.0 (64.0)	10.1 (74.6)	9.6 (262)	6.1	37.7
Jefferson	Yes	4.9 (26.3)	9.4 (69.8)	7.3 (198)	4.7	26.3
Franklin	Yes	3.8 (20.1)	7.8 (58.1)	3.4 (93)	1.6	16.6
Clinton (IL)	No	2.5 (13.1)	3.8 (28.2)	1.3 (36)	1.1	8.7
Pike	No	3.3 (17.7)	4.2 (30.8)	0.6 (16)	0.4	8.4
Jersey (IL)	No	4.7 (25.1)	1.0 (7.7)	0.8 (22)	0.9	7.4
St. Francois	No	1.9 (10.4)	1.0 (7.1)	2.0 (56)	1.9	6.9
Monroe (IL)	Yes	1.5 (8.3)	2.4 (17.6)	1.0 (27)	1.0	5.9
Lincoln	No	1.2 (6.4)	0.7 (5.0)	1.4 (38)	0.9	4.2
Warren	No	1.4 (7.5)	0.4 (3.3)	0.9 (25)	0.9	3.7
Ste. Genevieve	No	0.9 (4.6)	1.4 (10.1)	0.6 (17)	0.5	3.4
Washington	No	0.9 (4.8)	0.5 (3.5)	0.9 (23)	0.5	2.7
Crawford	No	0.9 (4.8)	0.4 (3.1)	0.8 (22)	0.5	2.6
Montgomery	No	0.7 (3.7)	0.4 (2.9)	0.4 (12)	0.4	1.9
Gasconade	No	0.6 (3.2)	0.1 (1.0)	0.5 (15)	0.5	1.7

The population density metric is based on population/total county acreage * 10. This metric delivers a degree of urbanization to the summary. Based on this information, the following counties will receive no additional detailed analysis: Gasconade, Montgomery, Crawford, and Washington.

As with the Kansas City analysis, the meteorology of ozone formation in St. Louis City should be factored into this summary. As discussed above, the wind conditions associated with high ozone concentrations are easterly to southwesterly flows (with occasional northerly flow). This suggests less consideration should be given to Warren, Lincoln, Pike, and Jersey (IL) counties. In addition, Pike County is somewhat distant and isolated from the metropolitan area.

Clinton (IL), St. Francois, and Ste. Genevieve are the counties not in the current 1-hour nonattainment area to the east, south and southwest of the metropolitan area. These counties must be given close consideration due to the transport directions for St. Louis. These counties are all somewhat distant from the core St. Louis area and will not likely contribute on a significant and frequent basis. Ste. Genevieve County does not have any large contributing factors and is very rural in nature. However, the Bonne Terre monitor is in violation of the

current 8-hour NAAQS. This monitor appears to be impacted by two different phenomena that cause elevated 8-hour ozone concentrations. One is the downwind impact from the St. Louis area when northerly winds are present. The other events are related to transport mainly from the south and southeast. Based on present modeling information, the NOx controls in the eastern United States (especially Missouri, Illinois, Tennessee, and Kentucky) will have a large beneficial effect on ozone concentrations at this site. Upwind impacts from Ste. Genevieve and St. Francois counties on St. Louis will occur but the magnitude of this contribution will be smaller than the counties in the emissions current 1-hour nonattainment area. In addition, the rural nature of these counties is quite evident in Figure 25.

In the March 28th guidance, EPA suggested that 8-hour ozone boundaries contain, at least, any corresponding 1-hour ozone nonattainment areas. Therefore, by default, the current 1-hour area should be considered as the starting point for the 8-hour boundary.

Based on Table 9, there are several conclusions that can be drawn from the data. St. Louis City, St. Louis, Madison, St. Charles, St. Clair, and Jefferson counties contribute the most to ozone in St. Louis. Then, there is a drop-off in potential contribution to Franklin County. Another drop-off occurs to Clinton, Pike, Jersey, St. Francois, and Monroe. The counties in this last group are less likely to contribute frequently and significantly to ozone in St. Louis. Meteorological conditions indicated that Pike and Jersey counties are less likely than the other three counties. Another county of interest is Ste. Genevieve due to the violation of the standard at Bonne Terre.

COUNTY BY COUNTY SUMMARY

The following is a county by county summary of factors that suggest frequent and significant contribution to the 8-hour ozone problem in St. Louis and factors that do not suggest such a contribution. In addition, if special consideration should be given to some additional factors this is, also, presented.

St. Louis City
Supportive of contribution
1) Located in current 1-hour nonattainment area and MSA
2) Large emissions of NOx (60.9 TPD) and VOC (71.5 TPD)
3) Large population (333,960)
4) Greatest population density in the area (8.4 people per acre)
5) Part of core metropolitan area

Not supportive of contribution
None

St. Louis County
Supportive of contribution
1) Located in current 1-hour nonattainment area and MSA
2) Large emissions of NOx (131.7 TPD) and VOC (130.3 TPD)
3) Largest population in the area (996,181)
4) Second highest population density in the area (3.1 people per acre)

5) Part of core metropolitan area
6) Currently monitoring violation of the 8-hour NAAQS

Not supportive of contribution
None

Madison County (IL)
Supportive of contribution
1) Located in the current 1-hour nonattainment area and MSA
2) Large emissions of NOx (122.5 TPD) and VOC (76.5 TPD)
3) Large population (259,185)
4) Highest population density (5.5 people per acre)
5) Part of core metropolitan area
6) Currently monitoring violation of the 8-hour NAAQS

Not supportive of contribution
None

St. Charles County
Supportive of contribution
1) Located in the current 1-hour nonattainment area and MSA
2) Large emissions of NOx (103.8 TPD) and VOC (35.8 TPD)
3) Large population (280,448)
4) Third highest population density (0.78 people per acre)
5) Currently monitoring violation of the 8-hour NAAQS

Not supportive of contribution
None

St. Clair County (IL)
Supportive of contribution
1) Located in the current 1-hour nonattainment area and MSA
2) Large emissions of NOx (74.6 TPD) and VOC (64.0 TPD)
3) Large population (261,792)
4) Population density (0.6 people per acre)
5) Part of the core metropolitan area

Not supportive of contribution
None

Jefferson County
Supportive of contribution
1) Located in the current 1-hour nonattainment area and MSA
2) Large emissions of NOx (69.8 TPD) and VOC emissions (26.3 TPD)
3) Large population (198,116)
4) Population density (0.5 people per acre)

5) Currently monitoring violation of the 8-hour NAAQS

Not supportive of contribution
None

Franklin County
Supportive of contribution
1) Located in the current 1-hour nonattainment area and MSA
2) Large emissions of NOx (58.1 TPD) and VOC (20.1 TPD)
3) Large population (93,128)
4) Projected growth

Not supportive of contribution
1) Population density (0.2 people per acre)
2) Lower density of emissions than other counties in the 1-hour area

Clinton County (IL)
Supportive of contribution
1) Located in the MSA, not in the current 1-hour nonattainment area
2) Large emissions of NOx (28.2 TPD) and VOC (13.1 TPD)
3) Possible "upwind" county

Not supportive of contribution
1) Small population (35,674)
2) Population density (0.11 people per acre)
3) Limited growth
4) Low emission density

Pike County
Supportive of contribution
1) Large emissions of NOx (30.8 TPD) and VOC (17.7 TPD)

Not supportive of contribution
1) Not located in the MSA or current 1-hour nonattainment area
2) "Downwind" county
3) Small population (16,411)
4) Population density (0.04 people per acre)
5) Very low emission density

Jersey County (IL)
Supportive of contribution
1) Located in the MSA, not the current 1-hour maintenance area
2) Large VOC emissions (25.1 TPD) and medium NOx emissions (7.7 TPD)
3) Reasonable growth expected

Not supportive of contribution

1) "Downwind" county
2) Small population (21,515)
3) Population density (0.09 people per acre)
4) Low emission density

St. Francois County
Supportive of contribution
1) Medium emissions of NOx (7.1 TPD) and VOC (10.4 TPD)
2) Medium population (55,790)
3) Possible "Upwind" county
4) Most urban of the rural, surrounding counties

Not supportive of contribution
1) Not located in the current 1-hour nonattainment area or MSA
2) Population density (0.19 people per acre)
3) Low emission density

Monroe County (IL)
Supportive of contribution
1) Located in current 1-hour nonattainment area and MSA
2) High NOx emissions(17.6 TPD) and medium VOC emissions (8.3 TPD)
3) "Upwind" County

Not supportive of contribution
1) Small population (26,640)
2) Population density (0.10 people per acre)
3) Low emission density

Lincoln County
Supportive of contribution
1) Located in MSA, not in current 1-hour maintenance area
2) Medium VOC emissions (6.4 TPD)
3) Population growth expected

Not supportive of contribution
1) Small NOx emissions (5.0 TPD)
2) Small population (37,733)
3) Population density (0.09 people per acre)
4) Low emission density
5) "Downwind" county

Warren County
Supportive of contribution
1) Located in MSA, not in current 1-hour maintenance area
2) Medium VOC emissions (7.5 TPD)
3) Population growth expected

Not supportive of contribution
1) Small NOx emissions (3.3 TPD)
2) Small population (25,435)
3) Population density (0.09 people per acre)
4) Low emission density
5) "Downwind" county

Ste. Genevieve County
Supportive of contribution
1) Medium NOx emissions (10.1 TPD)
2) Currently monitoring violation of the 8-hour NAAQS
3) "Upwind" county

Not supportive of contribution
1) Not located in current 1-hour nonattainment area or MSA
2) Small VOC emissions (4.6 TPD)
3) Small population (17,462)
4) Population density (0.05 people per acre)
5) Low emission density
6) Impacted by transport from south and southeast

Washington, Crawford, Montgomery, and Gasconade Counties
Supportive of contribution
None

Not supportive of contribution
1) Not located in current 1-hour maintenance area or MSA
2) Small emissions (>5 TPD VOC, >4 TPD NOx)
3) Small population (>25,000)
4) Population density (>0.05 people per acre)
5) Very low emission density

Remainder of Missouri

The current and recent past air quality information for the two ozone monitors in the Springfield MSA and the monitor in Mark Twain State Park (Monroe County) is contained in Table 10.

TABLE 10

Monitor	4th High 8-hour Ozone Values (ppb)					95-97	96-98	97-99
	1995	1996	1997	1998	1999	Average	Average	Average
S. Charleston	73	67	64	71	75	68	67	70
Hillcrest	85	81	68	71	81	78	73	73
Mark Twain	83	89	80	79	92	84	82	83

The Springfield MSA monitors are well below the 8-hour NAAQS. The Mark Twain State Park monitor is below the NAAQS. In the past, this monitor has been influenced by the St. Louis ozone plume to a large extent. This behavior is likely to continue and the Mark Twain site will monitor lower 8-hour ozone concentrations as additional controls are put in place in St. Louis and utility controls are implemented throughout Missouri.

Table 2: Emissions and Population Data for Kansas City and Surrounding Area

MISSOURI

	VOC Emission (TPY)*	NOx Emission (TPY)*	1990 Population	1999 Population	% VOC in MSA	% NOx in MSA	% '99 Pop in MSA	% Pop Growth 1990-99
PLATTE	262	6,838	57,867	71,688	3.0%	14.7%	4.1%	23.9%
CLAY	2,750	242	153,411	180,111	31.4%	0.5%	10.3%	17.4%
JACKSON	2,038	26,196	633,234	654,484	23.3%	56.3%	37.3%	3.4%
CLINTON	77	0	16,595	19,522	0.9%	0.0%	1.1%	17.6%
RAY	7	12	21,968	23,759	0.1%	0.0%	1.4%	8.2%
LAFAYETTE	151	17	31,107	32,810	1.7%	0.0%	1.9%	5.5%
CASS	14	149	63,808	83,099	0.2%	0.3%	4.7%	30.2%
MISSOURI MSA	**5,299**	**33,454**	**977,990**	**1,065,473**	**60.5%**	**71.9%**	**60.7%**	**8.9%**

	VOC Emission (TPY)*	NOx Emission (TPY)*	1990 Population	1999 Population	% VOC of MSA	% NOx of MSA	% '99 Pop of MSA	% Pop Growth 1990-99
Buchanan	638	6,893	83,083	81,635	7.3%	14.8%	4.6%	-1.7%
De Kalb	17	65	9,967	11,288	0.2%	0.1%	0.6%	13.3%
Caldwell	0	0	8,380	8,926	0.0%	0.0%	0.5%	6.5%
Carroll	60	0	10,748	10,108	0.7%	0.0%	0.6%	-6.0%
Saline	17	660	23,523	22,782	0.2%	1.4%	1.3%	-3.2%
Johnson	65	26	42,514	48,053	0.7%	0.1%	2.7%	13.0%
Pettis	679	3,571	35,437	37,110	7.8%	7.7%	2.1%	4.7%
Henry	70	6,816	20,044	21,288	0.8%	14.7%	1.2%	6.2%
Bates	0	0	15,025	16,061	0.0%	0.0%	0.9%	6.9%

KANSAS

	VOC Emission (TPY)	NOx Emission (TPY)	1990 Population	1999 Population	% VOC in MSA	% NOx in MSA	% '99 Pop in MSA	% Pop Growth 1990-99
WYANDOTTE	2,740	9,034	162,026	151,379	31.3%	19.4%	8.6%	-6.6%
JOHNSON	462	1,516	355,021	440,198	5.3%	3.3%	25.1%	24.0%
LEAVENWORTH	95	330	64,371	71,766	1.1%	0.7%	4.1%	11.5%
MIAMI	164	2,171	23,466	27,083	1.9%	4.7%	1.5%	15.4%
KANSAS MSA	**3,461**	**13,051**	**604,884**	**690,426**	**39.5%**	**28.1%**	**39.3%**	**14.1%**

	VOC Emission (TPY)	NOx Emission (TPY)	1990 Population	1999 Population	% VOC of MSA	% NOx of MSA	% '99 Pop of MSA	% Pop Growth 1990-99
Atchison	366	353	16,932	16,856	4.2%	0.8%	1.0%	-0.4%
Jefferson	0	0	15,905	18,146	0.0%	0.0%	1.0%	14.1%
Douglas	120	7,554	81,798	98,343	1.4%	16.2%	5.6%	20.2%
Franklin	33	195	21,994	25,136	0.4%	0.4%	1.4%	14.3%
Anderson	109	187	7,803	8,119	1.2%	0.4%	0.5%	4.0%
Linn	213	27,531	8,254	9,296	2.4%	59.2%	0.5%	12.6%

COUNTY	1-hour Maintenance Area
COUNTY	Metropolitan Statistical Area
County	Surrounding Counties

* Missouri emission totals are scaled from 1996 Ozone Season Inventory by (12/5)

Table 3: Population and Employment Projections

Population

County	1970	1980	1990	2000	2010	2020
Jackson	654,178	629,266	633,232	653,264	672,813	697,954
Clay	123,702	136,488	153,411	178,167	201,287	228,717
Platte	32,081	46,341	57,867	71,603	84,461	99,778
Wyandotte	186,845	172,335	162,026	151,577	146,095	143,914
Johnson (KS)	220,073	270,269	355,054	446,092	531,321	633,110
Cass	39,448	51,029	63,808	81,248	97,637	117,351
Leavenworth	53,340	54,809	64,371	70,940	77,089	84,434
Ray	17,599	21,378	21,971	22,993	23,958	25,125

Employment

County	1970	1980	1990	2000	2010	2020
Jackson	391,255	431,278	442,089	460,516	493,930	512,064
Clay	41,350	52,074	83,266	107,142	119,496	125,108
Platte	12,184	16,187	32,114	45,441	54,848	63,222
Wyandotte	82,535	82,996	92,017	92,858	97,539	102,449
Johnson (KS)	73,232	145,973	241,291	328,372	376,273	393,154
Cass	13,528	14,833	20,533	28,781	33,019	34,942
Leavenworth	20,331	24,662	28,960	33,205	36,165	37,924
Ray	4,792	5,853	6,510	7,451	8,121	8,454

NOTE: U.S. Census Bureau Information

Table 6: 1996 Modeling Emission Inventory for Missouri and Illinois (MSA) Counties in the St. Louis Area

		VOC (TPD)		
COUNTY	**POINT**	**AREA/NR**	**MOBILE**	**TOTAL**
ST. LOUIS	25.78	49.80	54.75	130.33
ST. LOUIS CITY	21.18	33.78	16.54	71.50
ST. CHARLES	2.57	20.72	12.51	35.80
JEFFERSON	2.70	14.34	9.27	26.31
FRANKLIN	3.66	9.93	6.49	20.08
PIKE	11.08	5.56	1.00	17.65
ST. FRANCOIS	1.14	6.59	2.67	10.40
WARREN	0.80	5.03	1.64	7.47
LINCOLN	0.00	3.75	2.63	6.38
CRAWFORD	0.24	3.02	1.55	4.81
WASHINGTON	0.01	2.98	1.77	4.76
STE. GENEVIEVE	0.50	2.83	1.23	4.56
MONTGOMERY	0.01	2.51	1.16	3.68
GASCONADE	0.01	3.17	N/A	3.18
MADISON	24.62	26.14	25.77	76.53
ST. CLAIR	18.38	22.94	22.64	63.96
JERSEY	0.07	22.58	2.43	25.08
CLINTON	0.84	7.86	4.42	13.12
MONROE	0.09	5.17	3.01	8.27

		NOx (TPD)		
COUNTY	**POINT**	**AREA/NR**	**MOBILE**	**TOTAL**
ST. LOUIS	19.28	42.17	70.28	131.73
ST. CHARLES	75.85	11.39	16.58	103.82
JEFFERSON	49.89	6.11	12.91	68.91
ST. LOUIS CITY	11.98	27.13	21.81	60.92
FRANKLIN	41.78	7.33	8.94	58.05
PIKE	28.40	1.10	1.32	30.82
STE. GENEVIEVE	7.50	0.95	1.67	10.13
ST. FRANCOIS	1.40	2.05	3.65	7.09
LINCOLN	0.00	1.40	3.57	4.98
WASHINGTON	0.10	0.90	2.53	3.52
WARREN	0.18	0.83	2.28	3.28
CRAWFORD	0.02	0.83	2.22	3.07
MONTGOMERY	0.65	0.61	1.61	2.87
GASCONADE	0.19	0.82	N/A	1.01
MADISON	66.11	12.24	44.10	122.45
ST. CLAIR	26.41	10.70	37.47	74.58
CLINTON	14.46	4.85	8.86	28.17
MONROE	0.80	3.38	13.39	17.57
JERSEY	0.00	3.18	4.51	7.69

Table 7: Emissions and Population Data for St. Louis and Surrounding Area

MISSOURI

	VOC Emission (TPD)	NOx Emission (TPD)	1990 Population	1999 Population	% VOC in MSA	% NOx in MSA	% '99 Pop in MSA	% Pop Growth 1990-99
FRANKLIN	20.08	58.05	80,603	93,128	4.1%	8.5%	3.6%	15.5%
JEFFERSON	26.31	69.81	171,380	198,116	5.4%	10.2%	7.7%	15.6%
ST. CHARLES	35.80	103.82	212,907	280,448	7.4%	15.2%	10.9%	31.7%
ST. LOUIS	130.33	131.73	993,529	996,181	26.9%	19.3%	38.8%	0.3%
ST. LOUIS CITY	71.50	60.92	396,685	333,960	14.7%	8.9%	13.0%	-15.8%
LINCOLN	6.38	4.98	28,892	37,733	1.3%	0.7%	1.5%	30.6%
WARREN	7.47	3.28	19,534	25,435	1.5%	0.5%	1.0%	30.2%
MISSOURI MSA	**297.87**	**432.59**	**1,903,530**	**1,965,001**	**61.4%**	**63.3%**	**76.5%**	**3.2%**

	VOC Emission (TPD)	NOx Emission (TPD)	1990 Population	1999 Population	% VOC of MSA	% NOx of MSA	% '99 Pop of MSA	% Pop Growth 1990-99
Crawford	4.81	3.07	19,173	22,427	1.0%	0.4%	0.9%	17.0%
Gasconade	3.18	1.01	14,006	14,975	0.7%	0.1%	0.6%	6.9%
Montgomery	3.68	2.87	11,355	12,110	0.8%	0.4%	0.5%	6.6%
Pike	17.65	30.82	15,969	16,411	3.6%	4.5%	0.6%	2.8%
St. Francois	10.40	7.09	48,904	55,790	2.1%	1.0%	2.2%	14.1%
Ste. Genevieve	4.56	10.13	16,037	17,462	0.9%	1.5%	0.7%	8.9%
Washington	4.76	3.52	20,380	23,354	1.0%	0.5%	0.9%	14.6%

ILLINOIS

	VOC Emission (TPD)	NOx Emission (TPD)	1990 Population	1999 Population	% VOC in MSA	% NOx in MSA	% '99 Pop in MSA	% Pop Growth 1990-99
MADISON	76.53	122.45	249,238	259,185	15.8%	17.9%	10.1%	4.0%
MONROE	8.27	17.57	22,422	26,640	1.7%	2.6%	1.0%	18.8%
ST. CLAIR	63.96	74.58	262,852	261,792	13.2%	10.9%	10.2%	-0.4%
CLINTON	13.12	28.17	33,944	35,674	2.7%	4.1%	1.4%	5.1%
JERSEY	25.08	7.69	20,539	21,515	5.2%	1.1%	0.8%	4.8%
ILLINOIS MSA	**186.95**	**250.46**	**588,995**	**604,806**	**38.6%**	**36.7%**	**23.5%**	**2.7%**

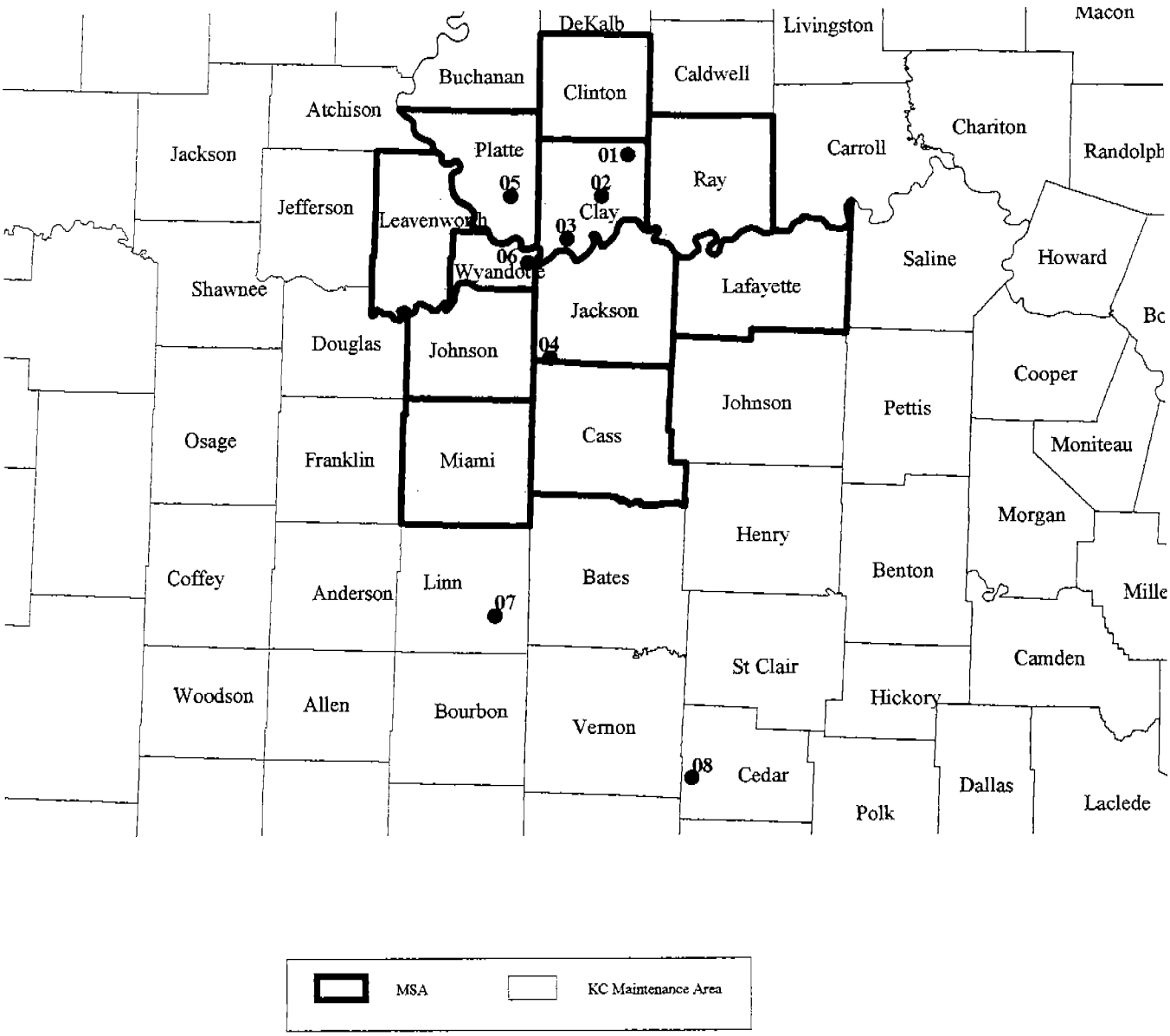
COUNTY	1-hour Nonattainment Area
COUNTY	Metropolitan Statistical Area
County	Surrounding Counties

Table 8: Population Growth Estimates for Missouri Counties in the St. Louis Area

Counties	1990 Pop.	1995 Pop.	2000 Pop.	2005 Pop.	2010 Pop.	2015 Pop.	2020 Pop.	2000-2020 Growth
St. Louis	993,529	998,570	996,362	990,062	983,030	977,522	973,585	-2.29%
St. Louis City	396,685	369,057	343,096	319,708	299,580	283,188	270,760	-21.08%
St. Charles	212,907	246,660	278,682	309,285	338,807	366,626	391,340	40.43%
Jefferson	171,380	183,298	194,377	205,147	215,668	225,566	234,351	20.57%
Franklin	80,603	85,414	89,879	94,134	98,196	101,975	105,253	17.11%
St. Francois	48,904	51,122	53,152	55,015	56,664	58,062	59,157	11.30%
Lincoln	28,892	32,342	35,773	39,301	42,895	46,380	49,594	38.64%
Warren	19,534	21,949	24,299	26,650	28,983	31,229	33,253	36.85%
Washington	20,380	21,301	22,185	23,017	23,774	24,456	25,038	12.86%
St. Genevieve	16,037	16,342	16,585	16,823	17,064	17,274	17,429	5.09%
Gasconade	14,006	14,356	14,708	15,090	15,522	15,959	16,369	11.29%
Pike	15,969	15,286	14,649	14,063	13,515	13,034	12,639	-13.72%
Montgomery	11,355	11,236	11,121	11,056	11,019	10,994	10,970	-1.36%

Figure 1

MONITORING LOCATIONS IN THE KANSAS CITY AREA



01 Watkins Mill State Park
02 Hwy 33 & County Home Liberty
03 49th & Winchester WOF
04 Richards Gebaur AFB
05 11500 North 71 Hwy KCI
06 JFK - Wyandotte Co.
07 Mine Creek
08 El Dorado Springs

Figure 2

VOC AND NOx POINT SOURCES
KANSAS AND MISSOURI

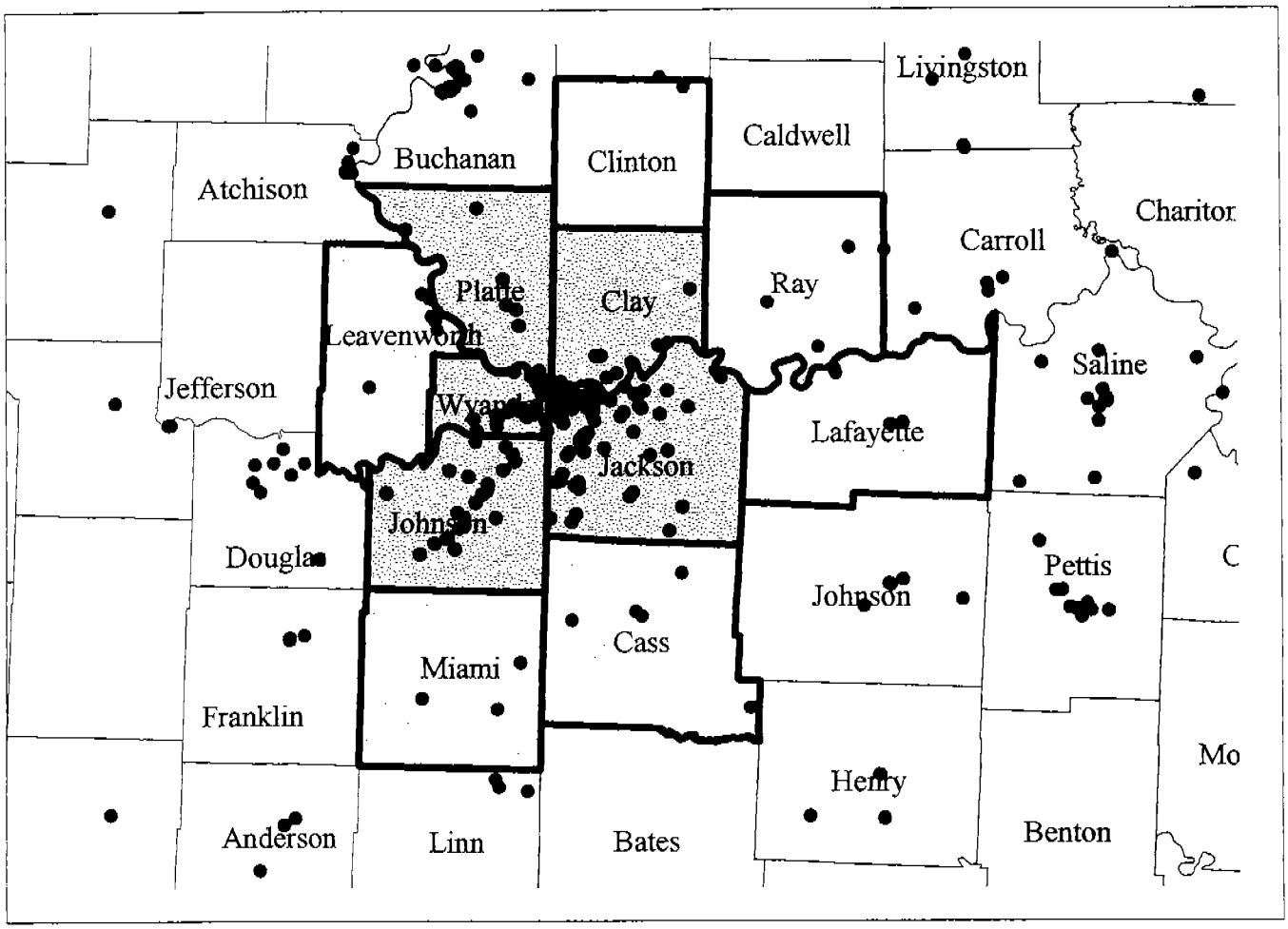


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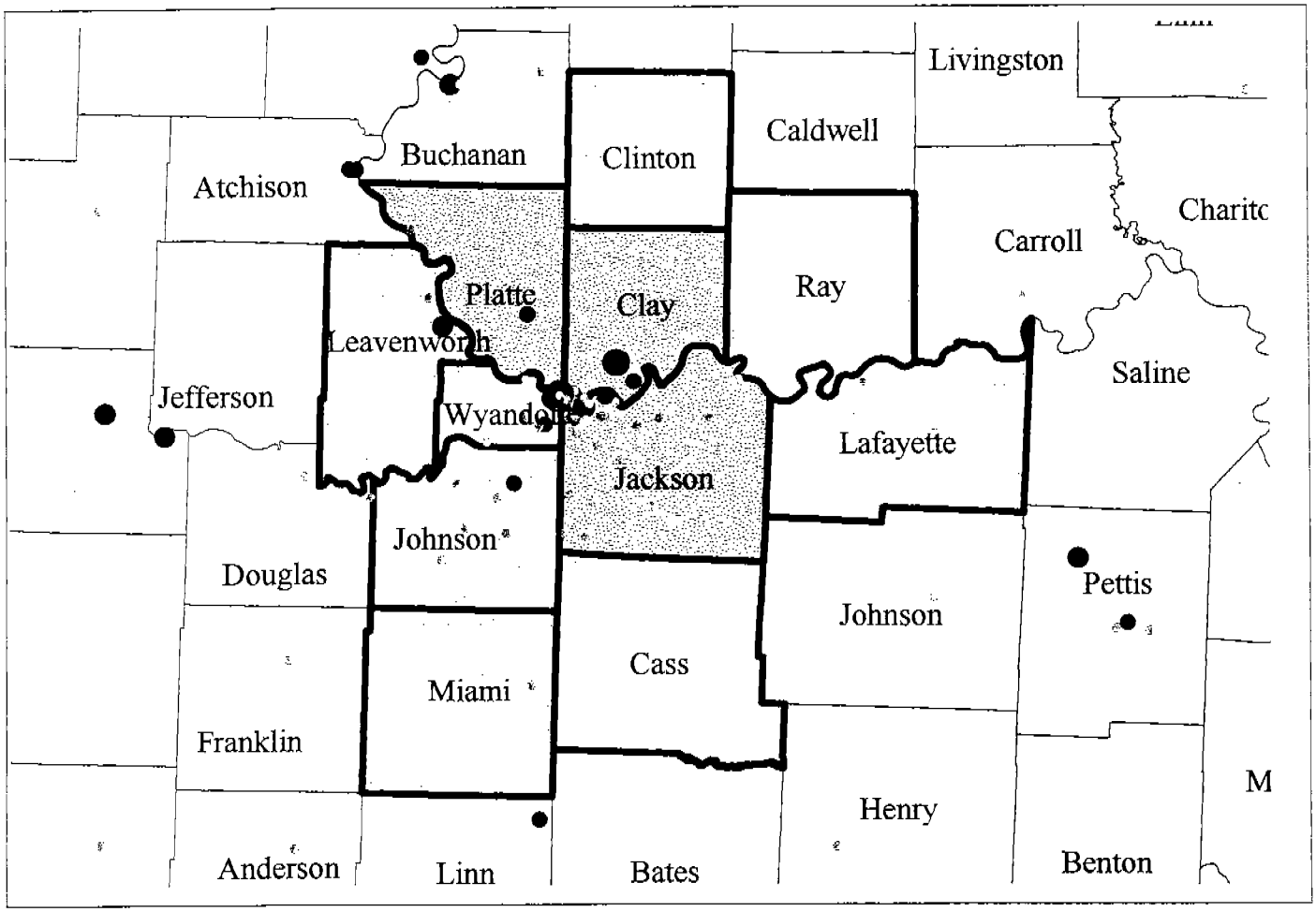
Figure 3

VOC POINT SOURCES
KANSAS AND MISSOURI



VOC (TPY)

- 25 - 100
- 100.01 - 250
- 250.01 - 1000
- 1000.01 - 5000

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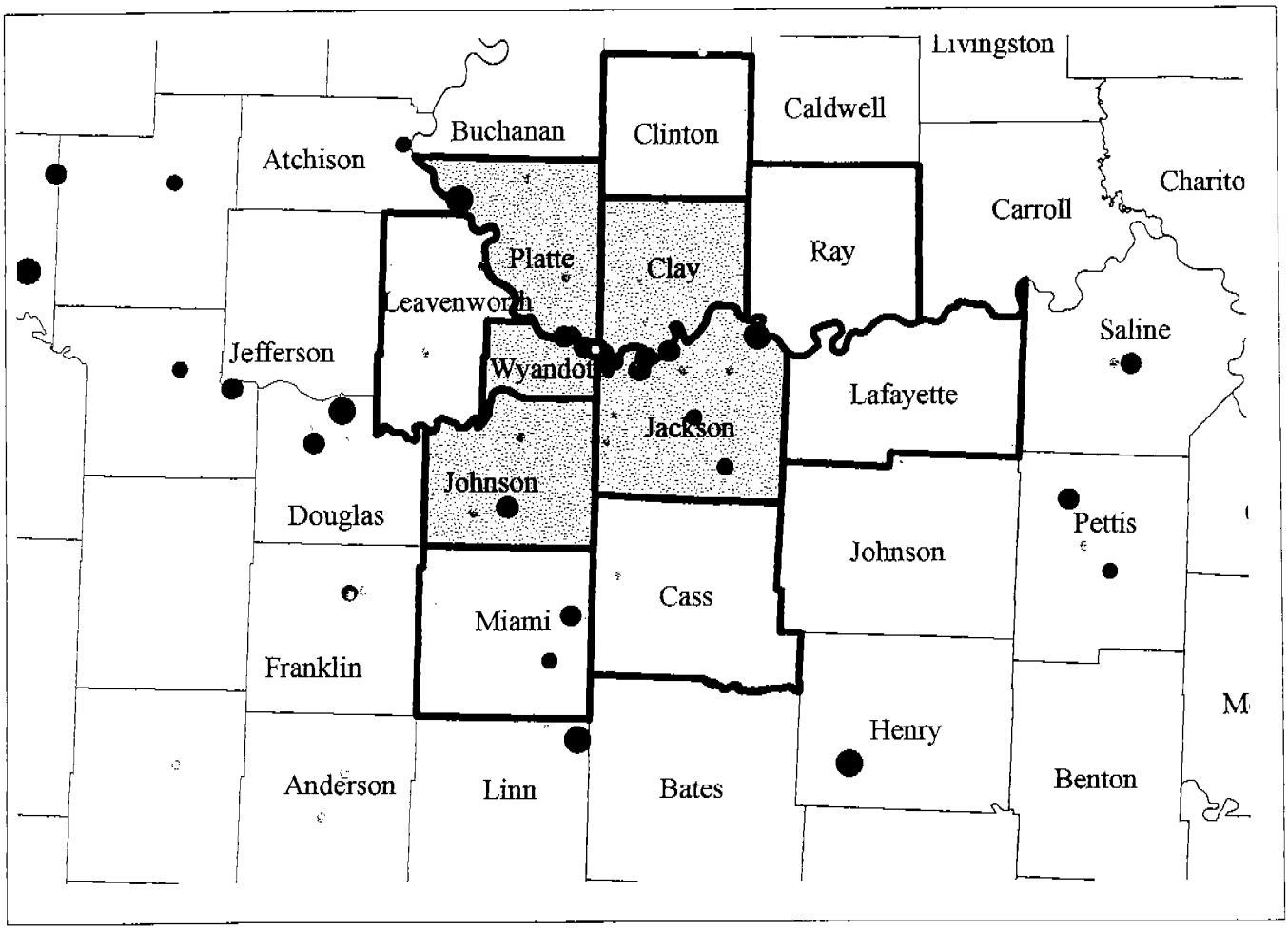
Figure 4

NOx POINT SOURCES
KANSAS AND MISSOURI



NOx (TPY)

- 25 - 100
- 100.01 - 500
- 500.01 - 5000
- 5000.01 - 28000

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FIGURE 5

1990 POPULATION DENSITY FOR COUNTIES IN THE KANSAS CITY AREA

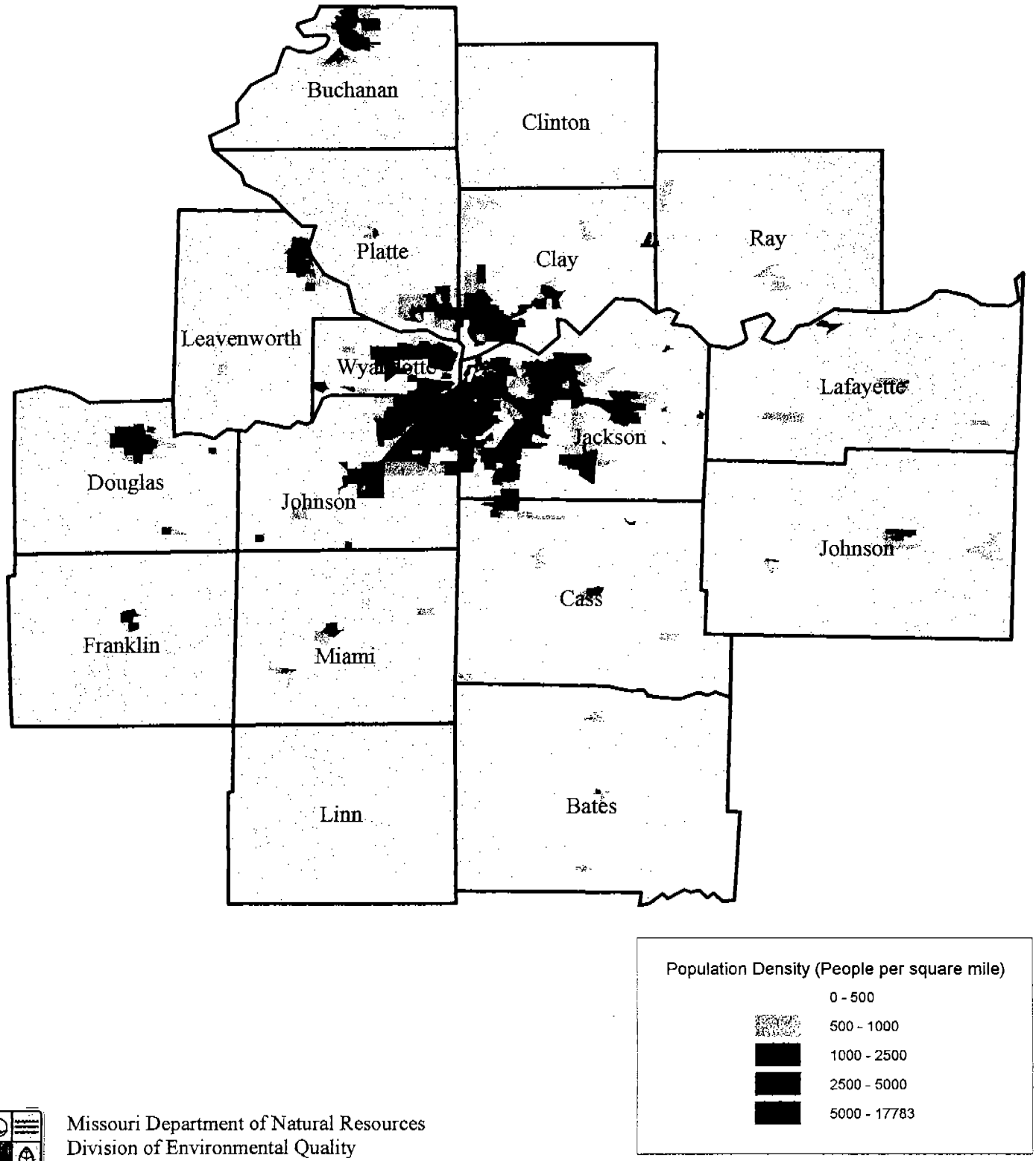

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FIGURE 6

2004 POPULATION DENSITY FOR MISSOURI COUNTIES IN THE KANSAS CITY AREA

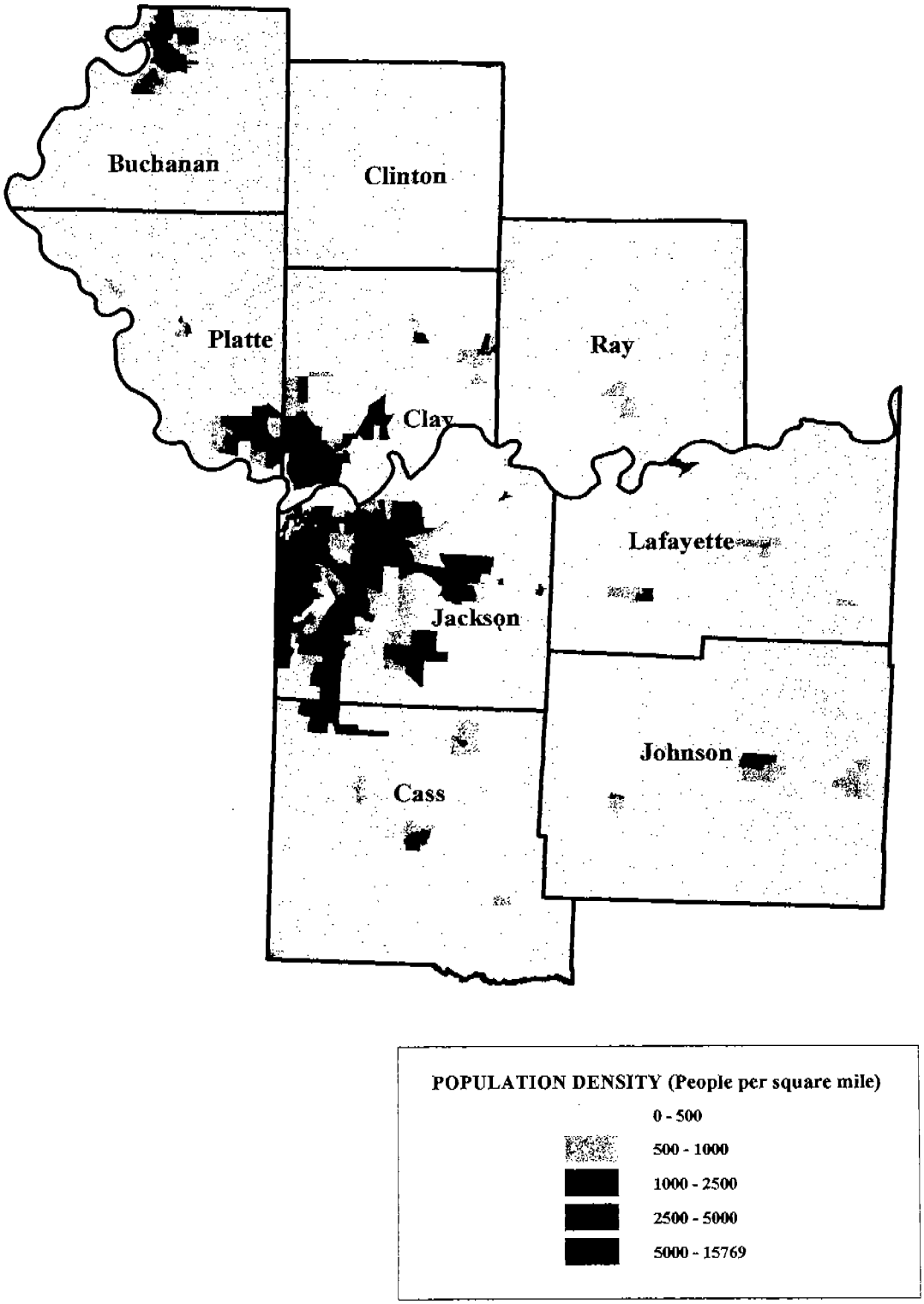

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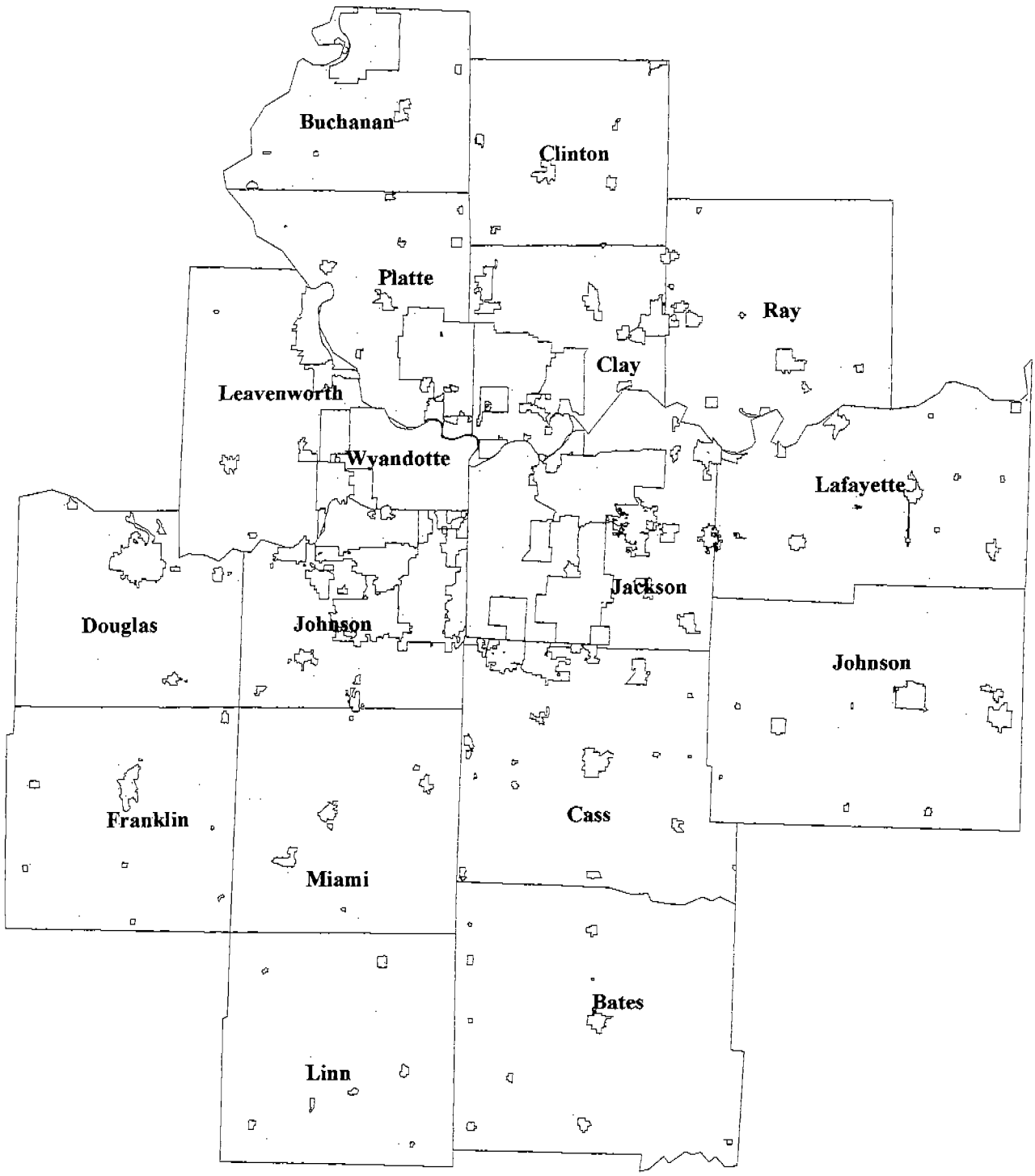
FIGURE 7

Degree of Urbanization in the Kansas City Area



Urban Areas

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FIGURE 8

1996 VMT FOR MISSOURI COUNTIES IN THE KANSAS CITY AREA

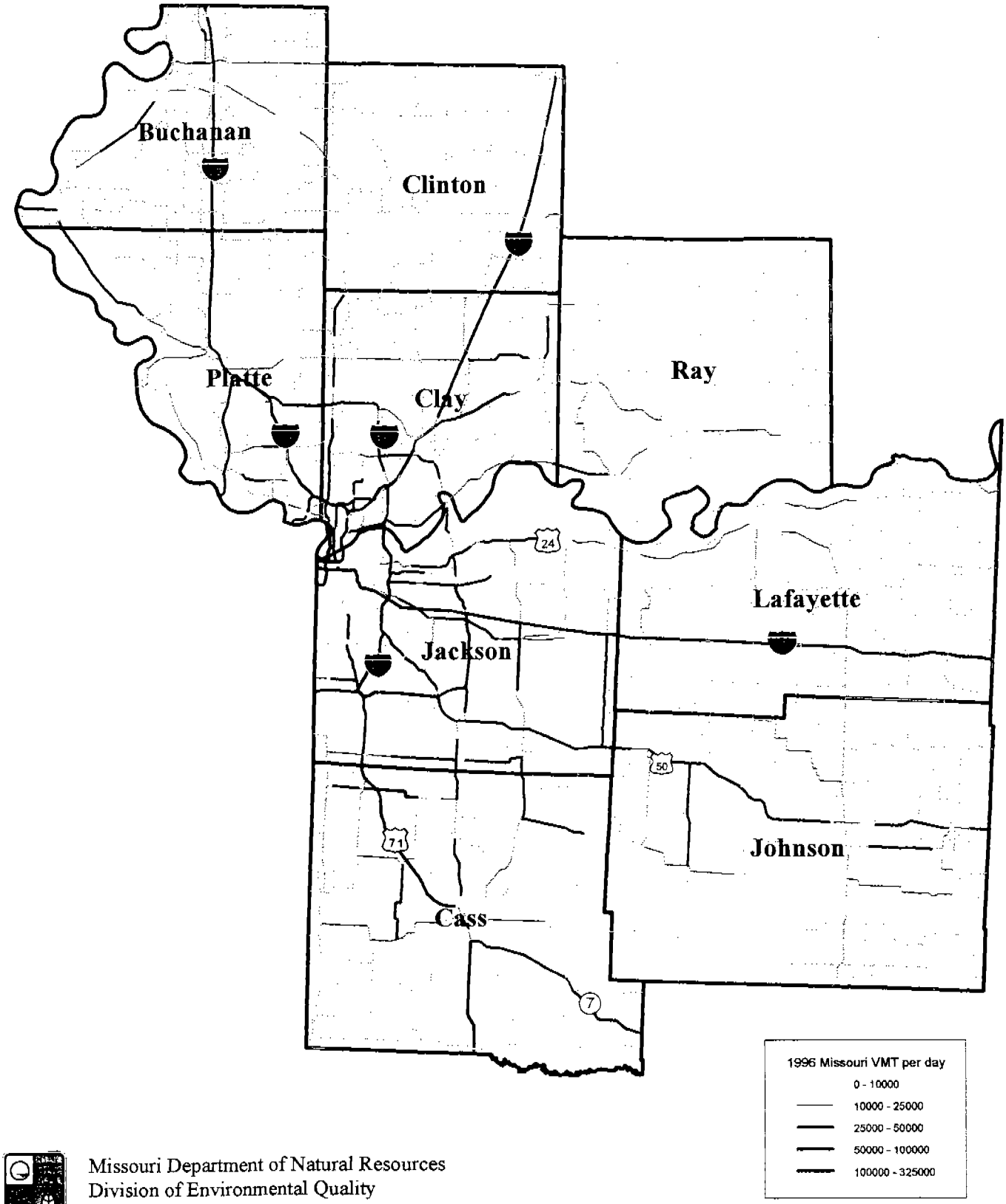

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FIGURE 9

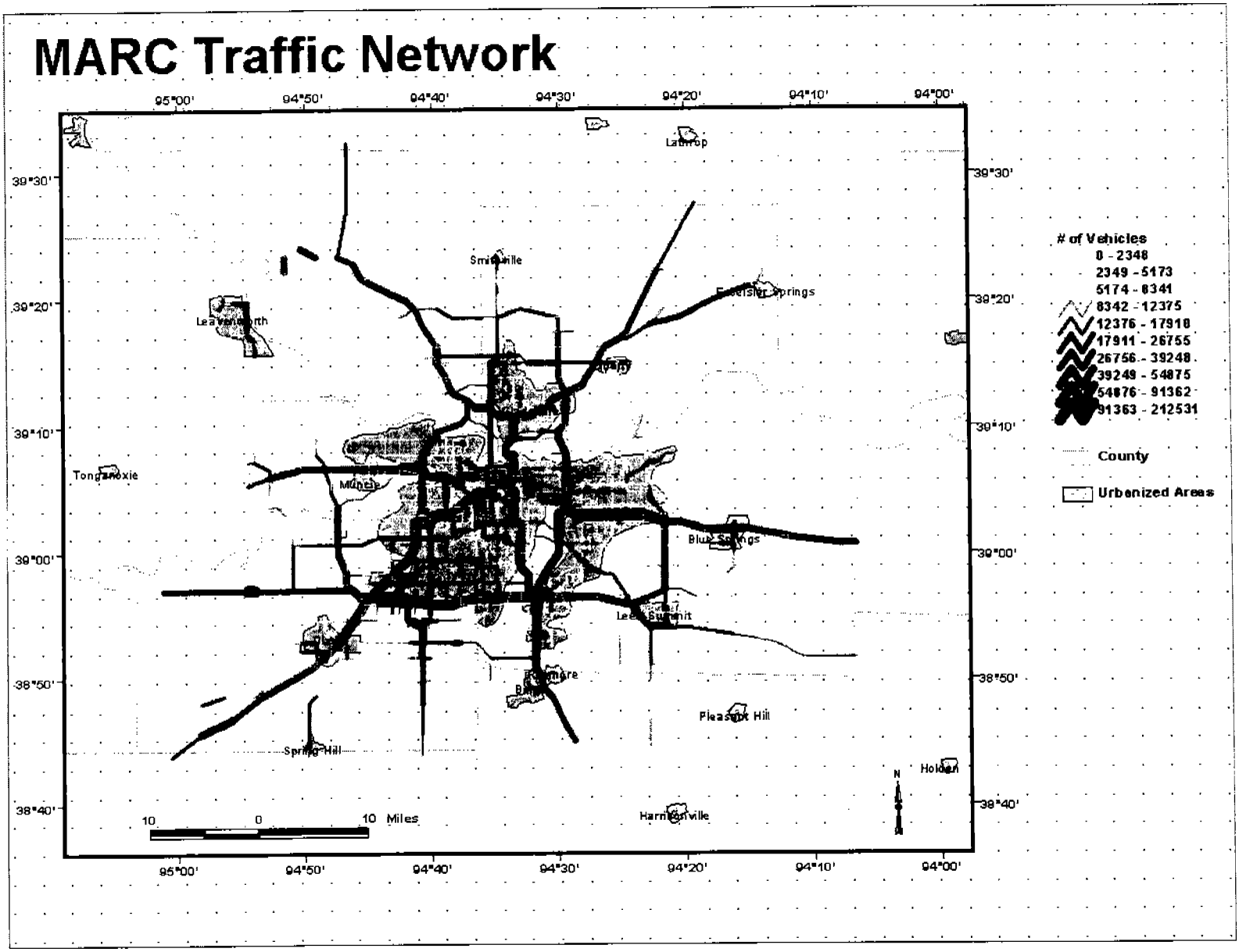
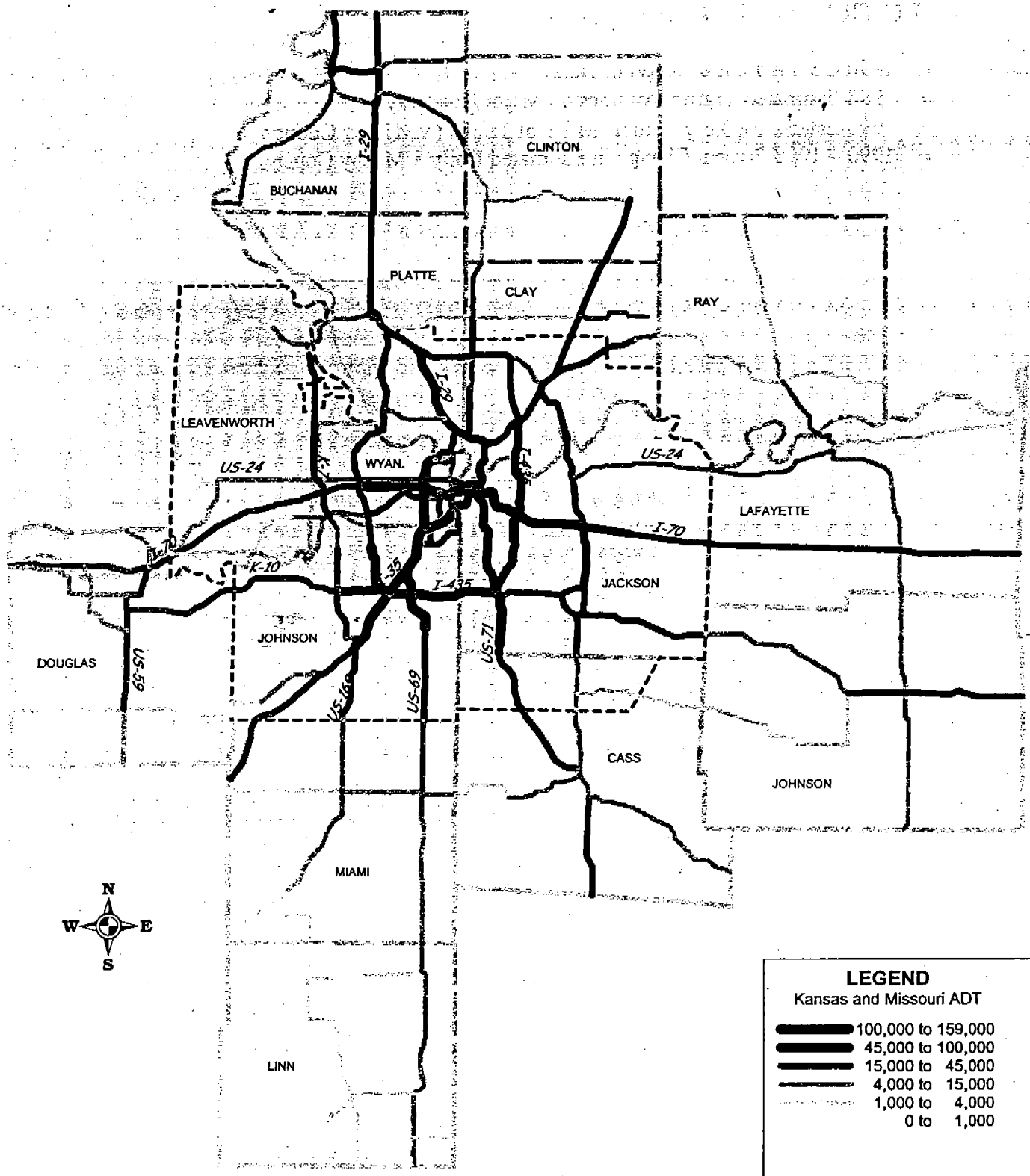

MARC Traffic Network
95°00'
94°50'
94°40'
94°30'
94°20'
94°10'
94°00'
39°30'
39°20'
39°10'
39°00'
38°50'
38°40'
Lathrop
Smithville
Excelsior Springs
Leavenworth
Tonganoxie
Muncie
Blue Springs
Lees Summit
Pleasant Hill
Spring Hill
Holden
Harrisonville
10
0
10 Miles
N
# of Vehicles
0 - 2348
2349 - 5173
5174 - 8341
8342 - 12375
12376 - 17910
17911 - 26755
26756 - 39248
39249 - 54875
54876 - 91362
91363 - 212531
County
Urbanized Areas

FIGURE 10

1998-1999 TRAFFIC COUNTS



LEGEND
Kansas and Missouri ADT

- 100,000 to 159,000
- 45,000 to 100,000
- 15,000 to 45,000
- 4,000 to 15,000
- 1,000 to 4,000
- 0 to 1,000

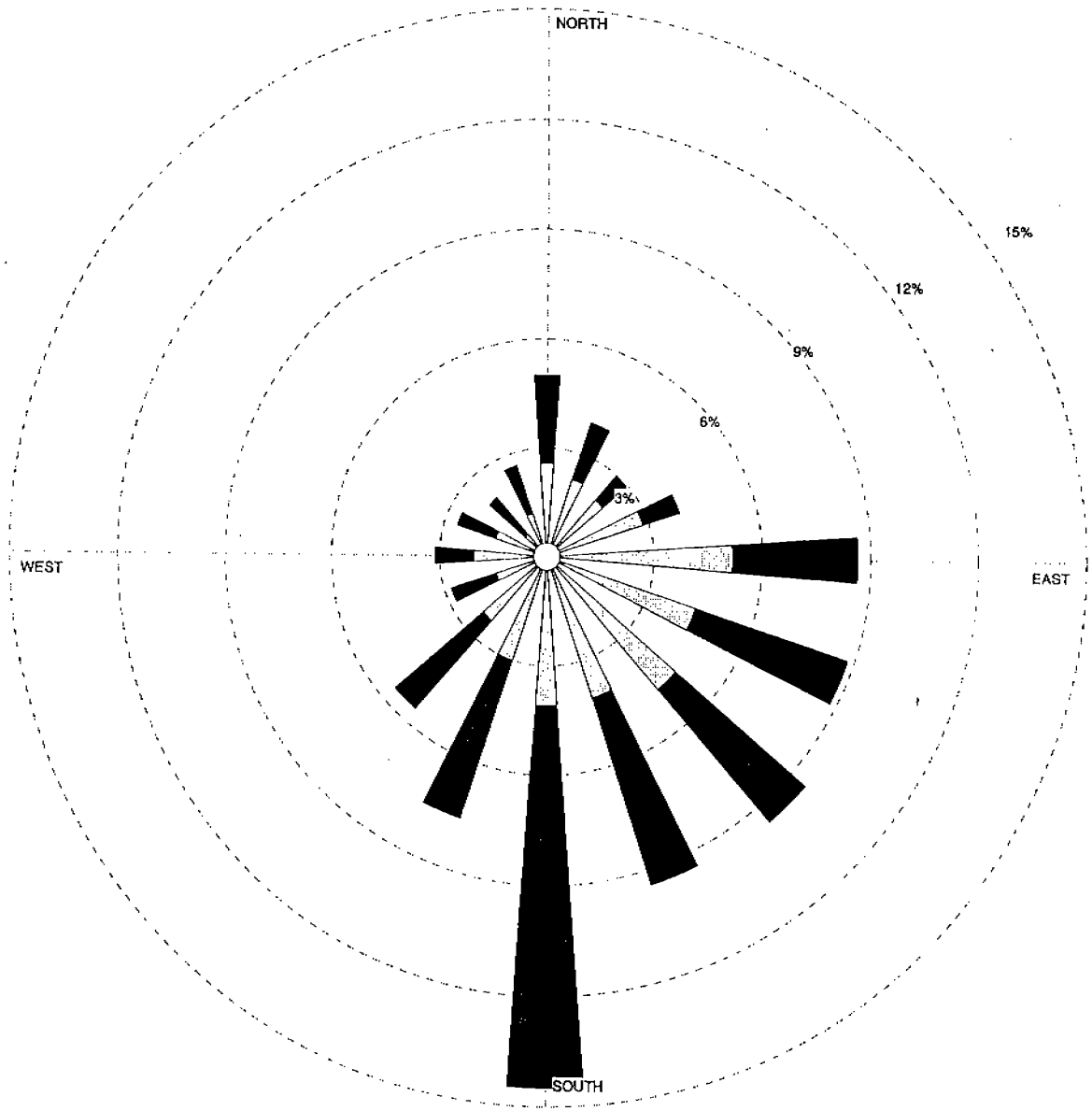
- MPO Boundary
- County Boundaries

MARC

FIGURE 11

WRPLOT View 1.0 - WIND ROSE PLOT:

STATION #3947 - ,



COMMENTS:

87-94 all hours less than 10 mph

PLOT YEAR-DATE-TIME:

87 88 89 90 91 92 93 94
January 1 - December 31
Midnight - 11 PM

ORIENTATION:
Direction (blowing from)

DISPLAY:
Wind Speed

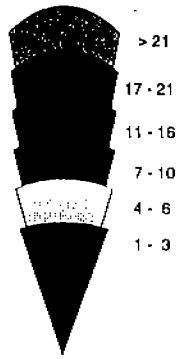
UNIT:
Knots

CALM WINDS:
6.23%

AVG. WIND SPEED:
6.94 Knots

DATE:
5/1/2000

Wind Speed (Knots)



MODELER:

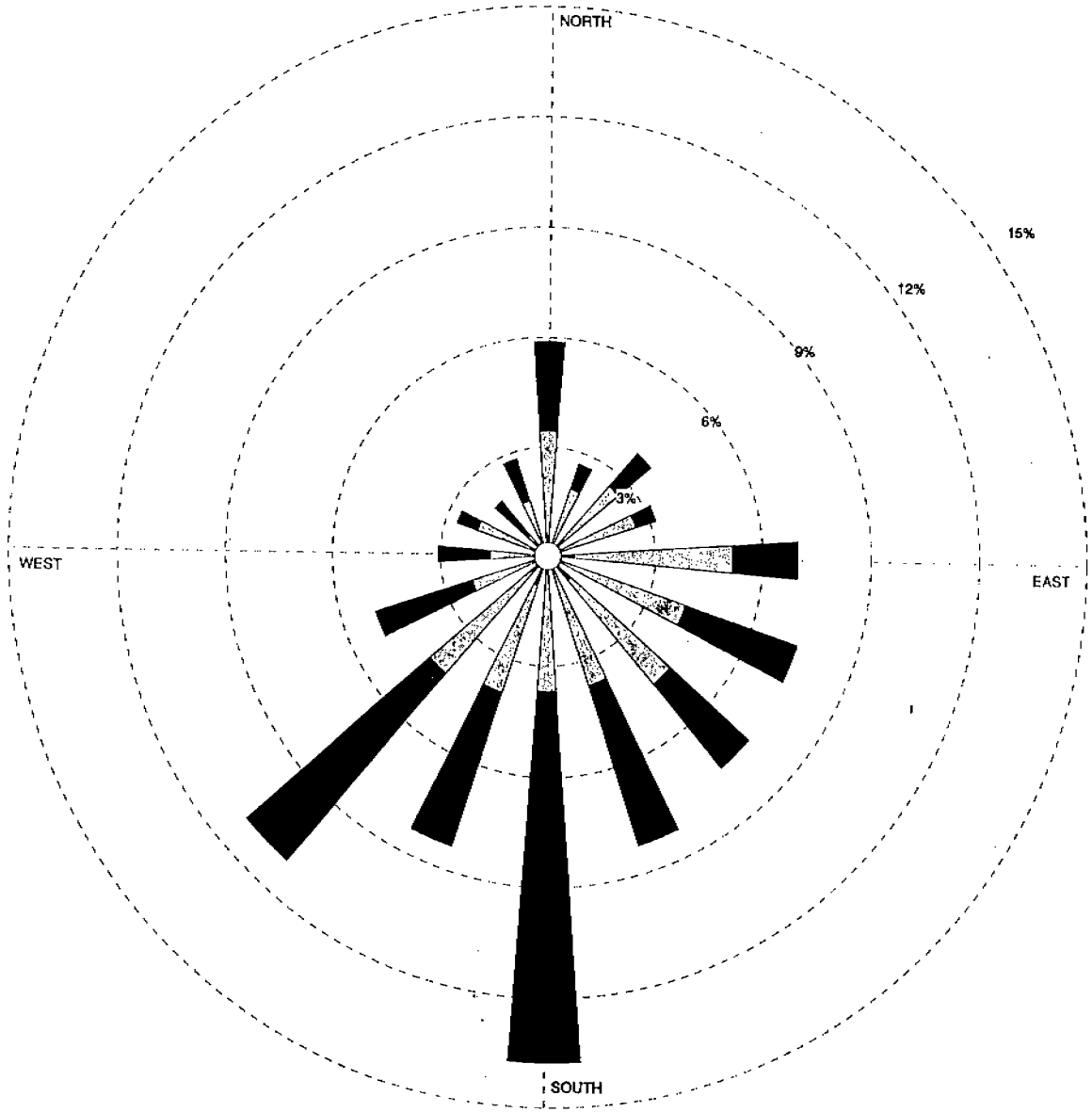
COMPANY NAME:

WRPLOT View 1.0 by Lakes Environmental Software - www.lakes-environmental.com

FIGURE 12

WRPLOT View 1.0 - WIND ROSE PLOT:

STATION #3947 - ,



COMMENTS:

7-10 for wind speeds less than 10 mph

PLOT YEAR-DATE-TIME:

87 88 89 90 91 92 93 94
January 1 - December 31
7 AM - 10 AM

ORIENTATION:
Direction (blowing from)

DISPLAY:
Wind Speed

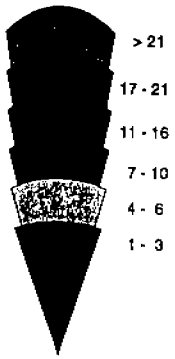
UNIT:
Knots

CALM WINDS:
5.30%

AVG. WIND SPEED:
6.63 Knots

DATE:
3/15/2000

Wind Speed (Knots)



MODELER:

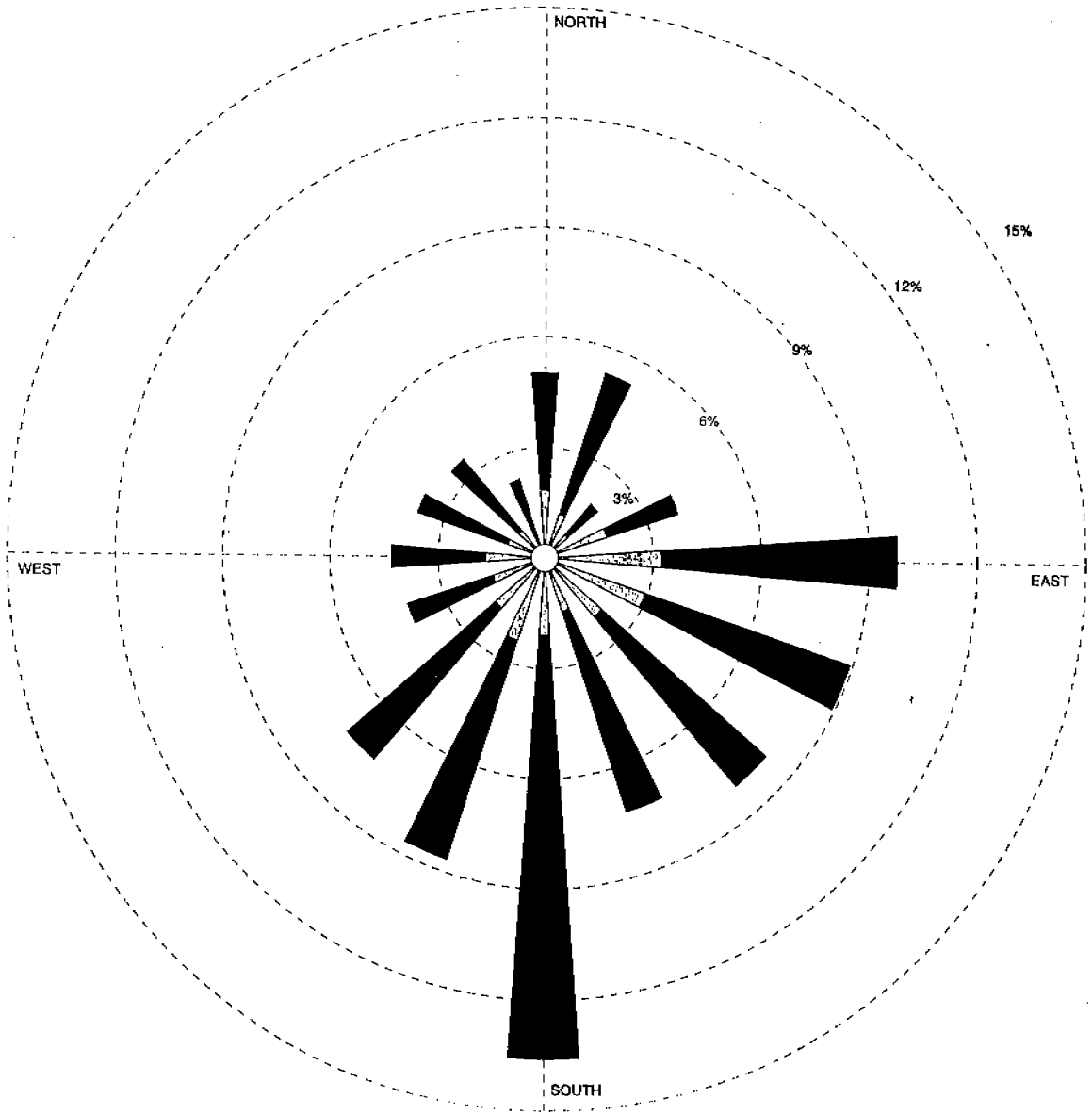
COMPANY NAME:

WRPLOT View 1.0 by Lakes Environmental Software - www.lakes-environmental.com

FIGURE 13

WRPLOT View 1.0 - WIND ROSE PLOT:

STATION #3947 - ,



COMMENTS:

Hours 1-4 for wind speeds less than 10

PLOT YEAR-DATE-TIME:

87 88 89 90 91 92 93 94
January 1 - December 31
1 PM - 4 PM

ORIENTATION :
Direction (blowing from)

DISPLAY:
Wind Speed

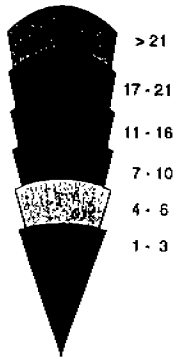
UNIT:
Knots

CALM WINDS:
1.83%

AVG. WIND SPEED:
8.11 Knots

DATE:
3/15/2000

Wind Speed (Knots)



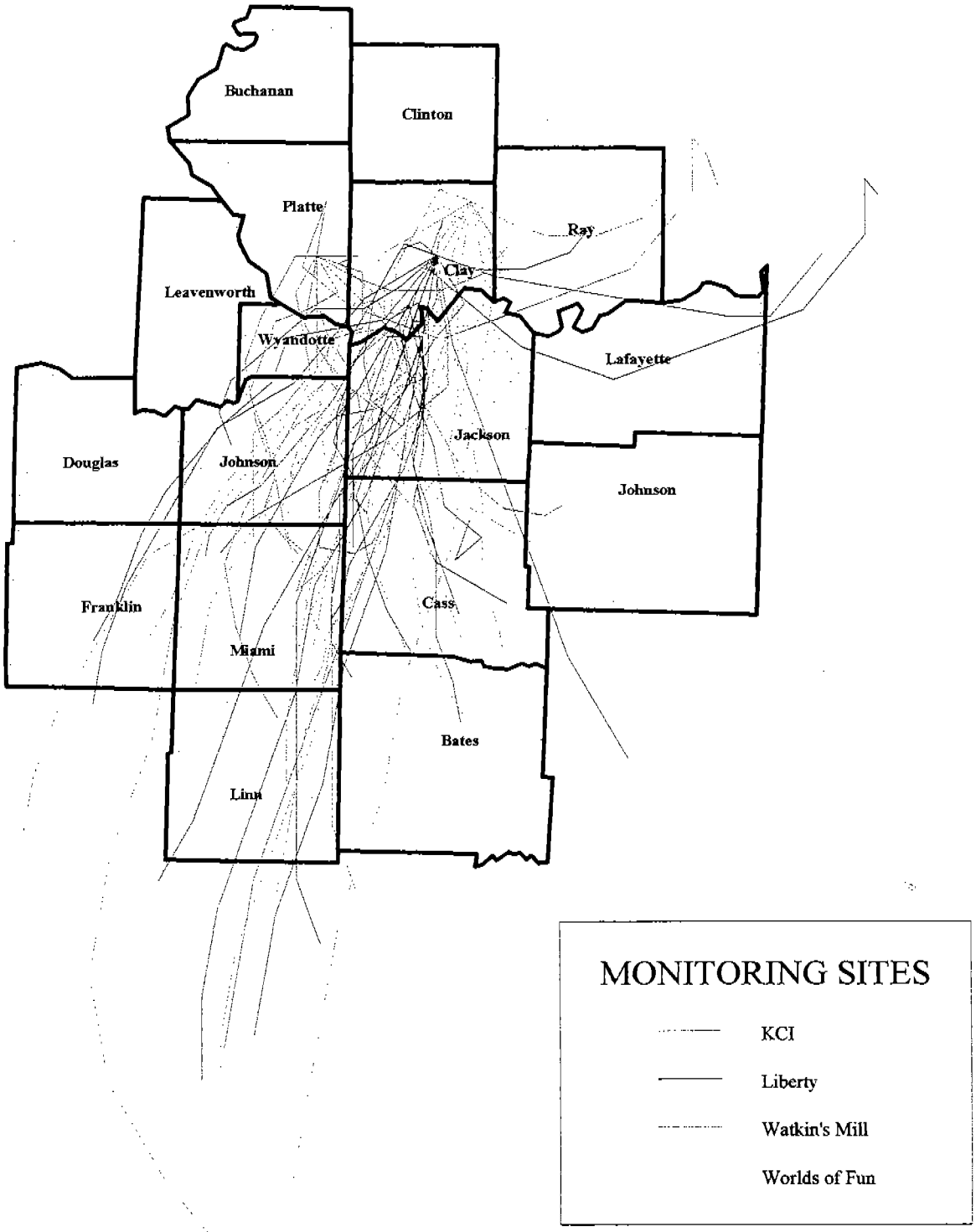
MODELER:

COMPANY NAME:

WRPLOT View 1.0 by Lakes Environmental Software - www.lakes-environmental.com

FIGURE 14

Back Trajectories for 8-Hour Ozone Exceedances



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Air Pollution Control Program

FIGURE 15

Back Trajectories for 8-Hour Ozone Exceedance Days and VOC Sources > 25 TPY

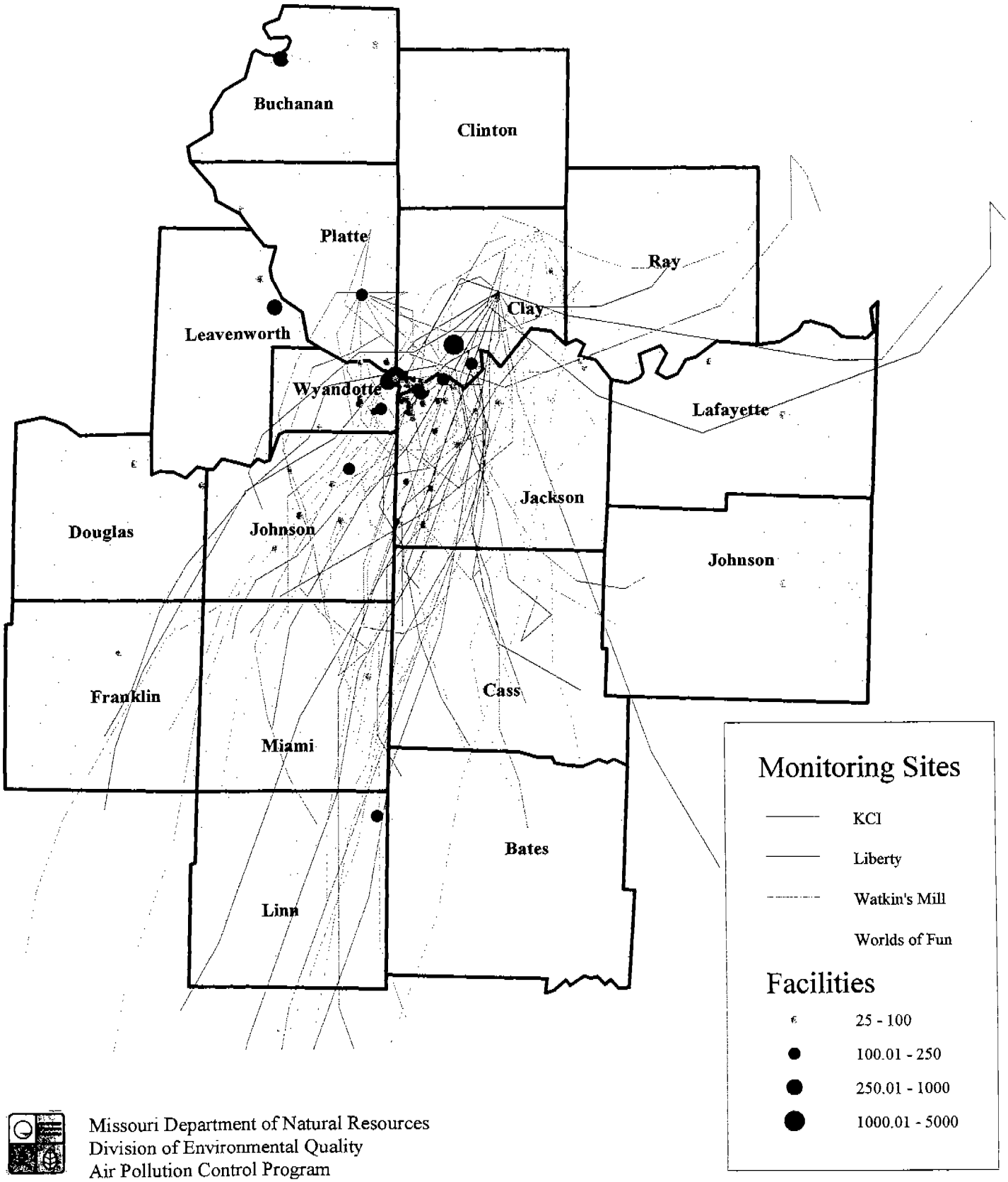

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FIGURE 16

Back Trajectories for 8-Hour Ozone Exceedance Days and NOx Sources > 25 TPY

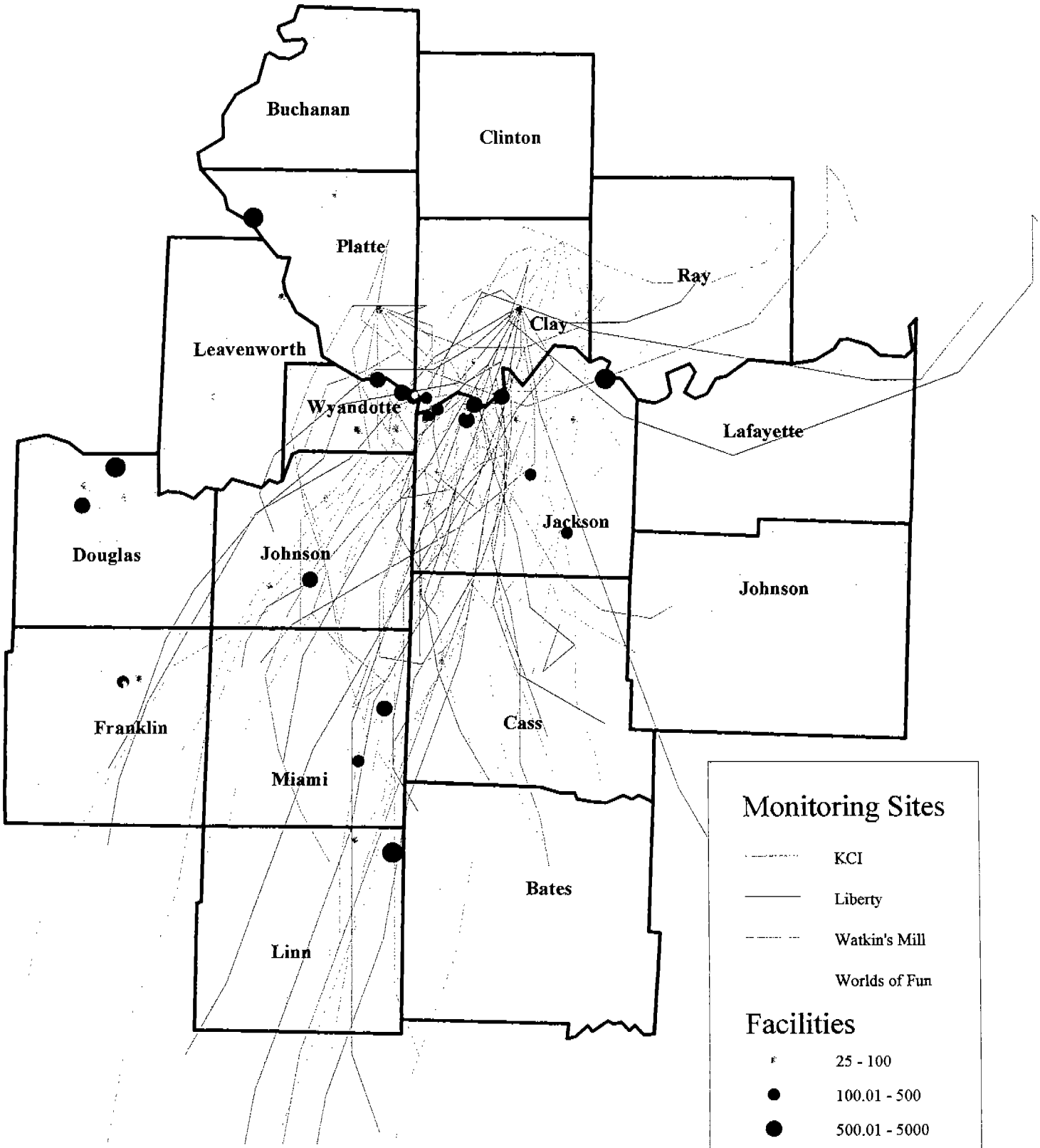

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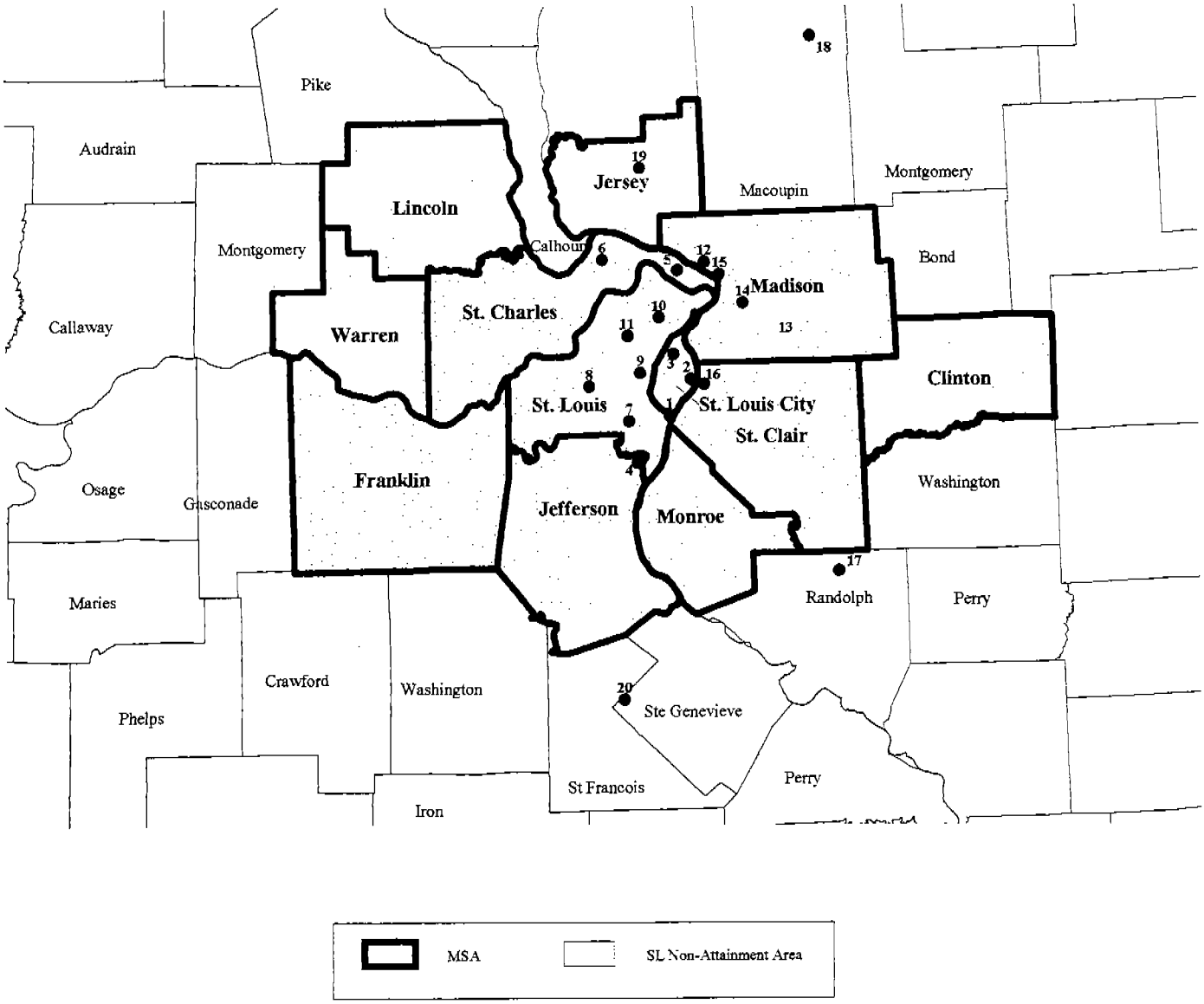
FIGURE 17

MONITORING LOCATIONS IN THE ST. LOUIS AREA



01 8227 S Broadway & Hurck
02 1122 Clark & Tucker
03 Newstead & cote Brilliante
04 Arnold Tenbrook & Tenbrook
05 Hwy 94 West Alton
06 Orchard Farm
07 4580 S Lindbergh Affton
08 305 Weidman Rd Queeny Park
09 55 Hunter Ave Clayton
10 3400 Pershall Rd
11 10267 St Charles Rock Rd
12 Alton IL
13 Maryville IL
14 Edwardsville IL
15 Wood River IL
16 East St Louis IL
17 Houston IL
18 Nilwood IL
19 Jerseyville IL
20 Bonne Terre

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Division of Environmental Quality
Air Pollution Control Program

FIGURE 18

Low-level Point Source VOC Emissions

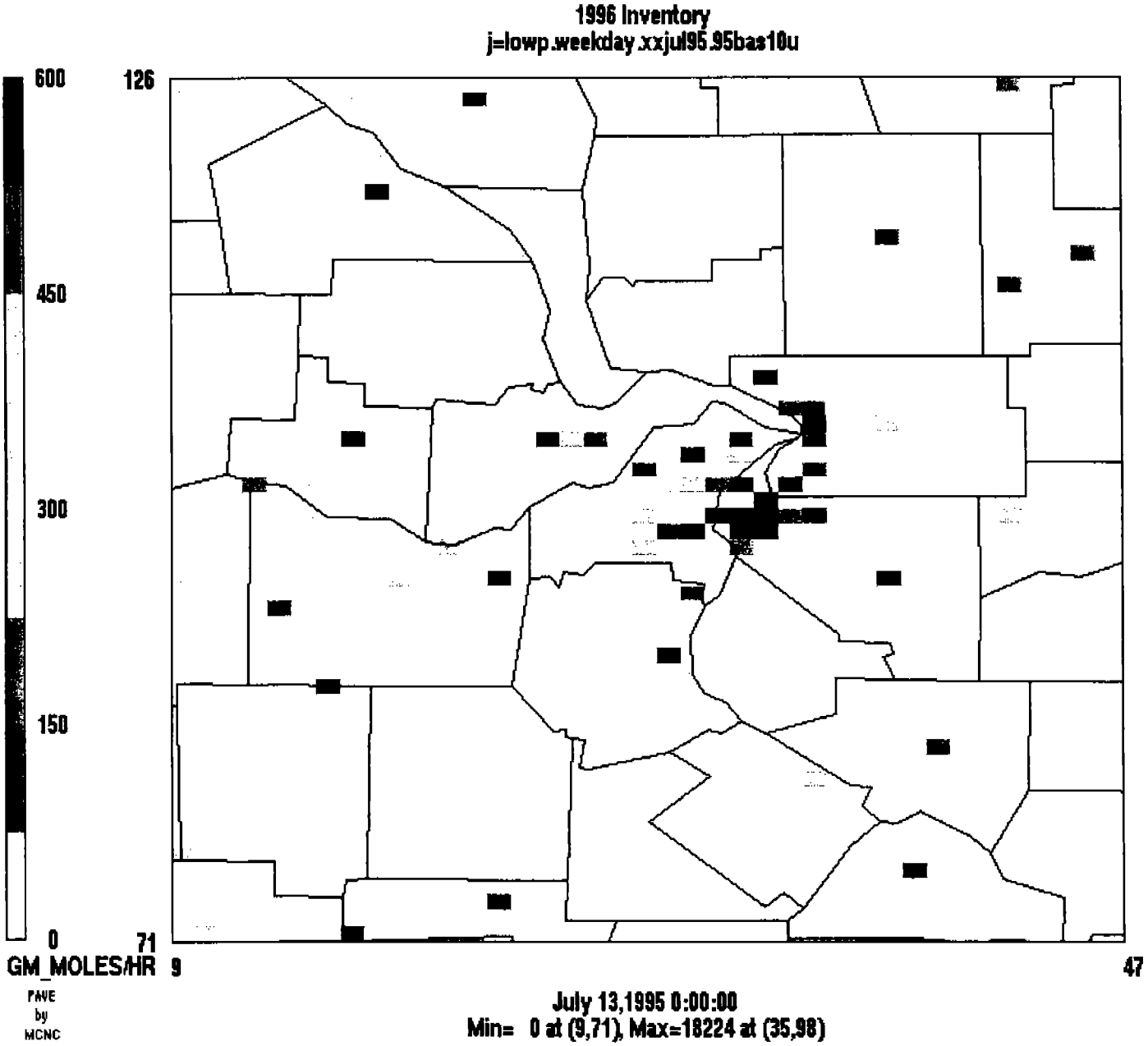


FIGURE 19

Area Source VOC Emissions

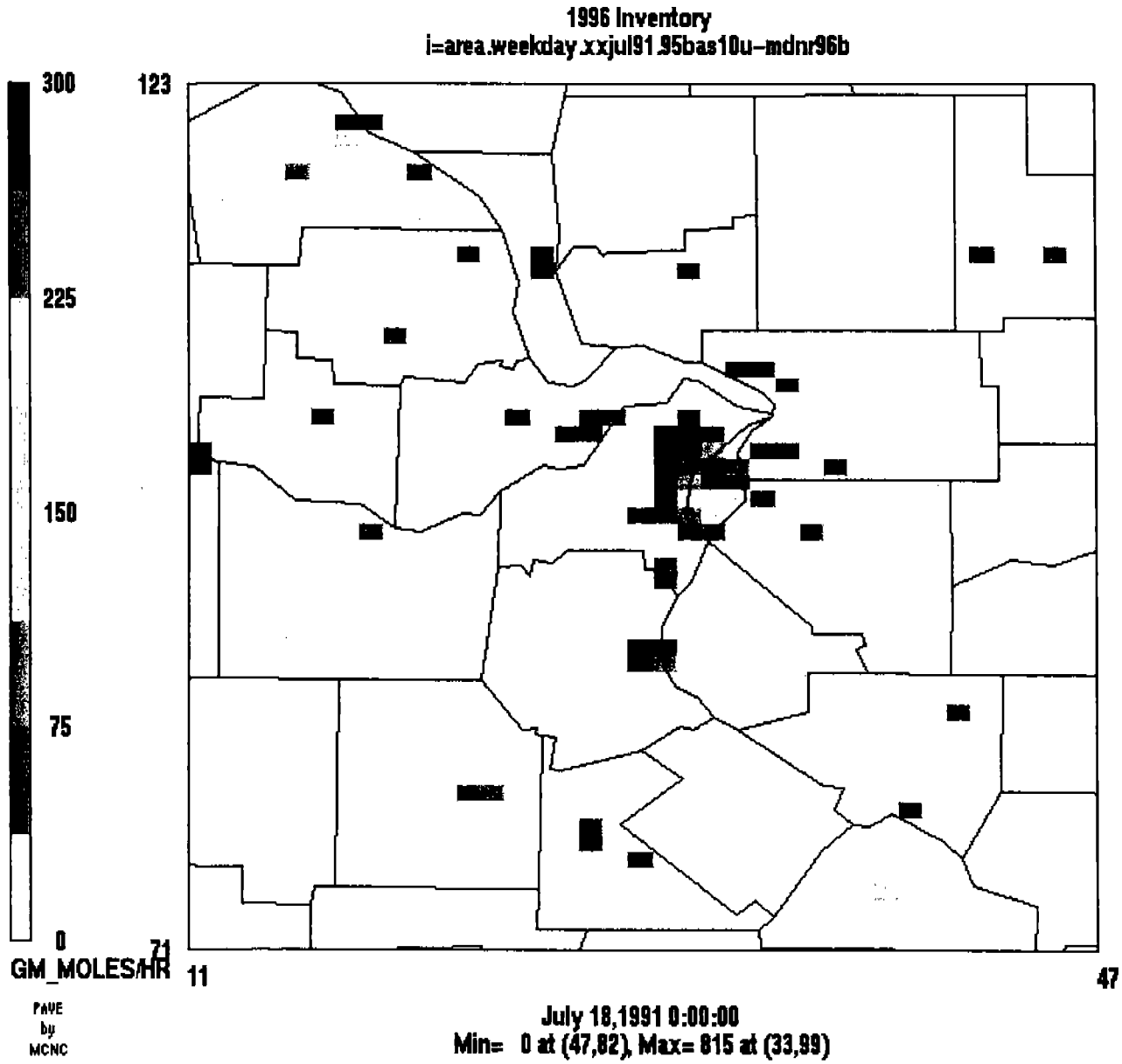


FIGURE 20

Mobile Source VOC Emissions

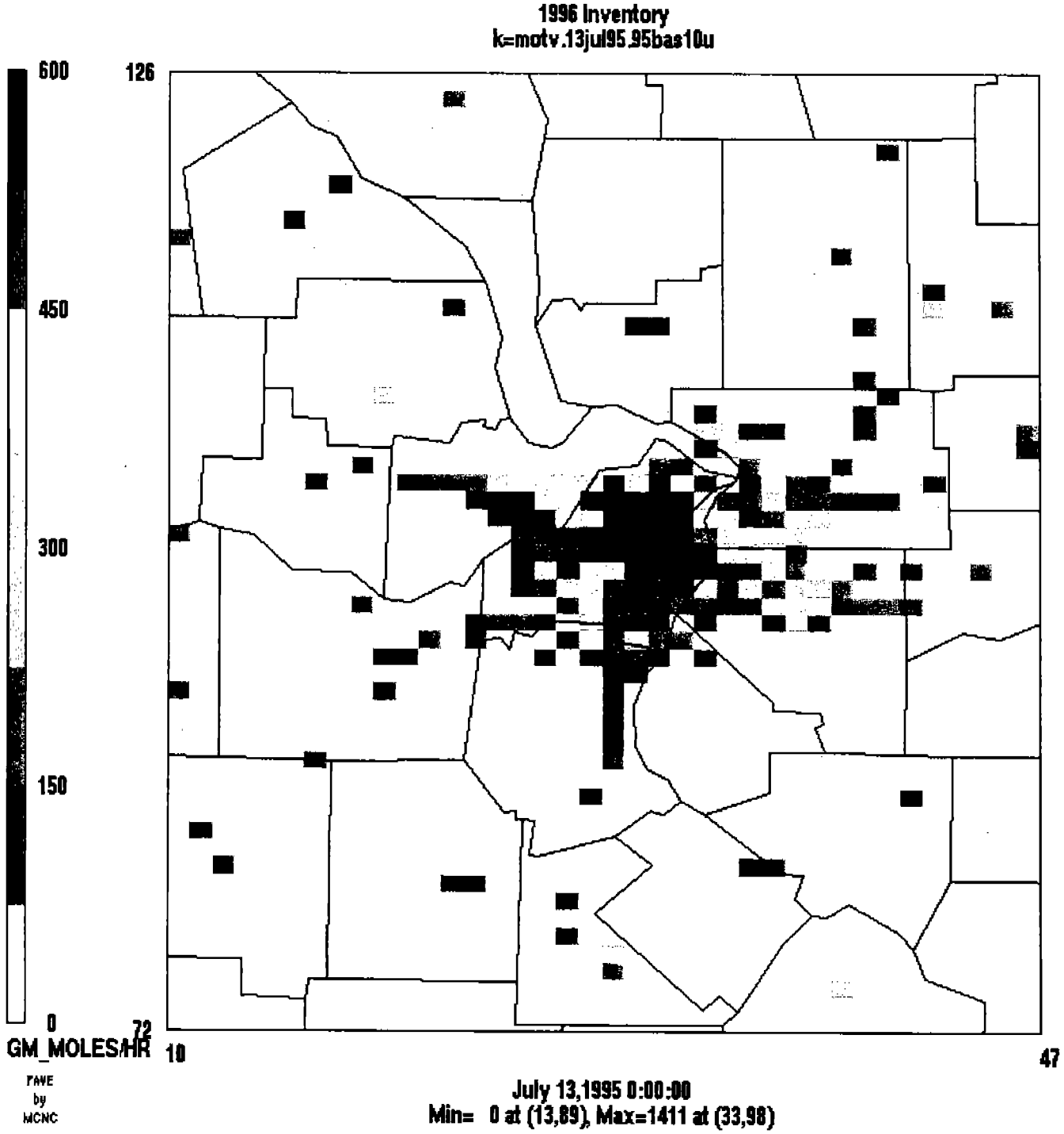


FIGURE 21

Low-level NOx Emissions

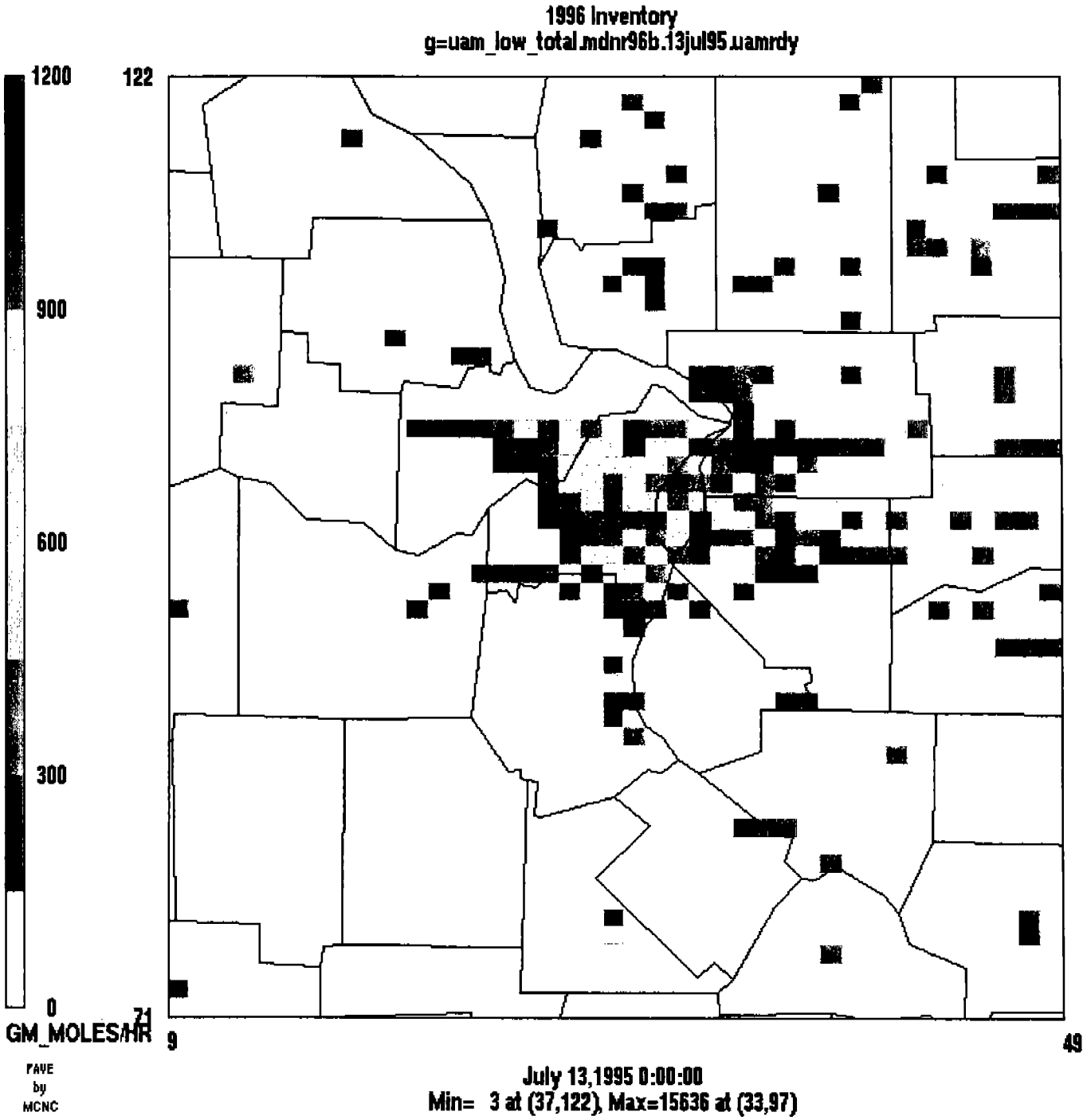
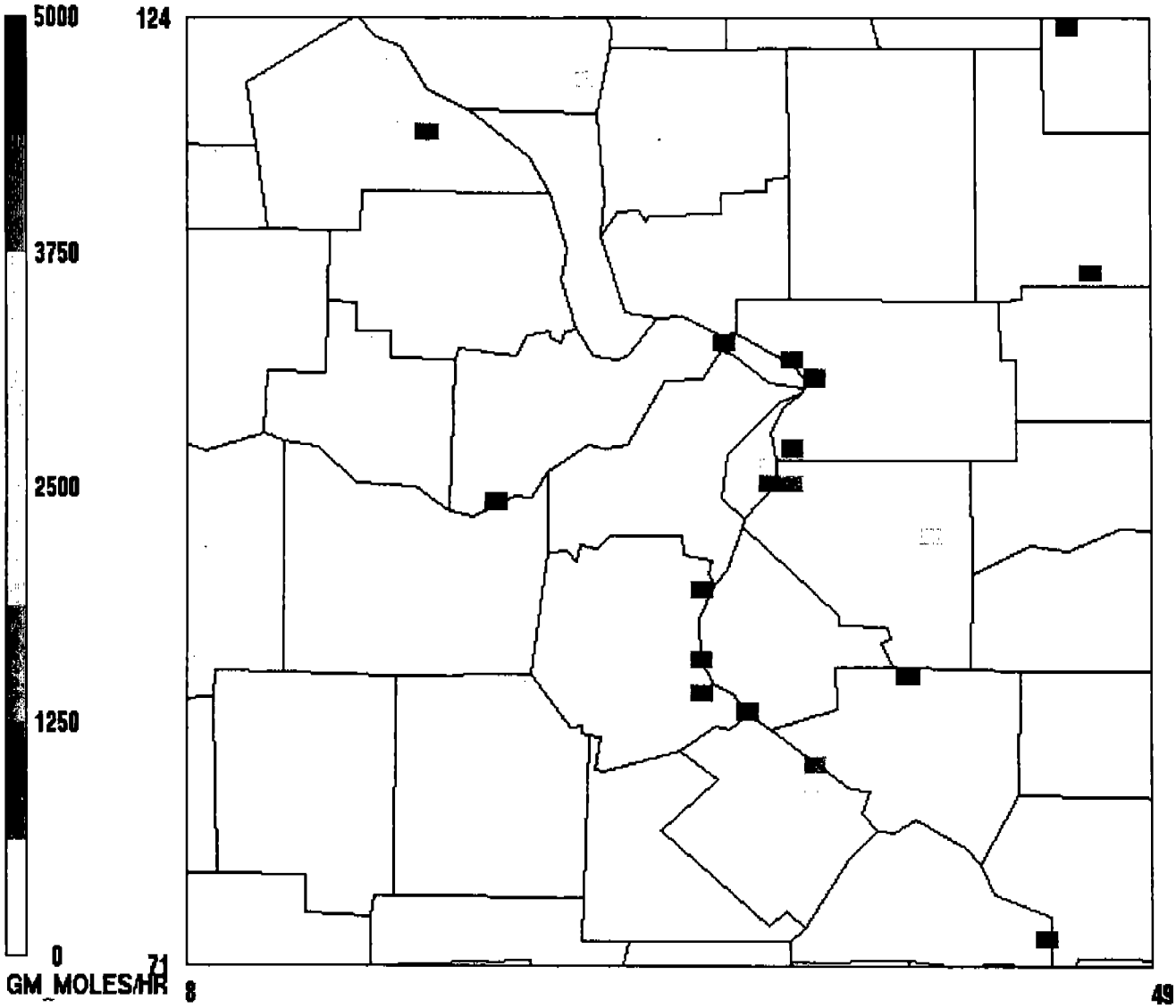


FIGURE 22

Elevated Pt. Source NOx Emissions

1996 Inventory
h=ptsr.weekday.xxjul95.95bas10u

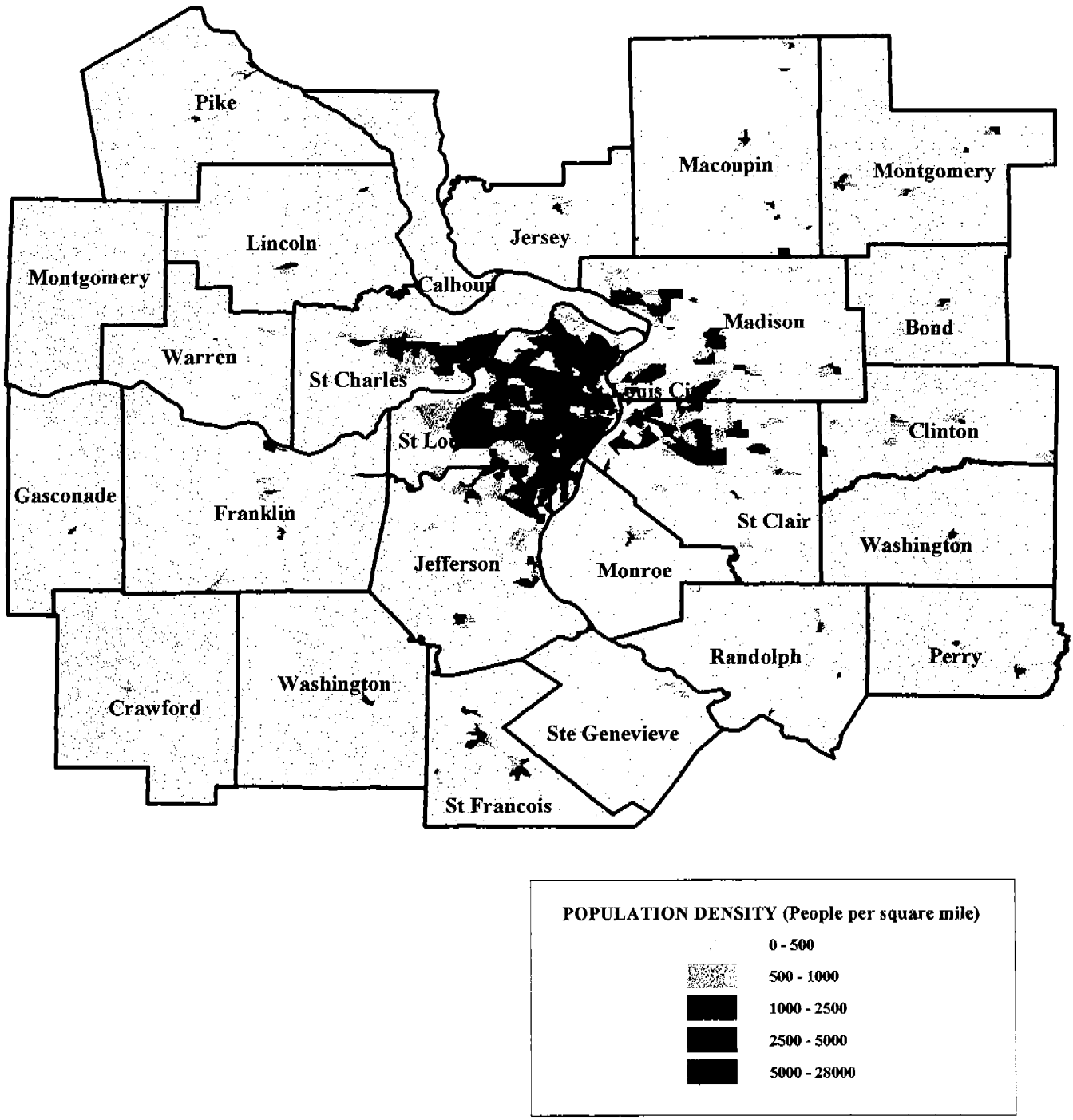


PAVE
by
MCNC

July 13,1995 0:00:00
Min= 0 at (8,71), Max=131751 at (39,87)

FIGURE 23

1990 POPULATION DENSITY FOR COUNTIES IN THE ST. LOUIS AREA



Missouri Department of Natural Resources
Division of Environmental Quality
Air Pollution Control Program

FIGURE 24

2004 POPULATION DENSITY FOR MISSOURI COUNTIES IN THE ST. LOUIS AREA

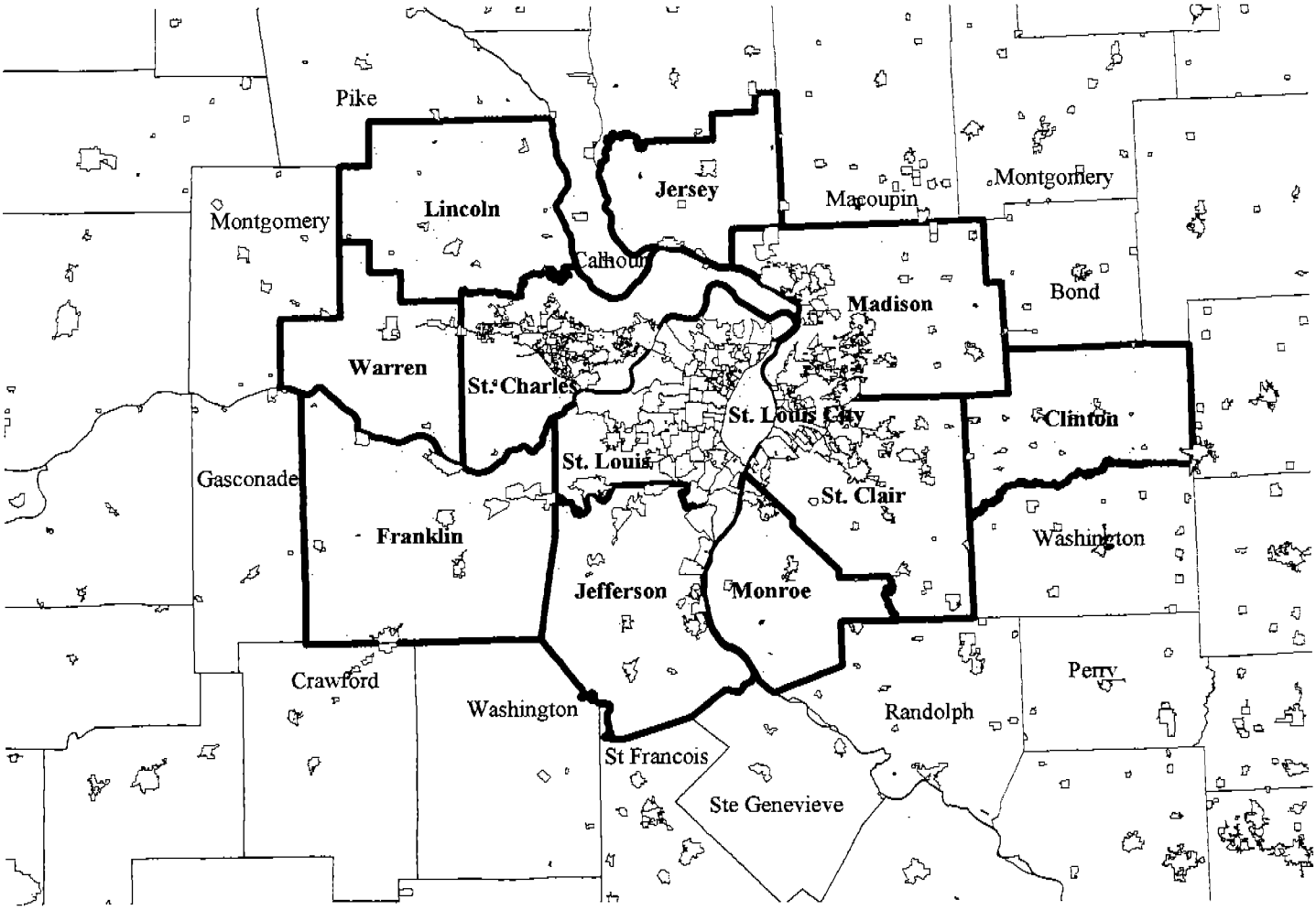
POPULATION DENSITY (People per square mile)

- 0 - 500
- 500 - 1000
- 1000 - 2500
- 2500 - 5000
- 5000 - 15769

Missouri Department of Natural Resources
Division of Environmental Quality
Air Pollution Control Program

FIGURE 25

Degree of Urbanization in the St. Louis Area

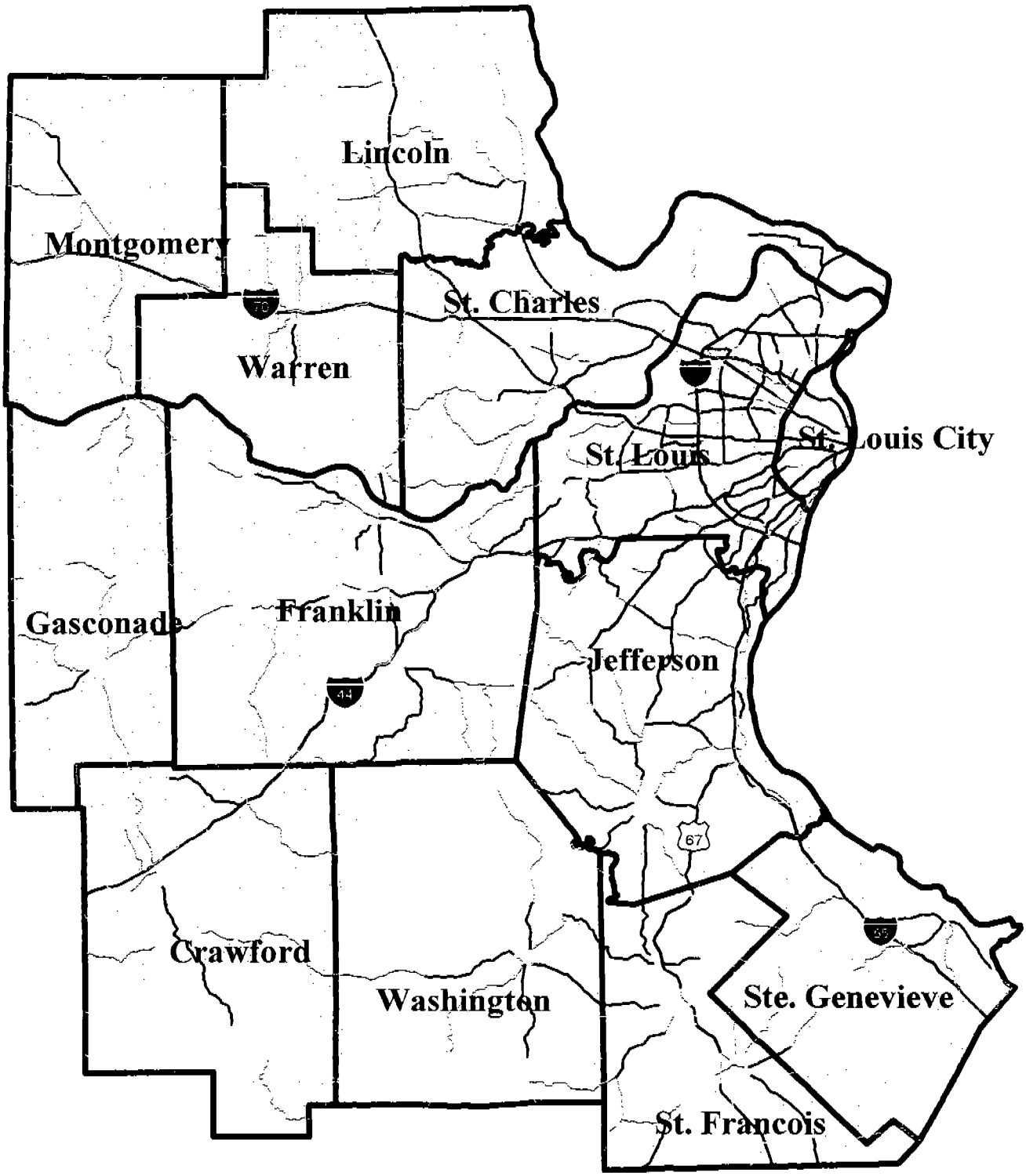


Urban Areas

Missouri Department of Natural Resources
Division of Environmental Quality
Air Pollution Control Program

FIGURE 26

1996 VMT FOR MISSOURI COUNTIES IN THE ST. LOUIS AREA



1996 Missouri VMT per day

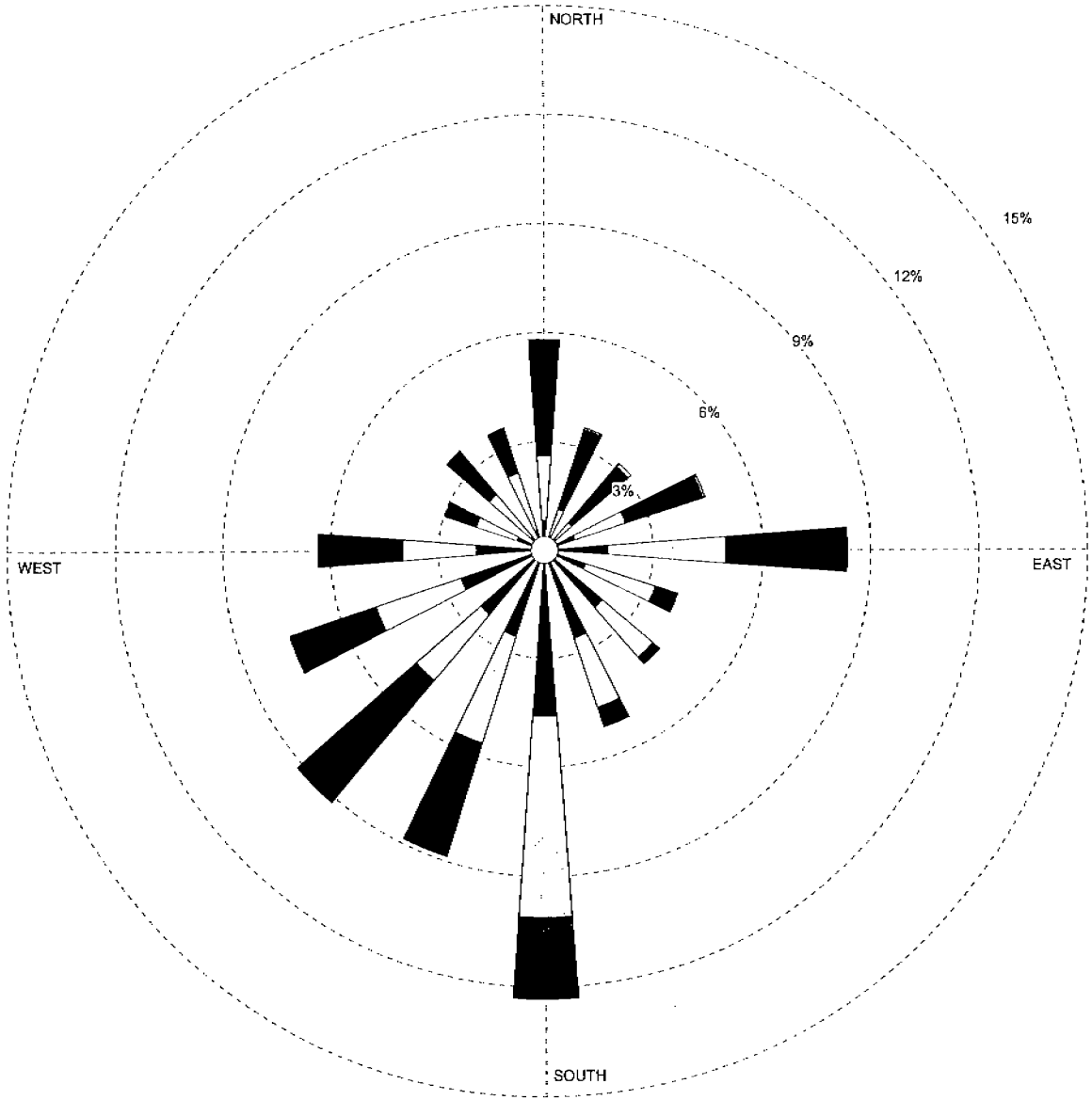
- 0 - 10000
- 10000 - 25000
- 25000 - 50000
- 50000 - 100000
- 100000 - 450000

Missouri Department of Natural Resources
Division of Environmental Quality
Air Pollution Control Program

FIGURE 27

WRPLOT View 1.0 - WIND ROSE PLOT:

STATION #3947 - ,



COMMENTS:

Maryville site
95-98 all hours

PLOT YEAR-DATE-TIME:
91 91 96 98
January 1 - December 31
Midnight - 11 PM

DISPLAY:
Wind Speed

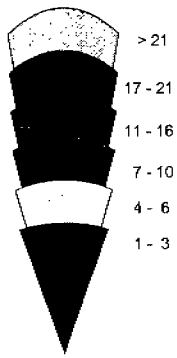
UNIT:
Knots

CALM WINDS:
6.19%

AVG. WIND SPEED:
5.89 Knots

DATE:
6/27/2000

Wind Speed (Knots)



MODELER:

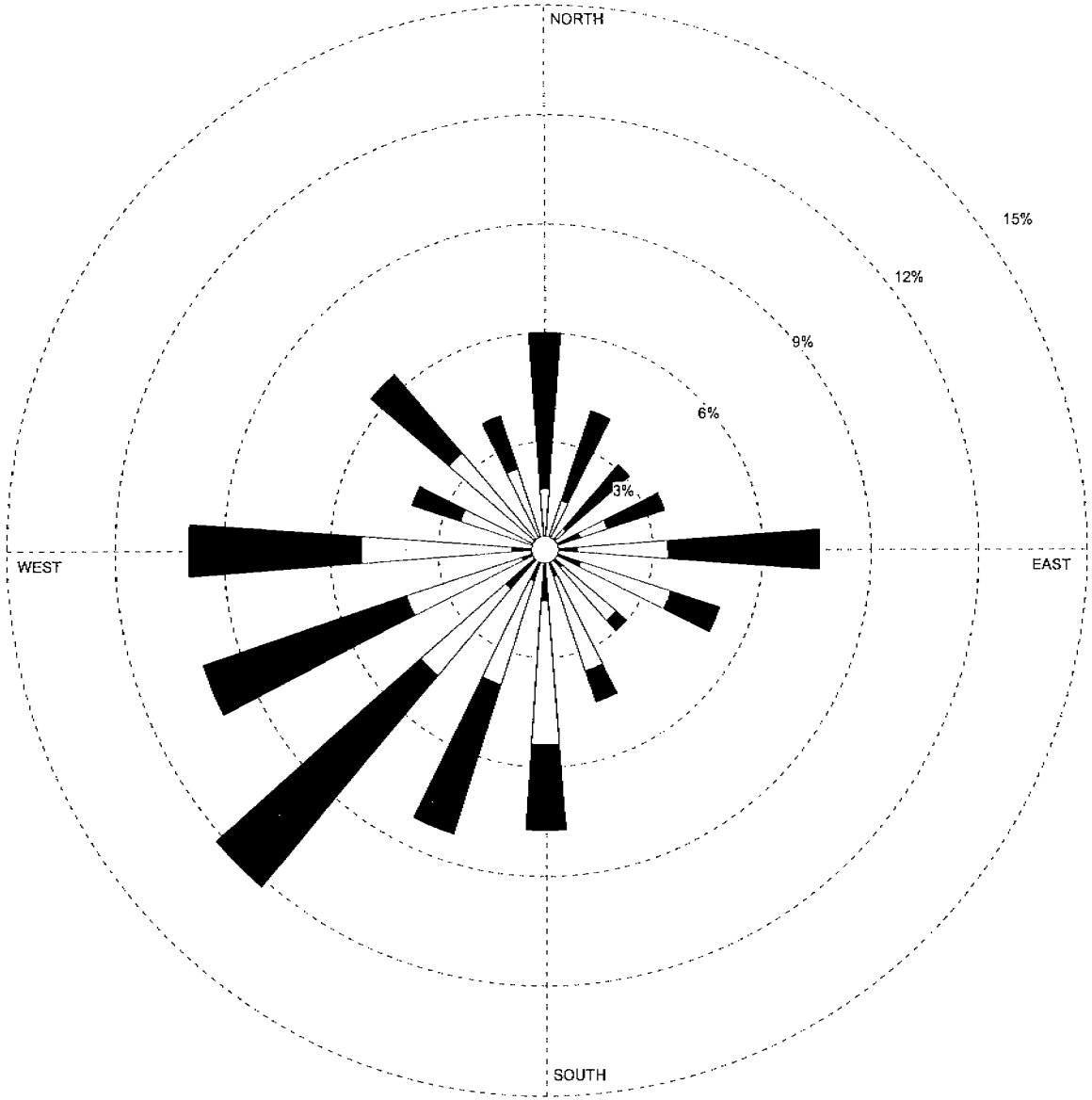
COMPANY NAME:

WRPLOT View 1.0 by Lakes Environmental Software - www.lakes-environmental.com

FIGURE 28

WRPLOT View 1.0 - WIND ROSE PLOT:

STATION #3947 - ,



COMMENTS:

Maryville site
95-98
7-10 am

PLOT YEAR-DATE-TIME:

91 91 96 98
January 1 - December 31
7 AM - 10 AM

DISPLAY:
Wind Speed

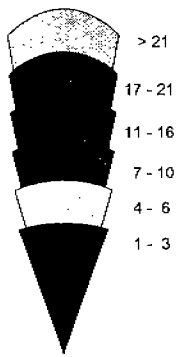
UNIT:
Knots

CALM WINDS:
0.13%

AVG. WIND SPEED:
6.90 Knots

DATE:
6/27/2000

Wind Speed (Knots)



MODELER:

COMPANY NAME:

WRPLOT View 1.0 by Lakes Environmental Software - www.lakes-environmental.com

FIGURE 29

WRPLOT View 1.0 - WIND ROSE PLOT:

STATION #3947 - ,

COMMENTS:

Maryville site
95-98
1-4 pm

PLOT YEAR-DATE-TIME:

91 91 96 98
January 1 - December 31
1 PM - 4 PM

DISPLAY:
Wind Speed

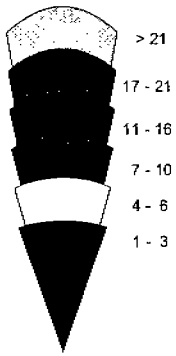
UNIT:
Knots

CALM WINDS:
0.39%

AVG. WIND SPEED:
7.79 Knots

DATE:
6/27/2000

Wind Speed (Knots)



MODELER:

COMPANY NAME:

WRPLOT View 1.0 by Lakes Environmental Software - www.lakes-environmental.com

Kansas City

8-Hour Exceedance

Forward Trajectory

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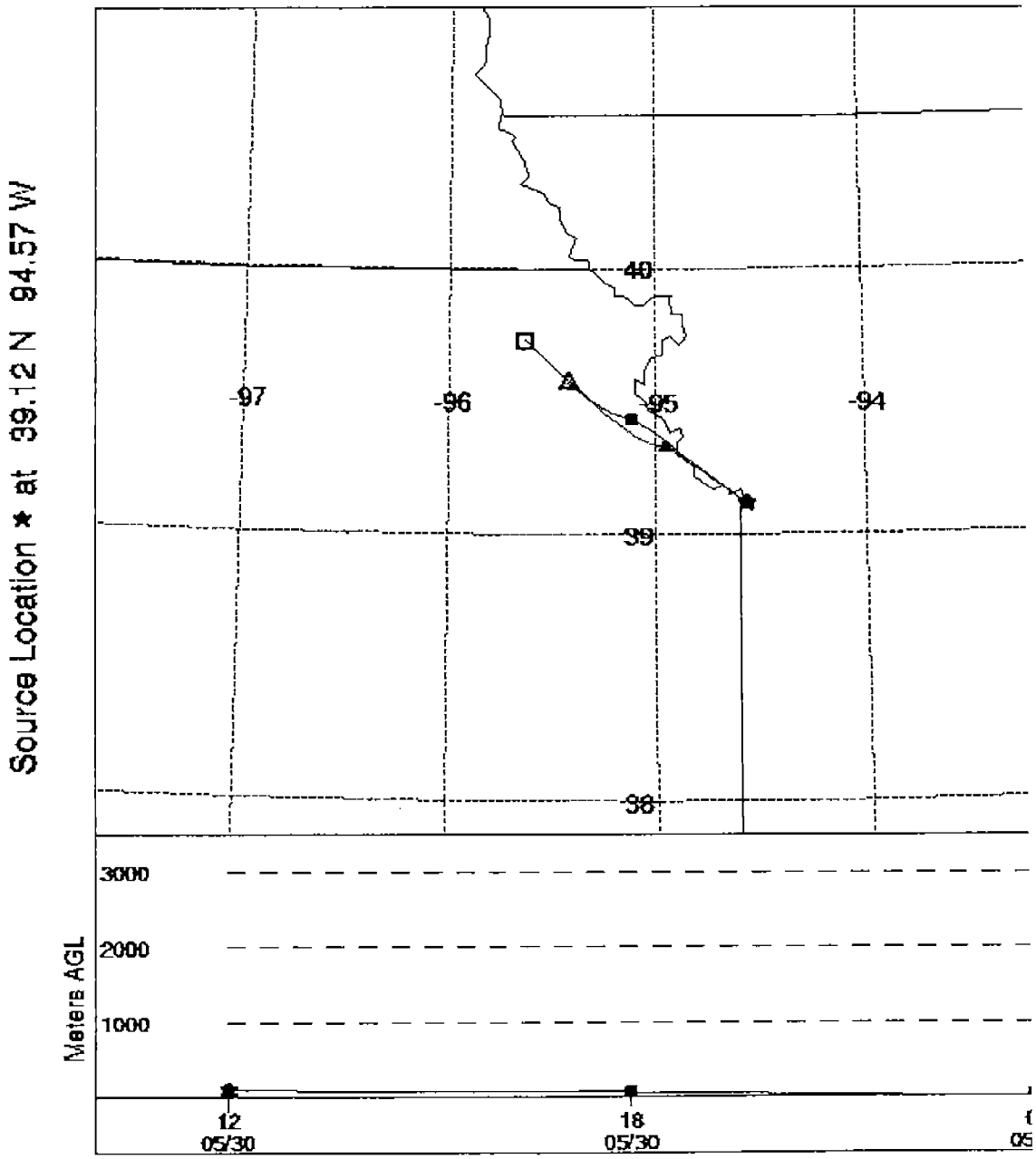
Wyandotte 86

NOAA AIR RESOURCES LABORATORY

Forward Trajectories Starting- 12 UTC 30 MAY 96



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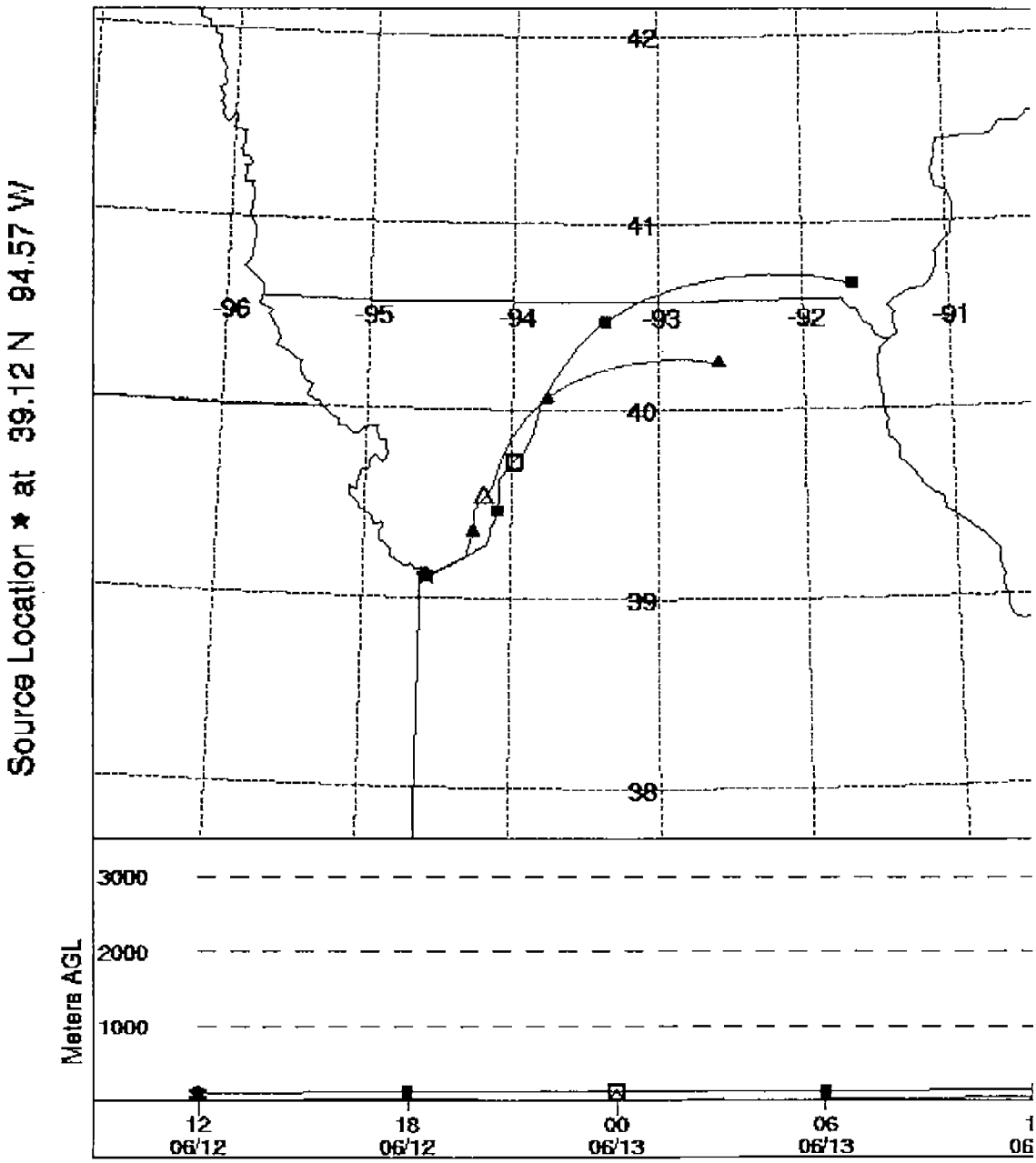
Liberty 87

NOAA AIR RESOURCES LABORATORY

Forward Trajectories Starting- 12 UTC 12 JUN 96



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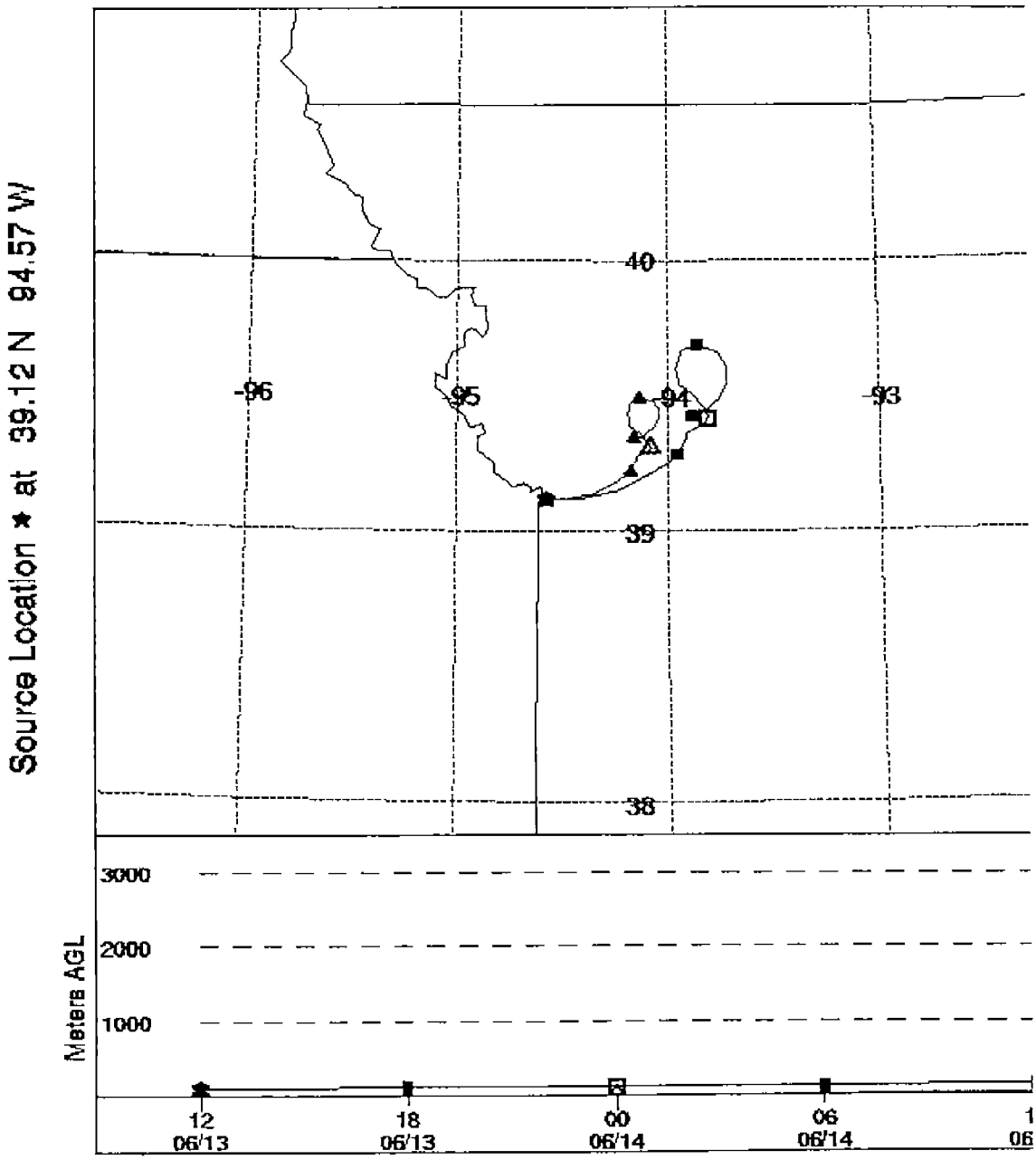
Liberty 101
Watkins Mill 88
Worlds of Fun 88

NOAA AIR RESOURCES LABORATORY

Forward Trajectories Starting- 12 UTC 13 JUN 96



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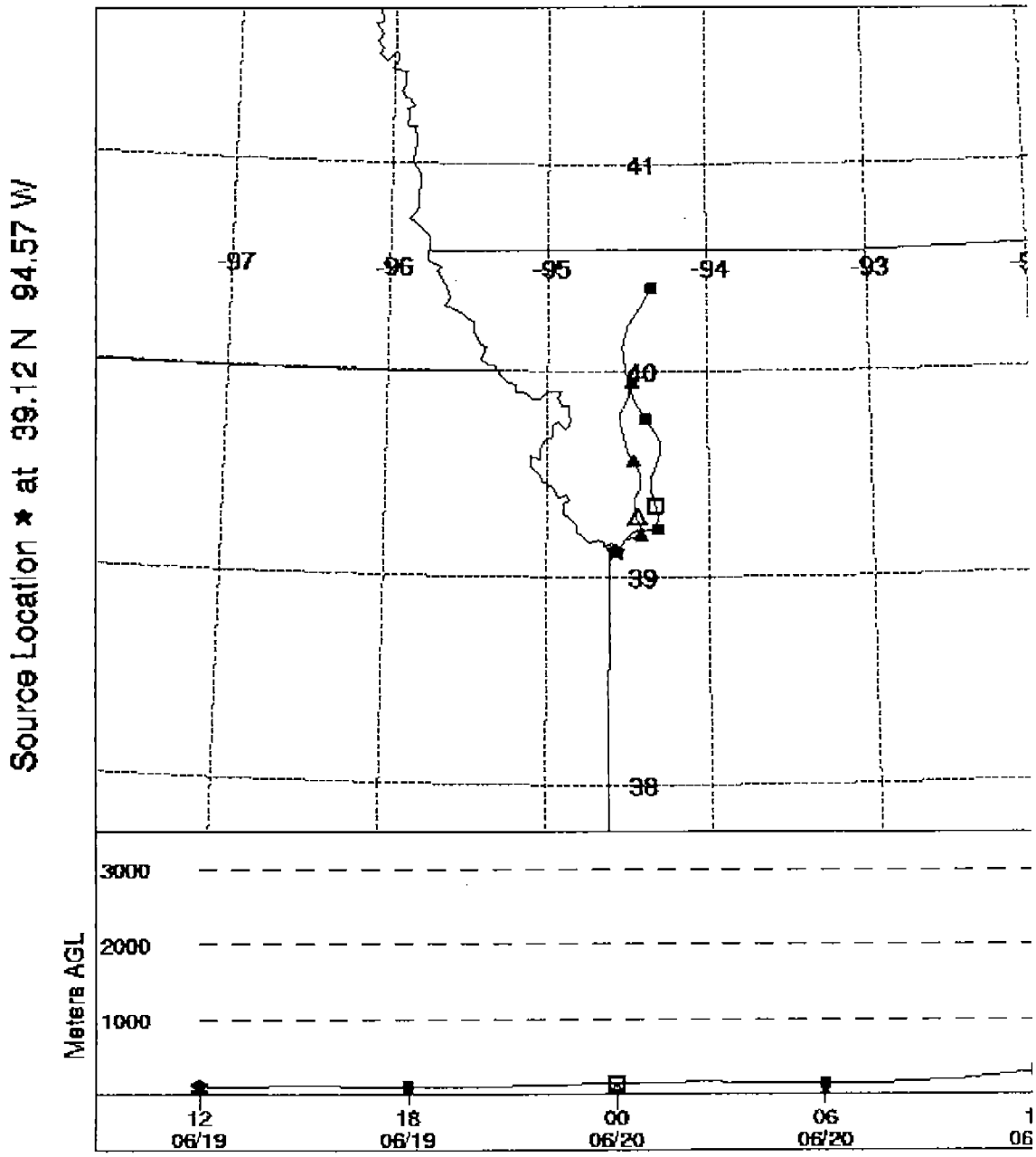
Liberty 87

NOAA AIR RESOURCES LABORATORY

Forward Trajectories Starting- 12 UTC 19 JUN 96



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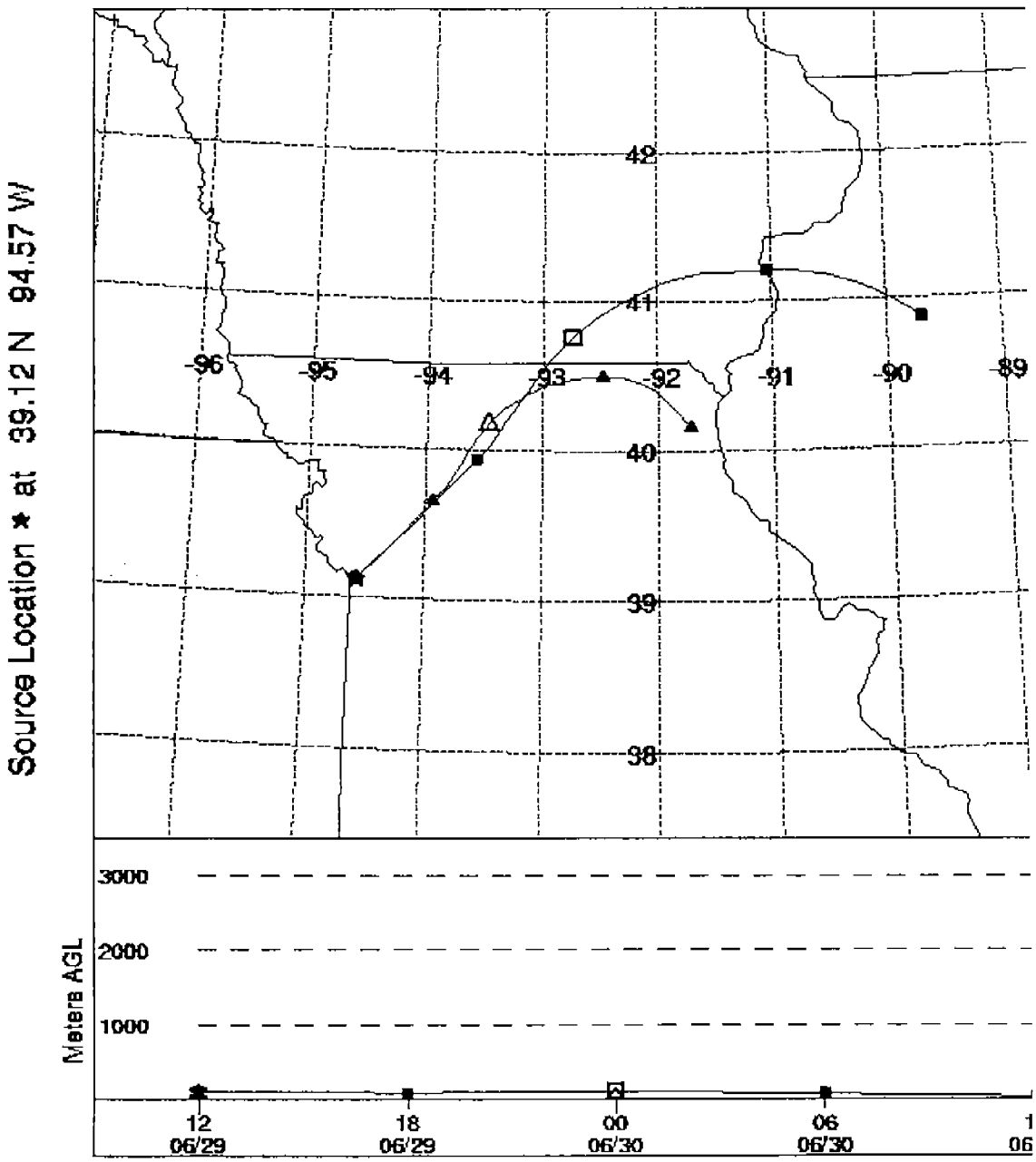
Liberty 88
Watkins Mill 85

NOAA AIR RESOURCES LABORATORY

Forward Trajectories Starting- 12 UTC 29 JUN 96



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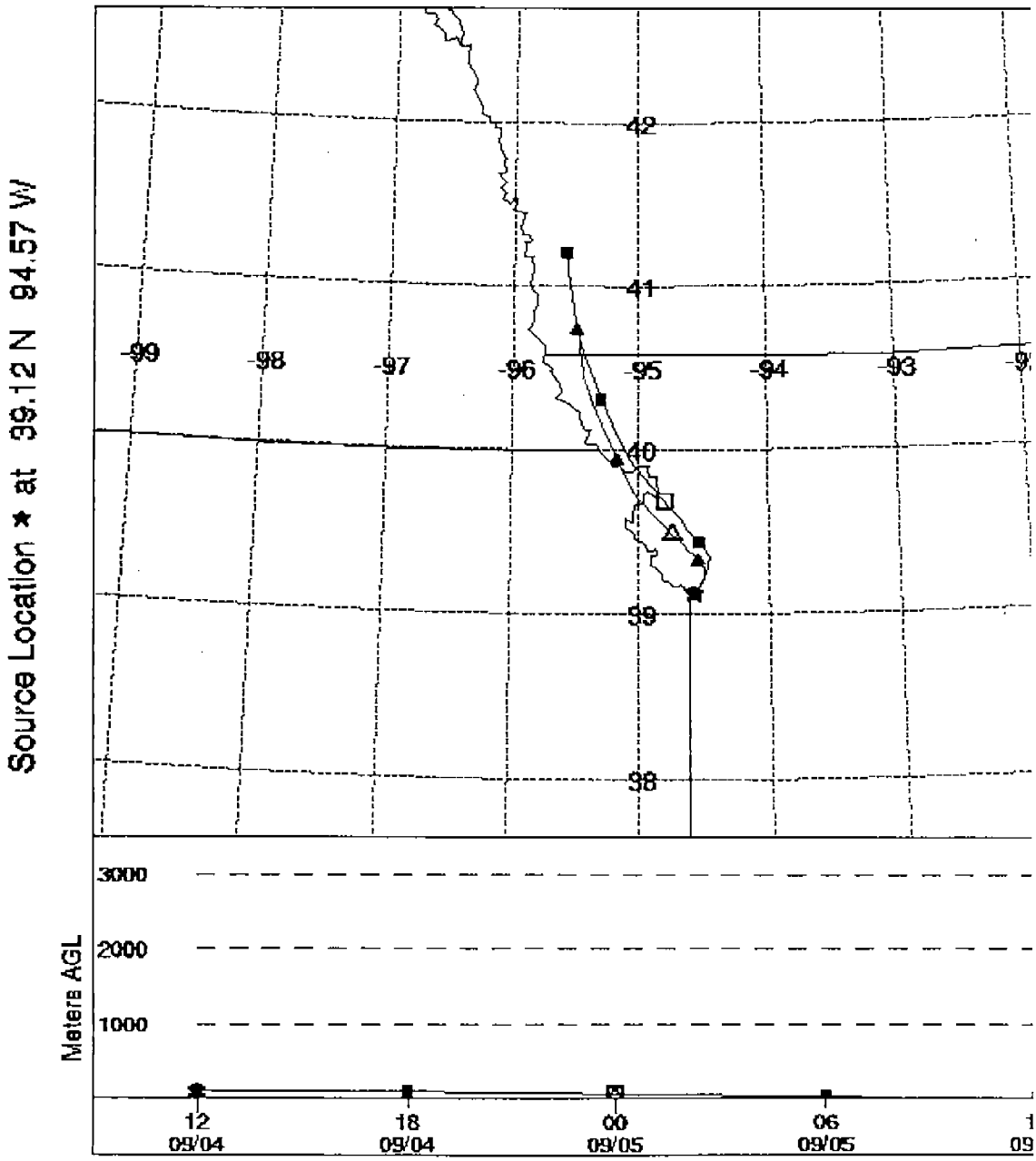
Wyandotte 89
KCI 87

NOAA AIR RESOURCES LABORATORY

Forward Trajectories Starting- 12 UTC 04 SEP 96



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Wyandotte 96
Miami Co. 98 (?)
KCI 82

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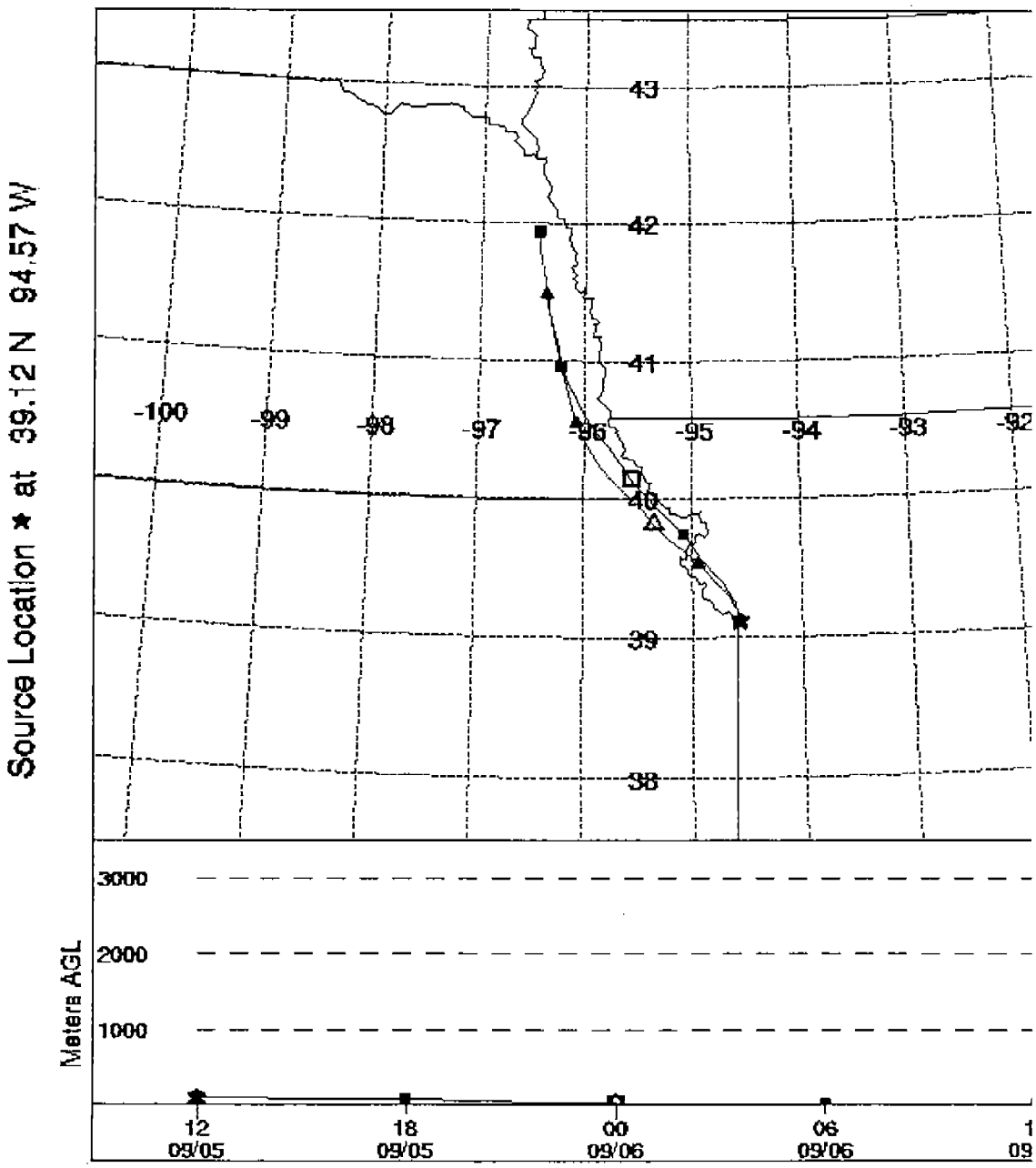
Forward Trajectories Starting- 12 UTC 05 SEP 96



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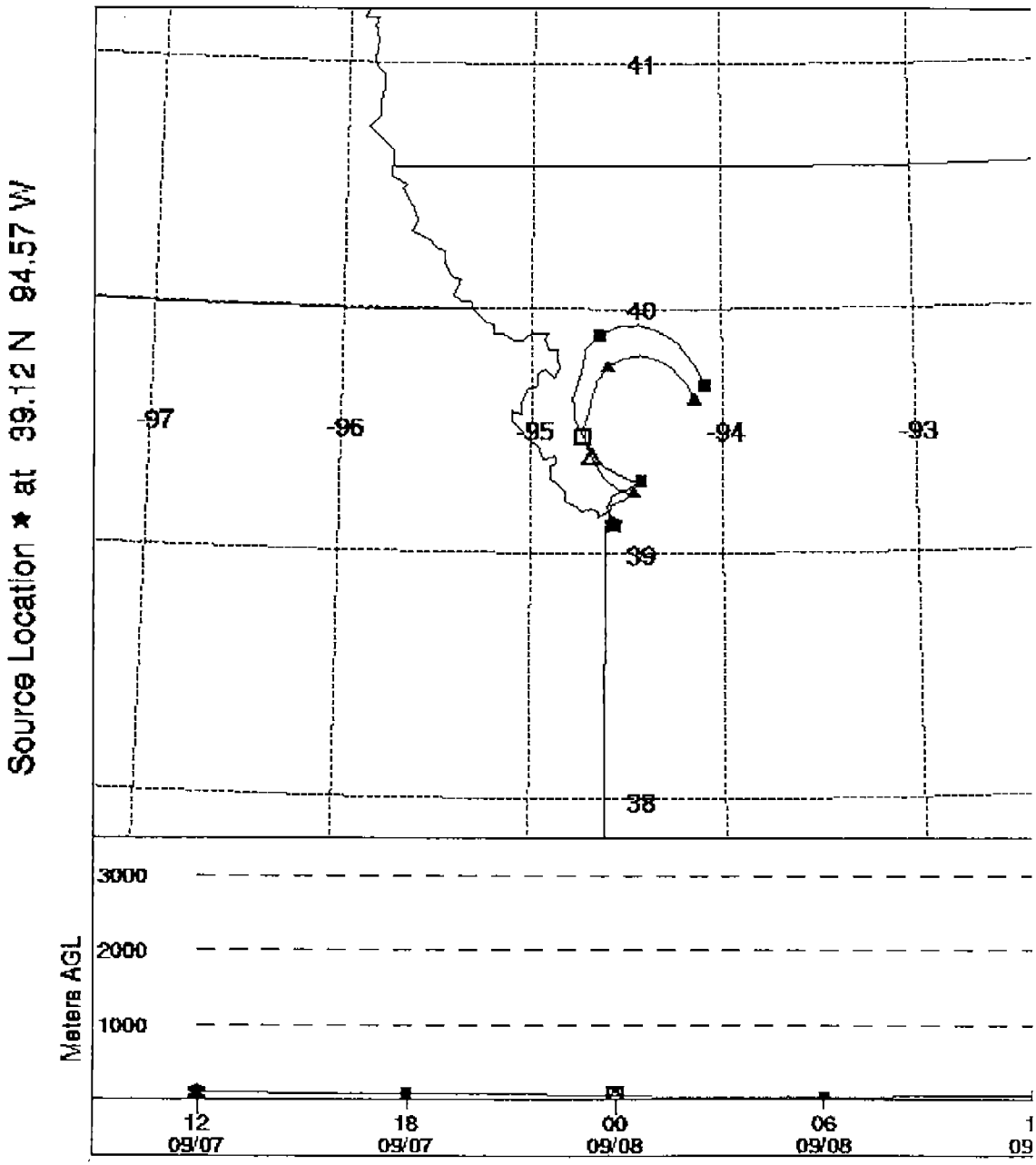
Wyandotte 99

NOAA AIR RESOURCES LABORATORY

Forward Trajectories Starting- 12 UTC 07 SEP 96



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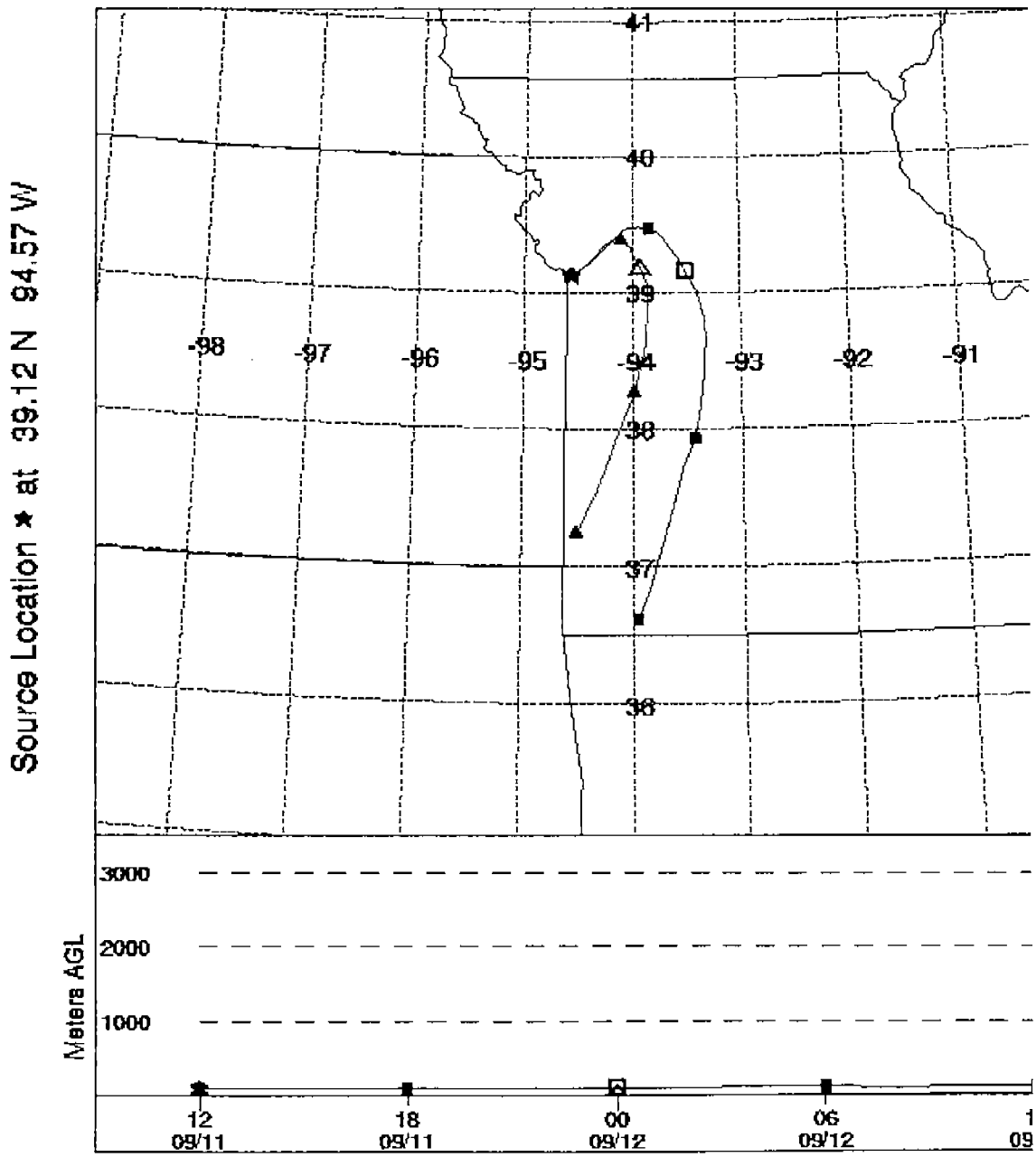
Miami Co. 90

NOAA AIR RESOURCES LABORATORY

Forward Trajectories Starting- 12 UTC 11 SEP 96



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Watkins Mill 85

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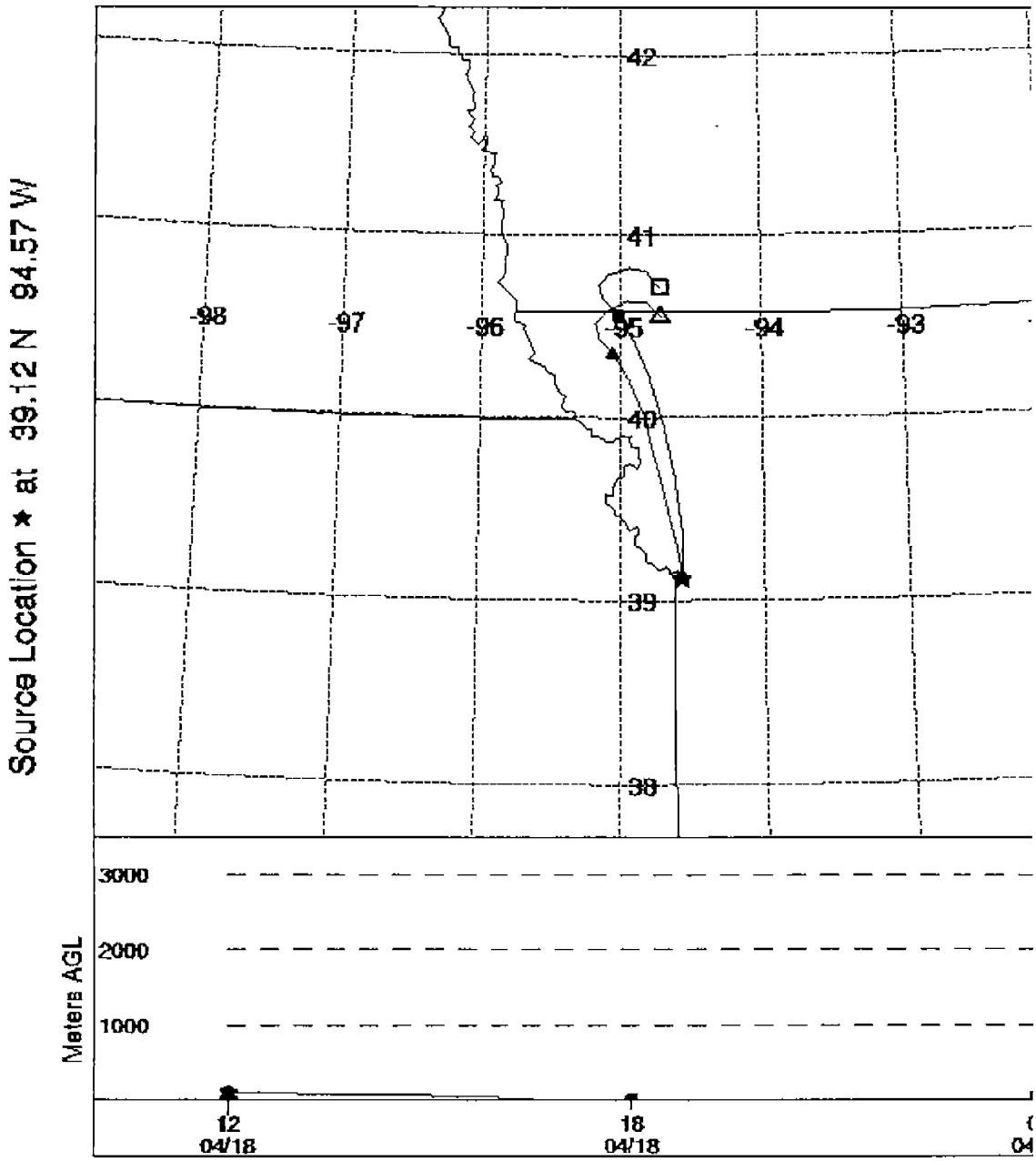
Forward Trajectories Starting- 12 UTC 18 APR 97



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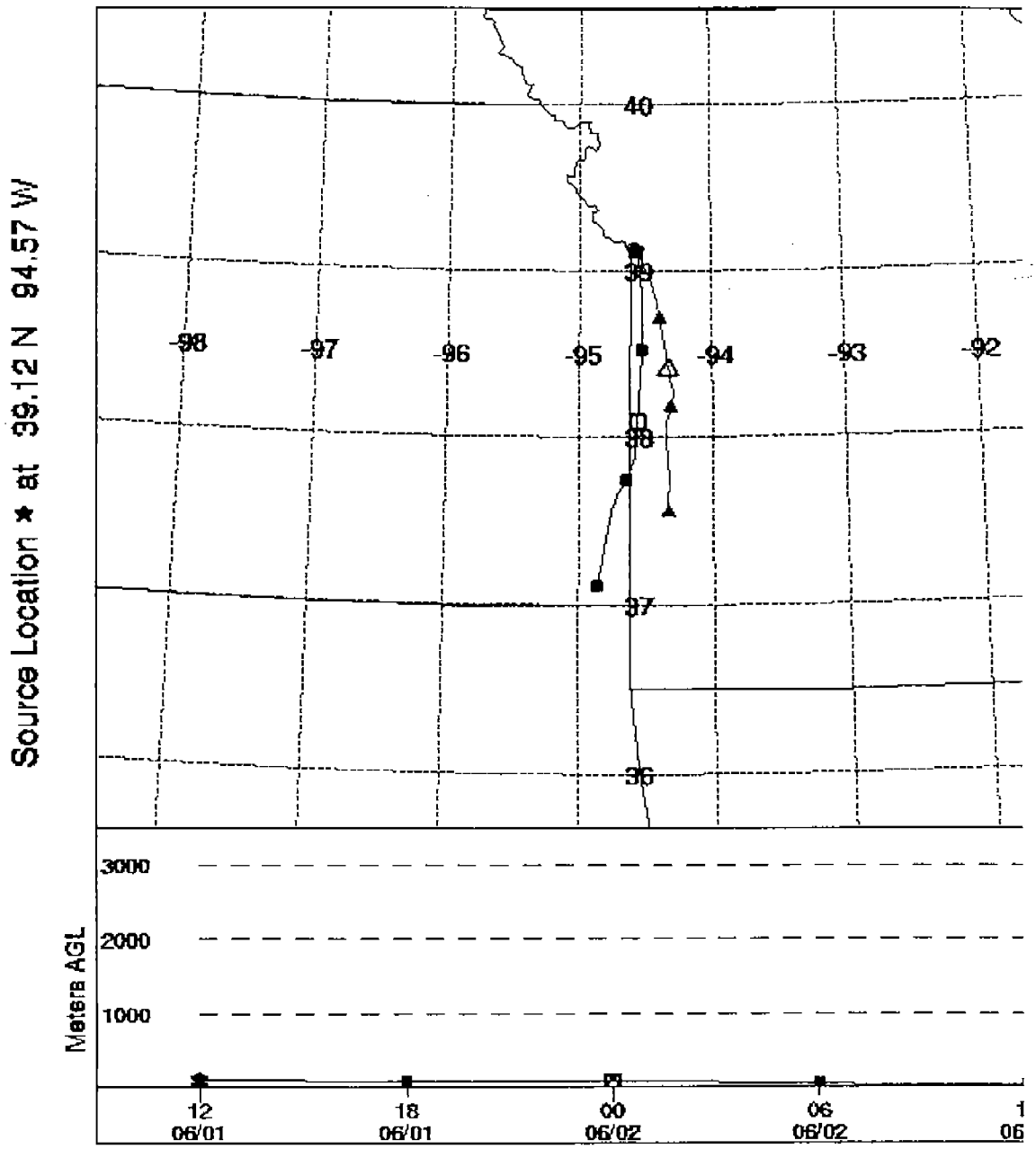
Wyandotte 93

NOAA AIR RESOURCES LABORATORY

Forward Trajectories Starting- 12 UTC 01 JUN 97



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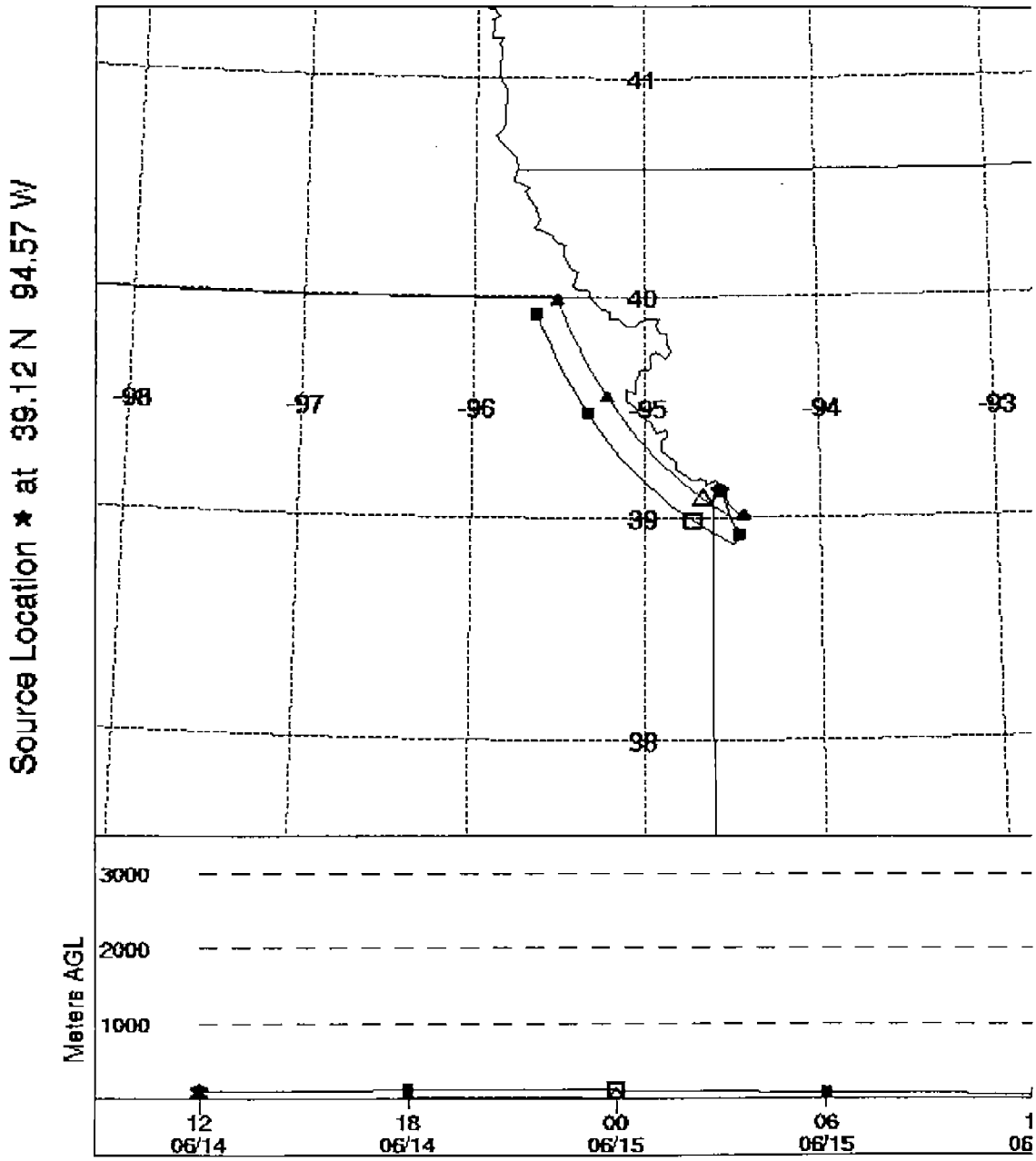
KCI 92
Wyandotte 89

NOAA AIR RESOURCES LABORATORY

Forward Trajectories Starting- 12 UTC 14 JUN 97



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KCI 89

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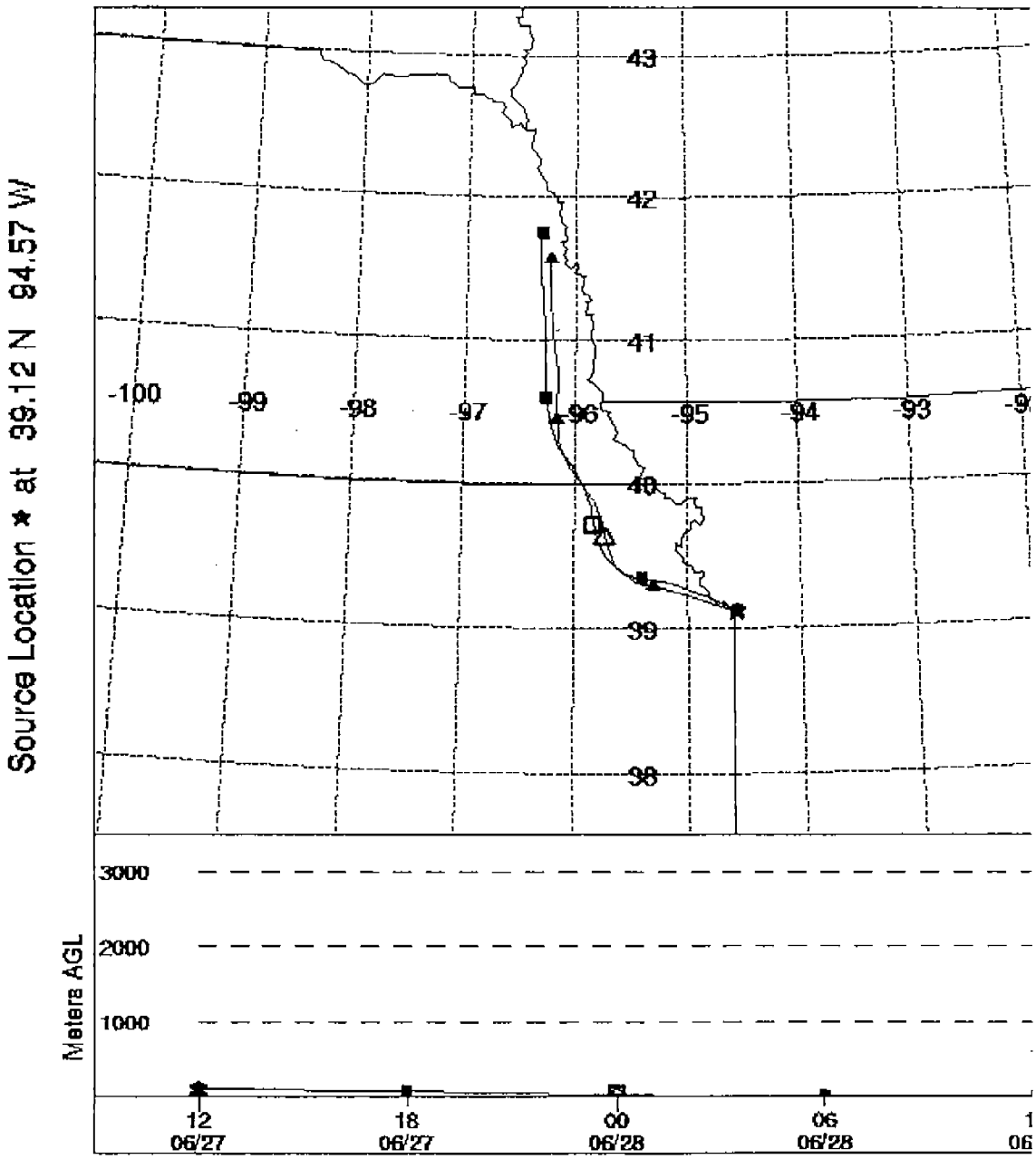
Forward Trajectories Starting- 12 UTC 27 JUN 97



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Liberty 97
Watkins Mill 96

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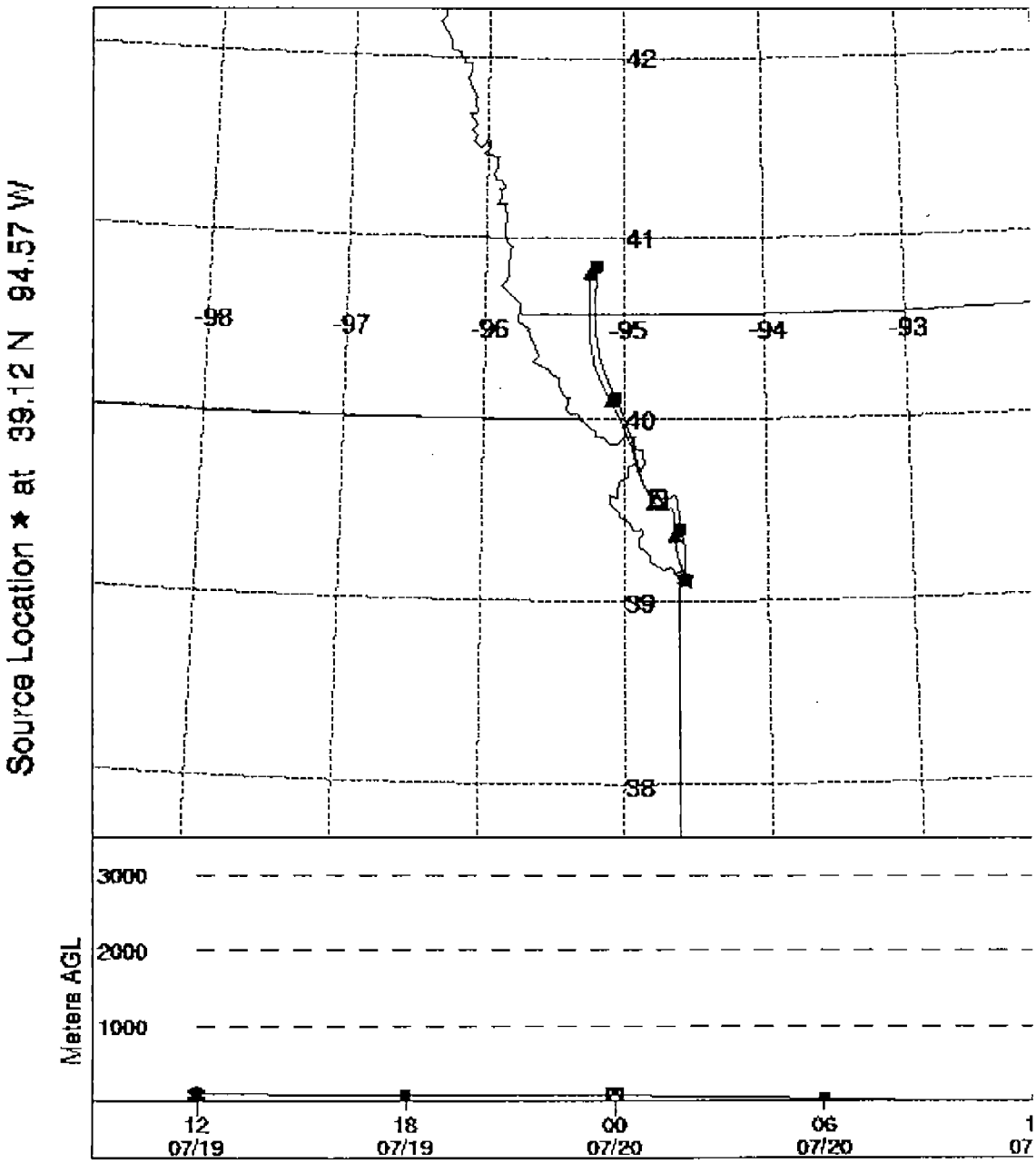
Forward Trajectories Starting- 12 UTC 19 JUL 97



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NOAA AIR RESOURCES LABORATORY

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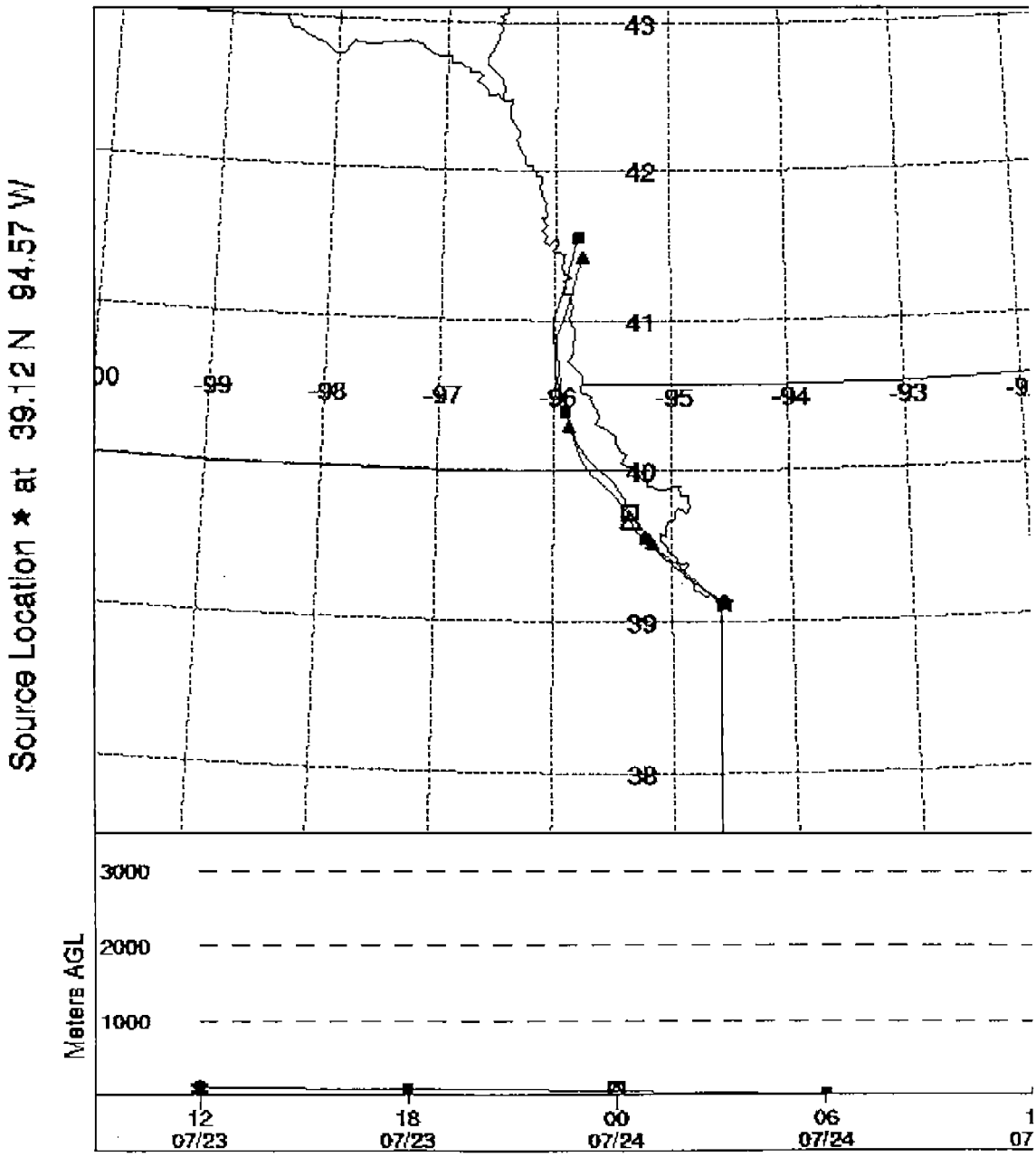

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Liberty 98
Watkins M.11 93

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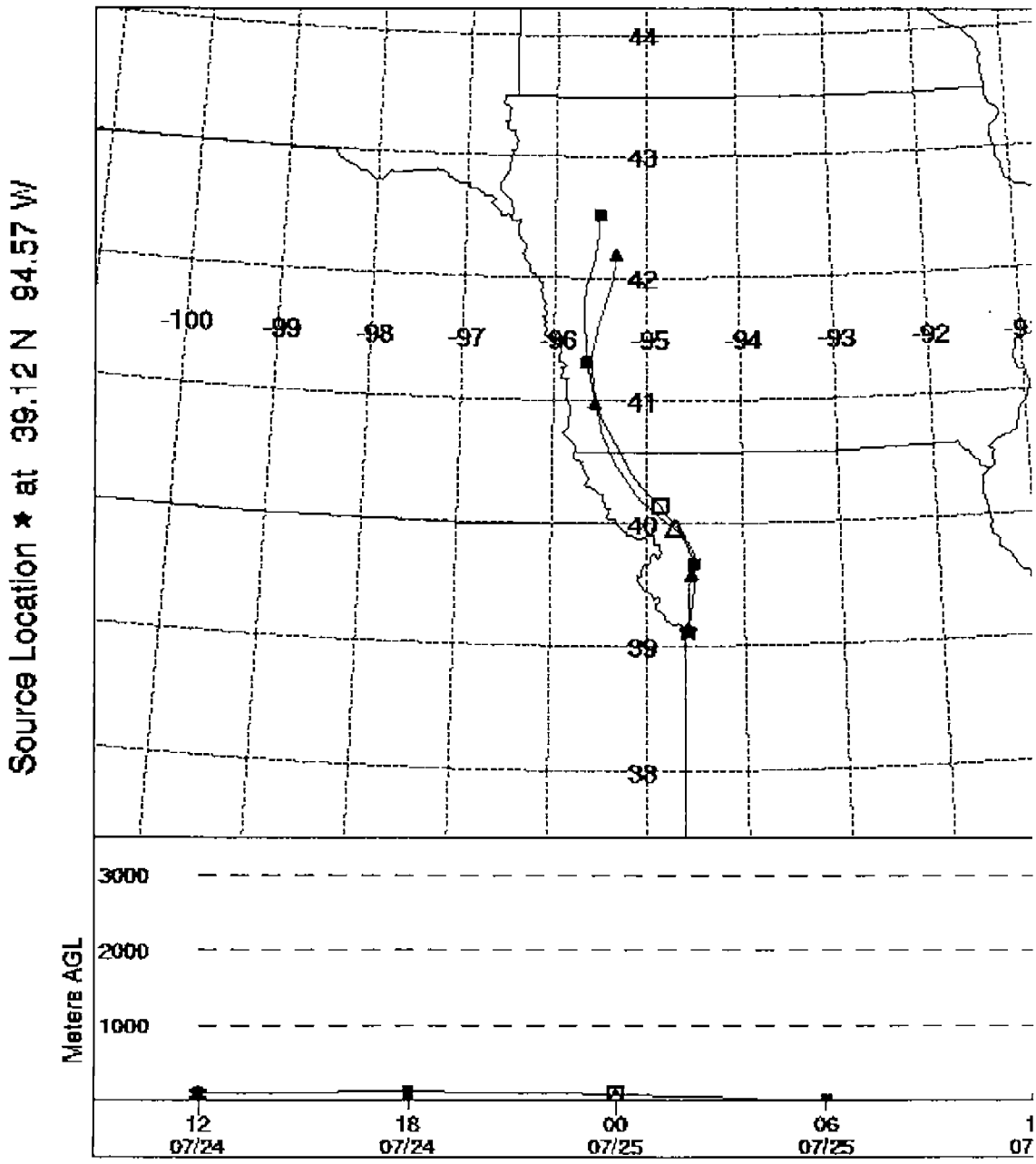
Forward Trajectories Starting- 12 UTC 24 JUL 97



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Watkins Mill 85
Liberty 85

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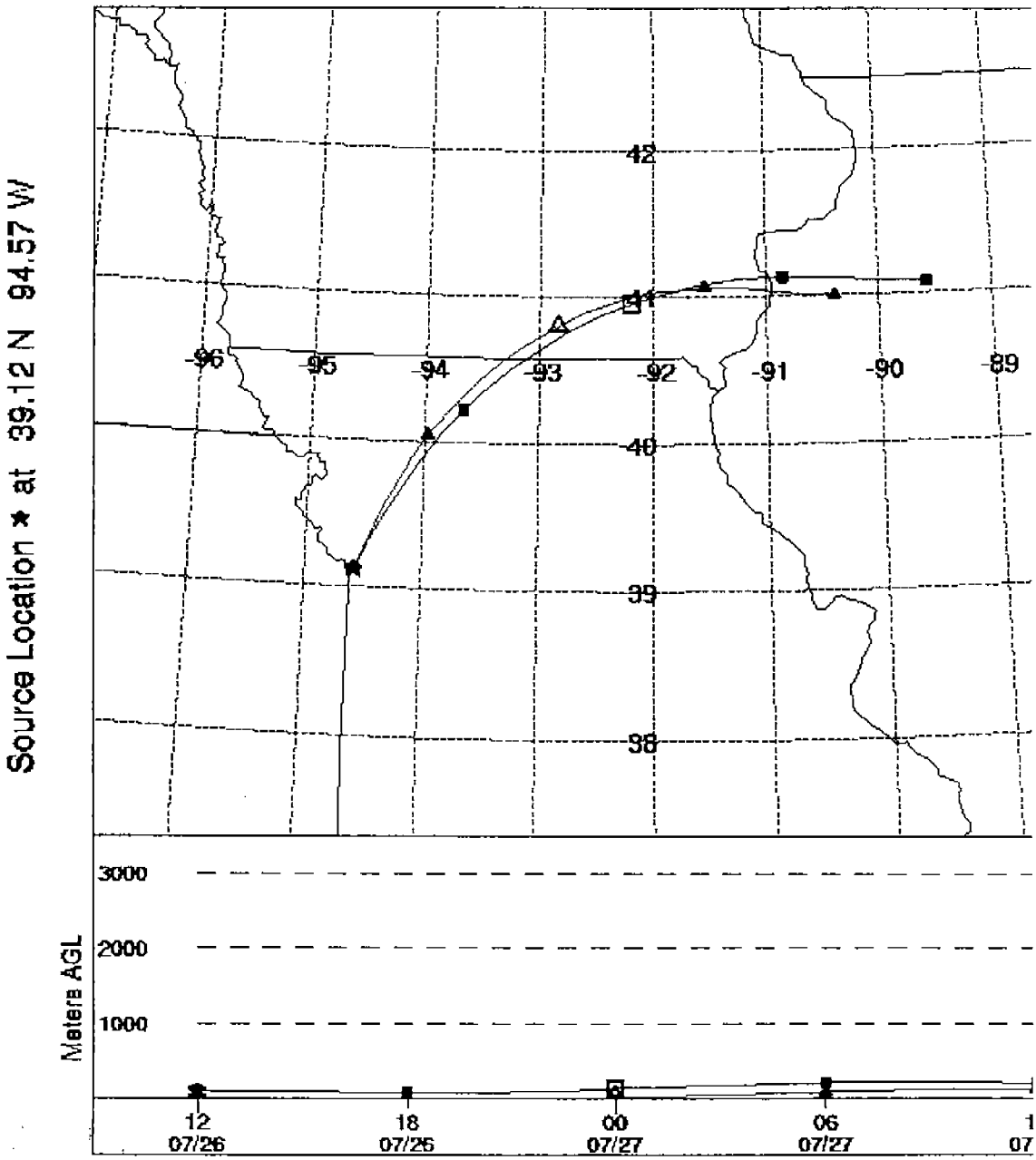
Forward Trajectories Starting- 12 UTC 26 JUL 97



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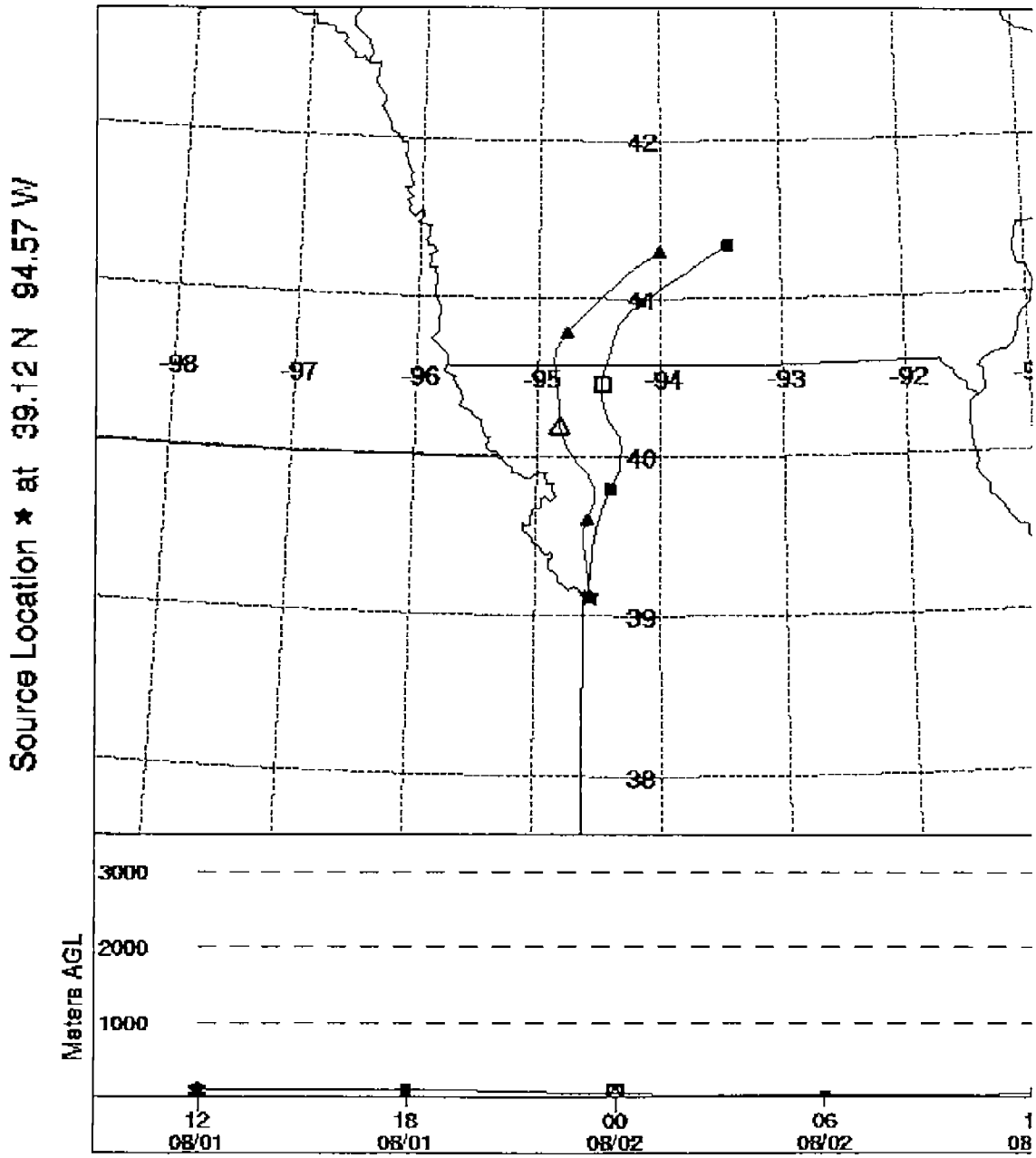
Liberty 111
Watkins Mill 107
Worlds of Fun 97
KCI 89

NOAA AIR RESOURCES LABORATORY

Forward Trajectories Starting- 12 UTC 01 AUG 97



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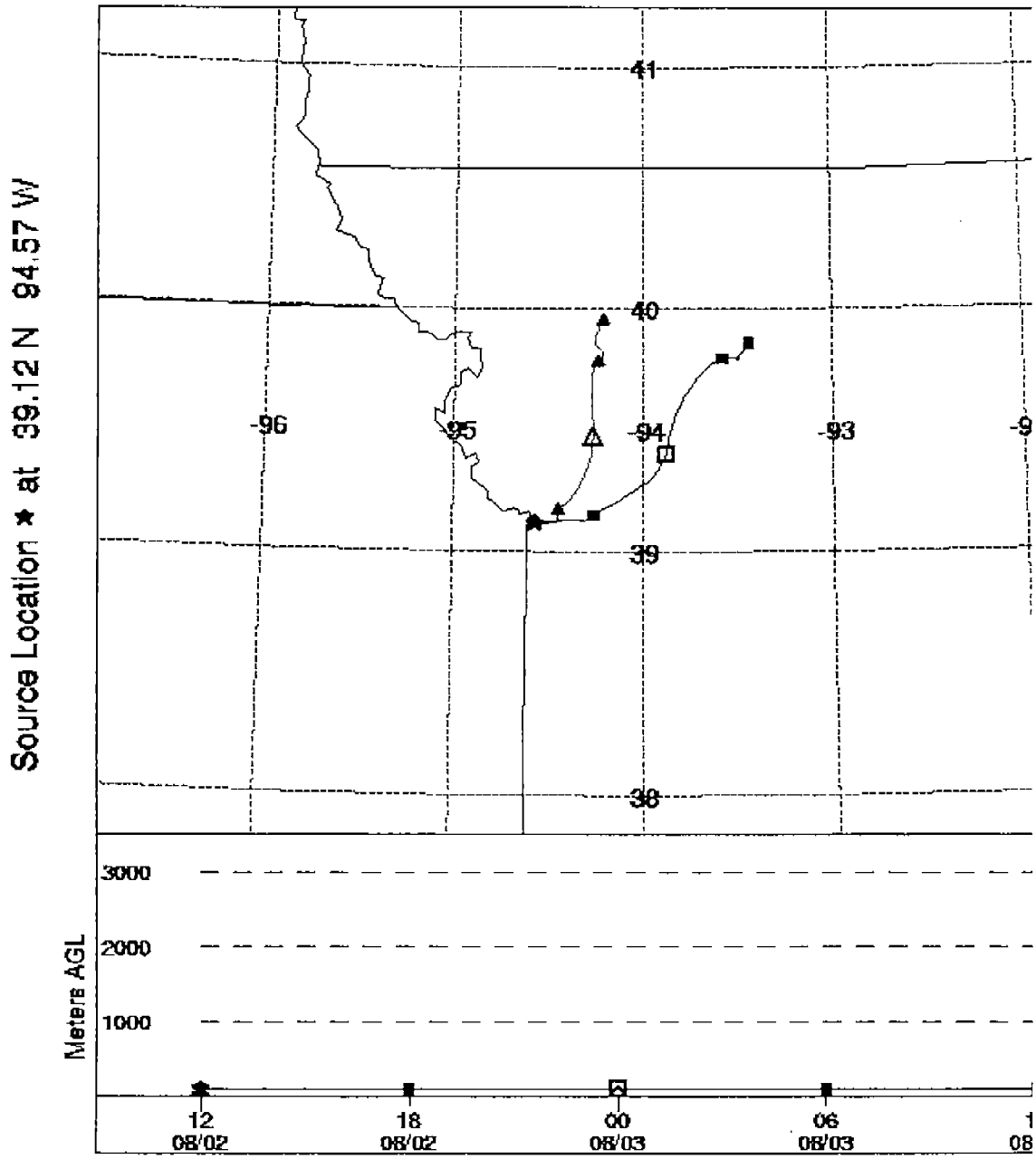
KCI 94
Liberty 88

NOAA AIR RESOURCES LABORATORY

Forward Trajectories Starting- 12 UTC 02 AUG 97



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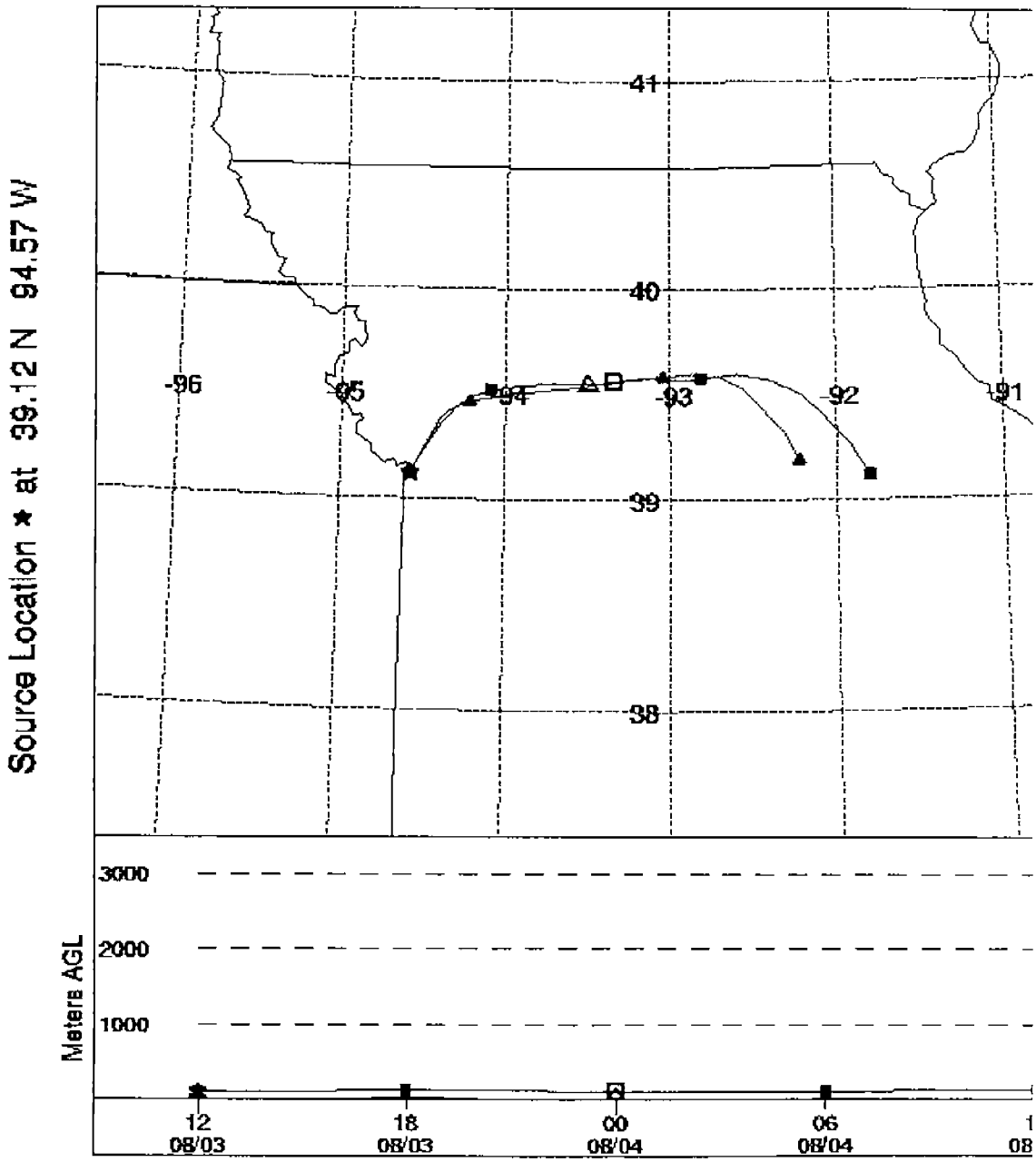
Liberty [redacted] 91

NOAA AIR RESOURCES LABORATORY

Forward Trajectories Starting- 12 UTC 03 AUG 97



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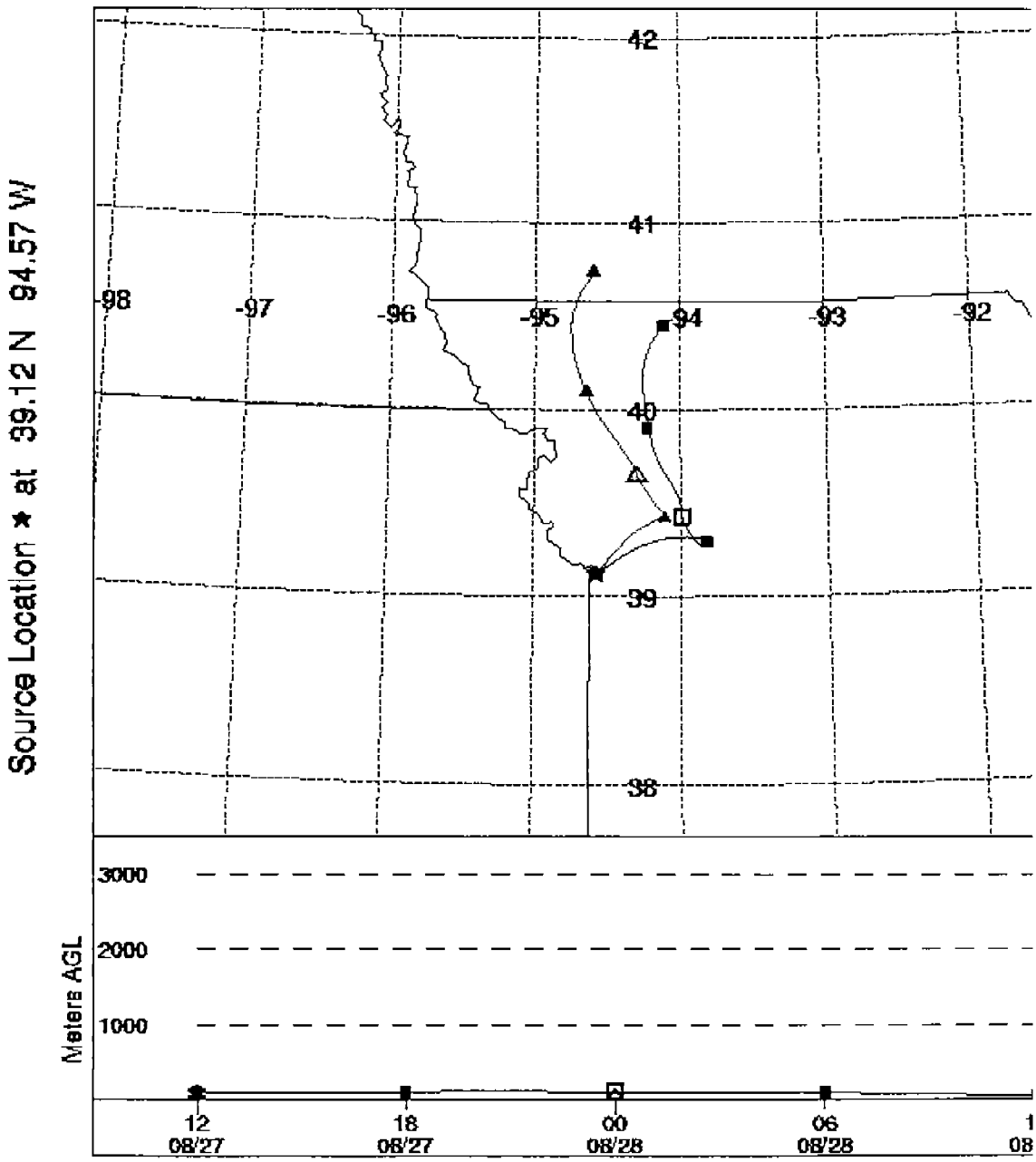
Liberty 99
Watkins Mill 95
Worlds of Fun 89

NOAA AIR RESOURCES LABORATORY

Forward Trajectories Starting- 12 UTC 27 AUG 97



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Liberty 102
Wetlands Mill 98
Worlds of Fun 88

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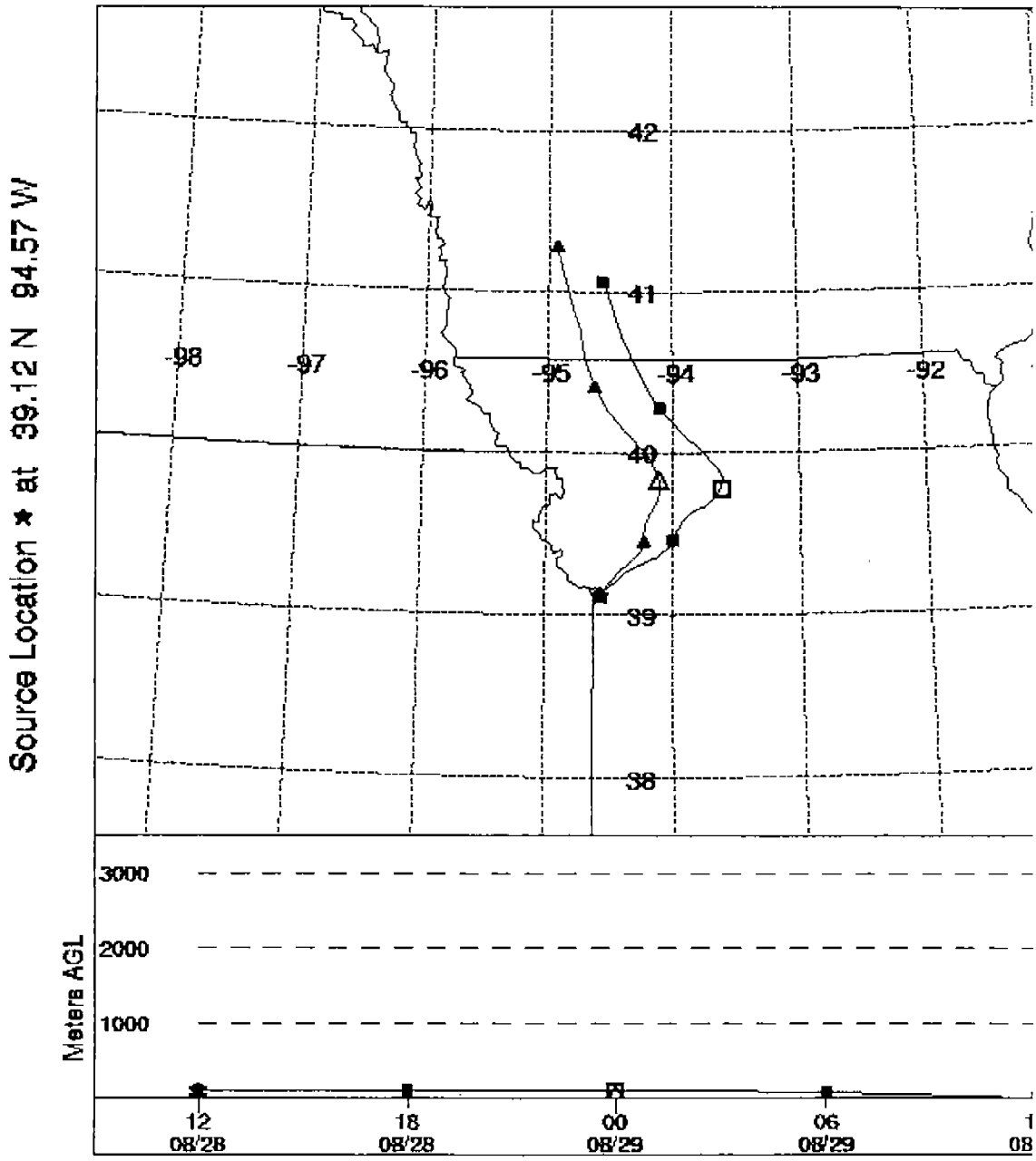
Forward Trajectories Starting- 12 UTC 28 AUG 97



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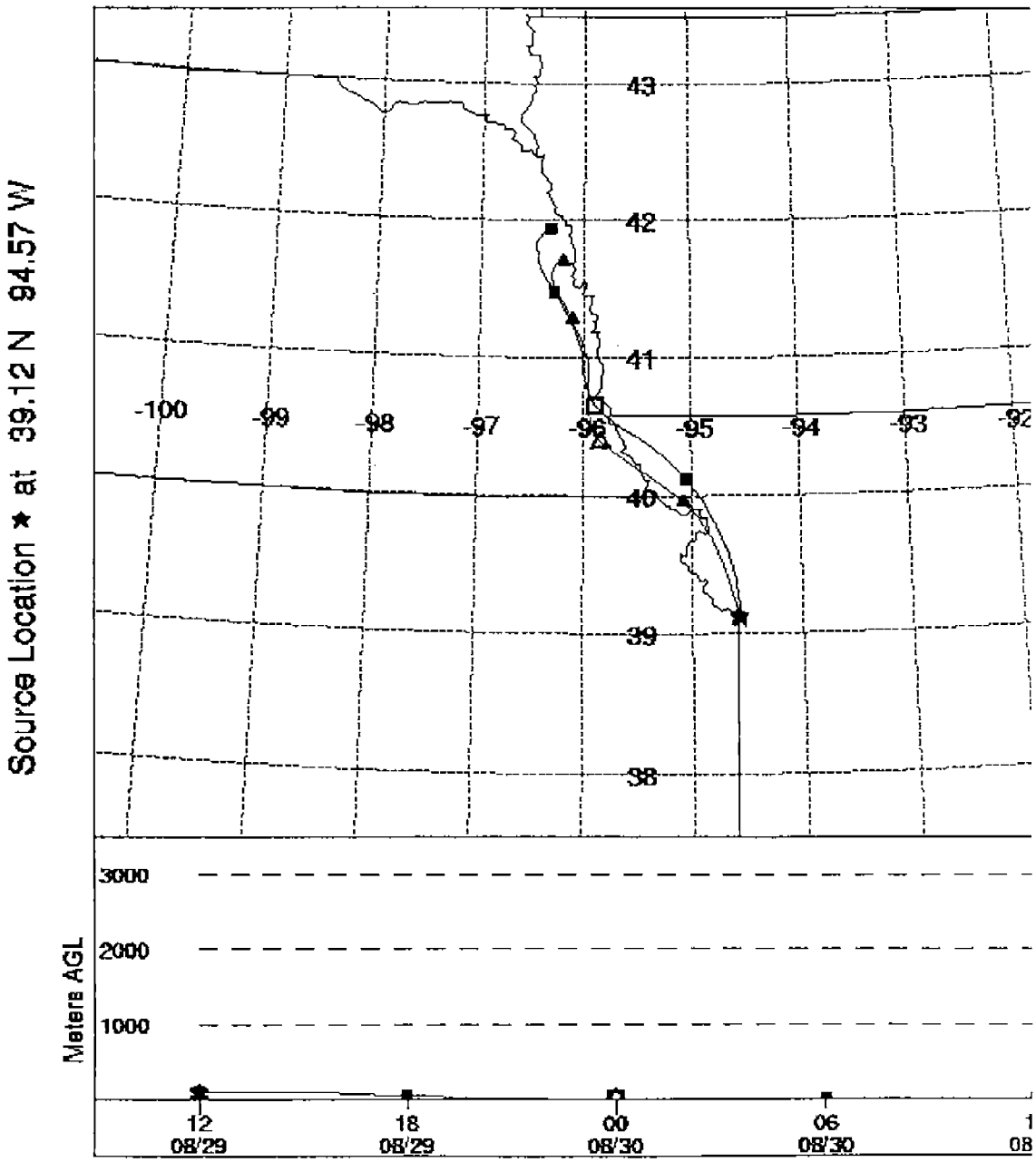
Liberty 85

NOAA AIR RESOURCES LABORATORY

Forward Trajectories Starting- 12 UTC 29 AUG 97



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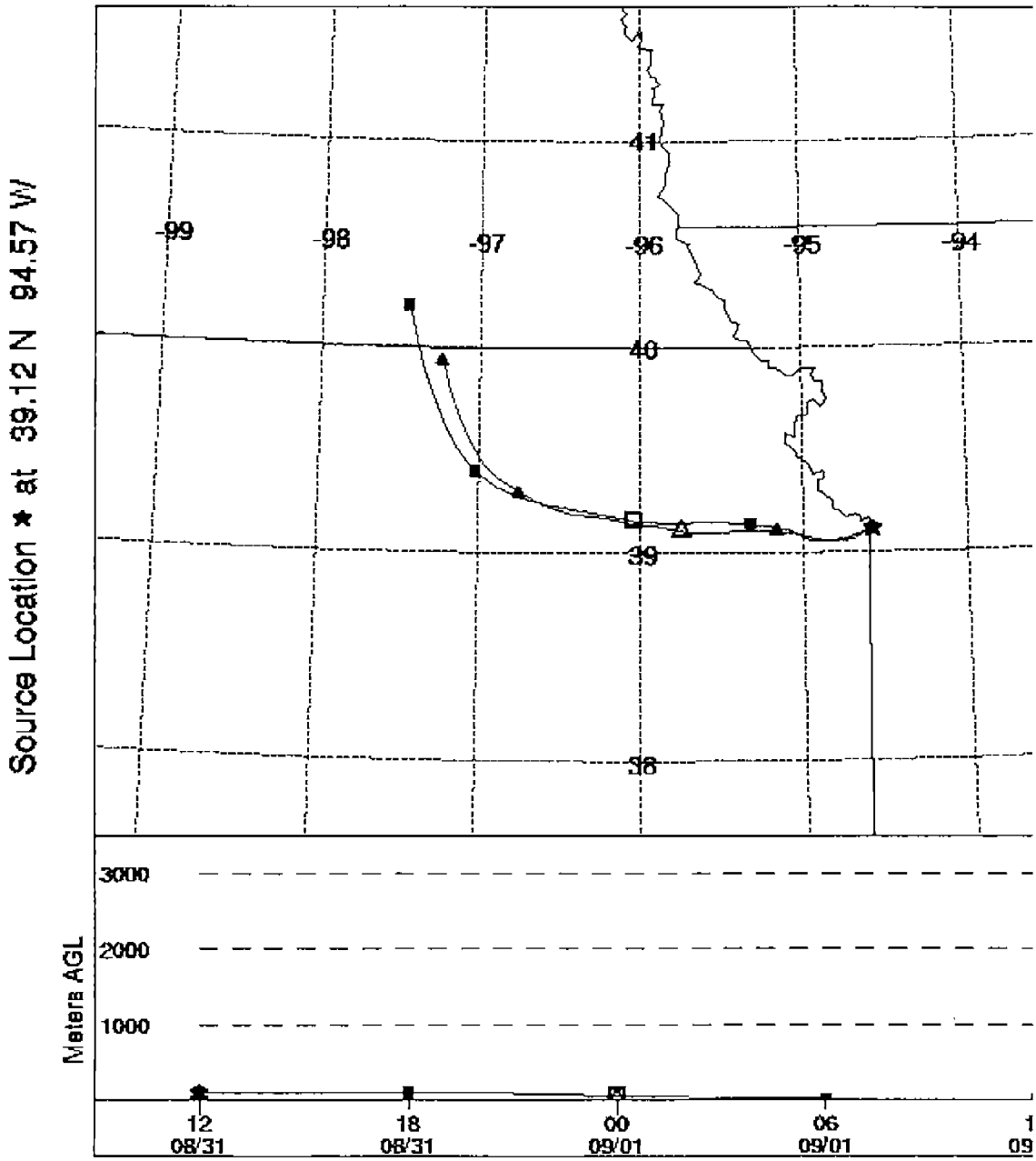
KCI 90

NOAA AIR RESOURCES LABORATORY

Forward Trajectories Starting- 12 UTC 31 AUG 97



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Liberty 88
Watkins Mill 87

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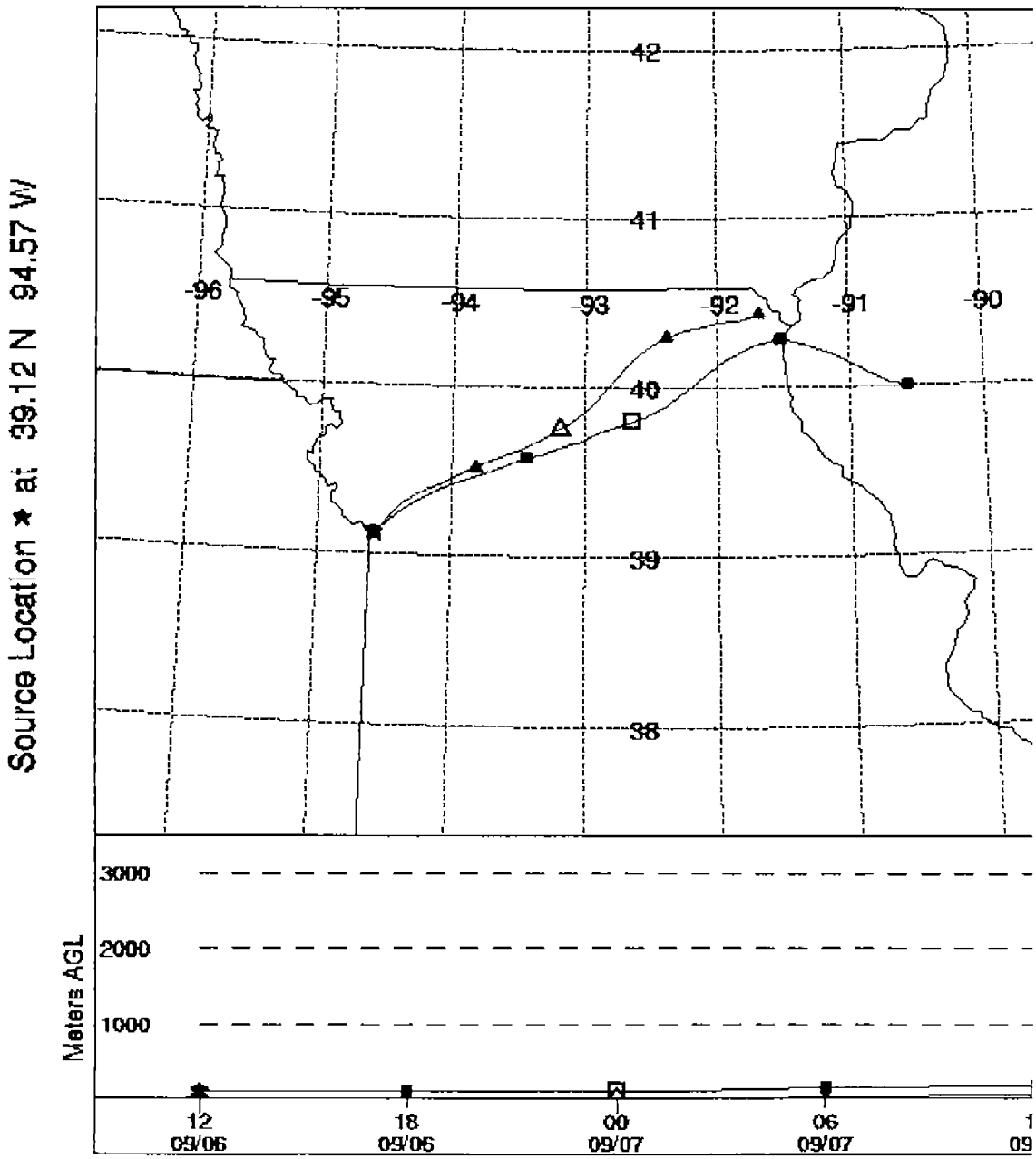
Forward Trajectories Starting- 12 UTC 06 SEP 97



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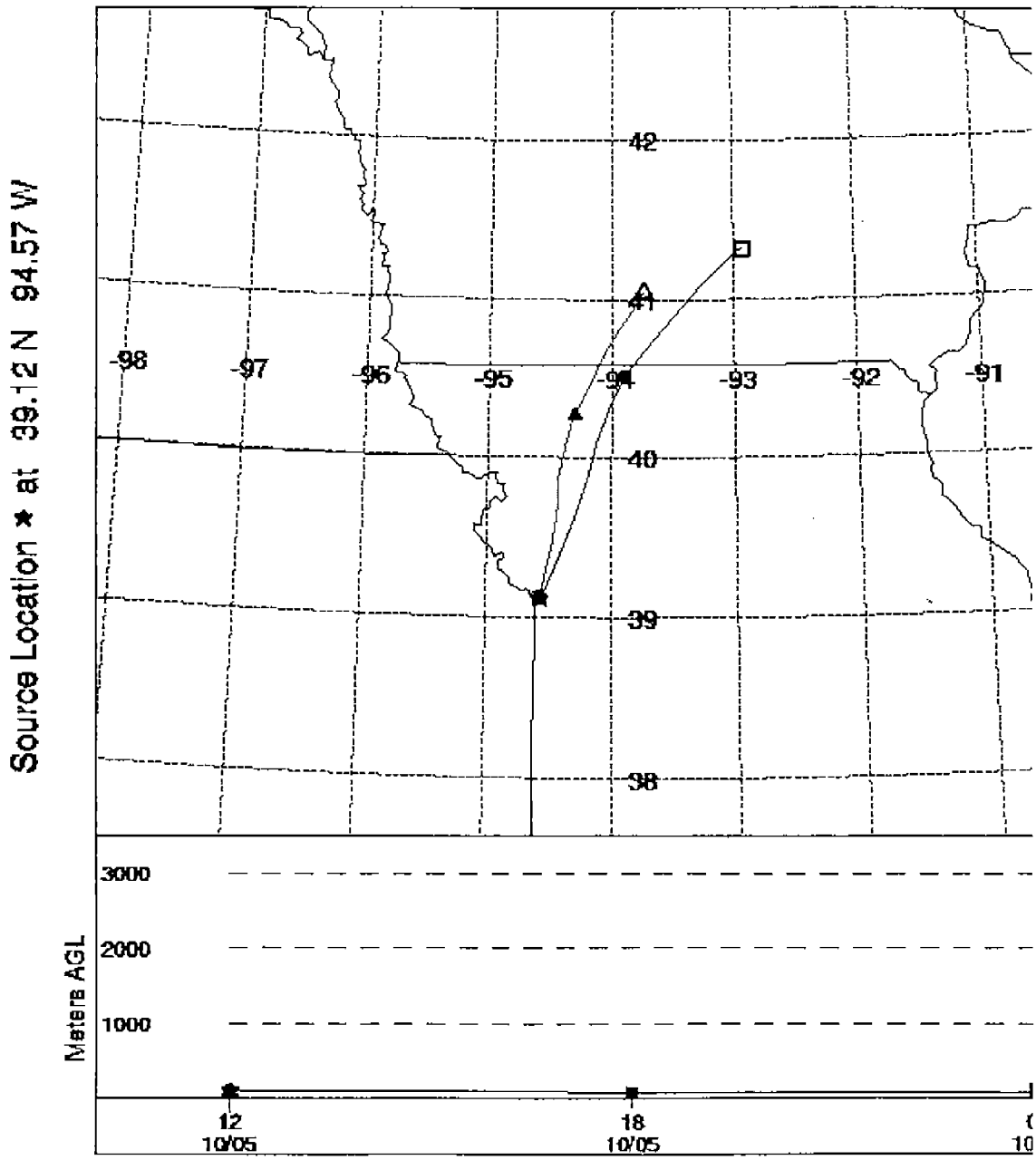
Watkins Mill 88
Liberty 86

NOAA AIR RESOURCES LABORATORY

Forward Trajectories Starting- 12 UTC 05 OCT 97



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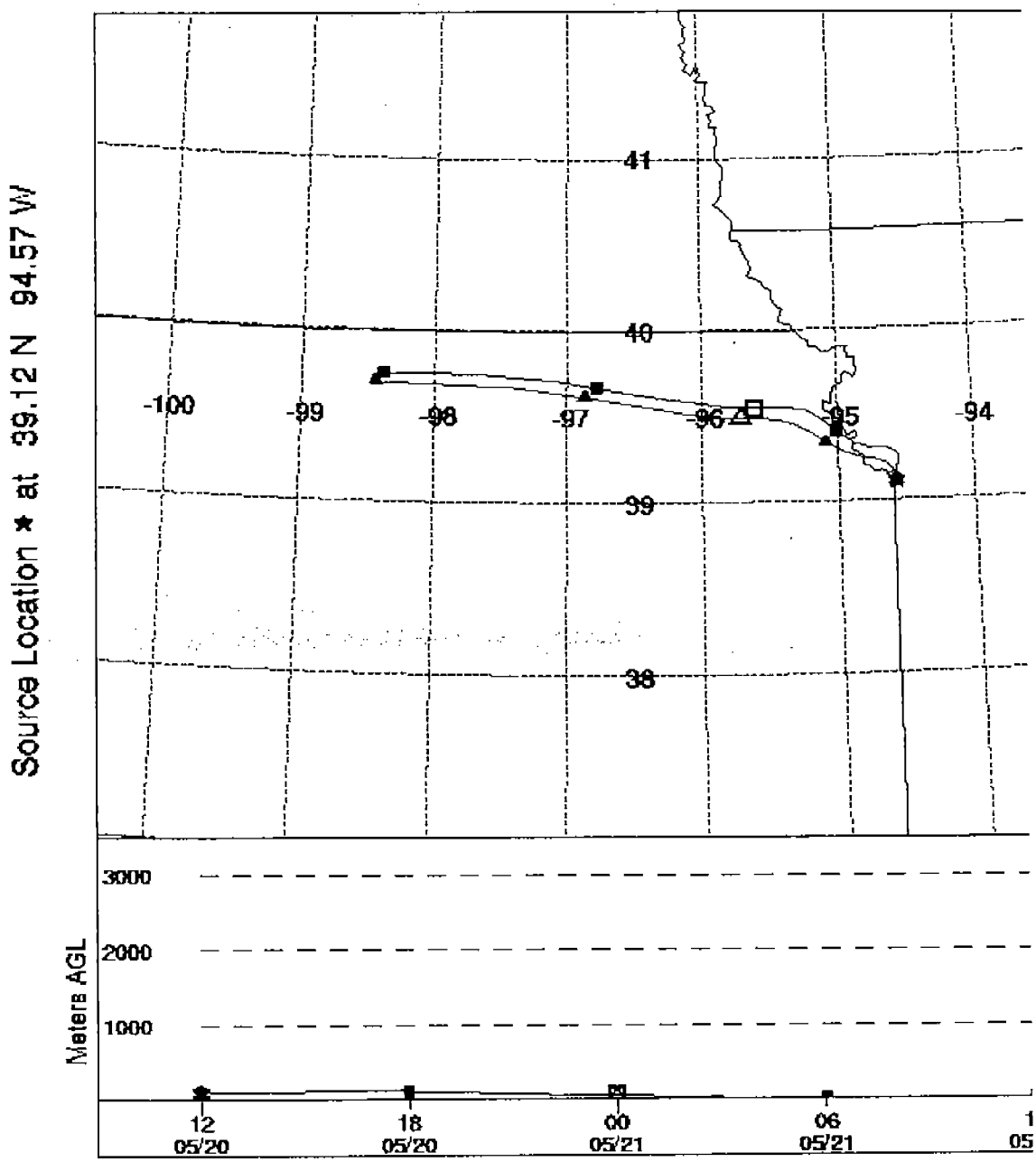
KCI 91
Liberty 85

NOAA AIR RESOURCES LABORATORY

Forward Trajectories Starting- 12 UTC 20 MAY 98



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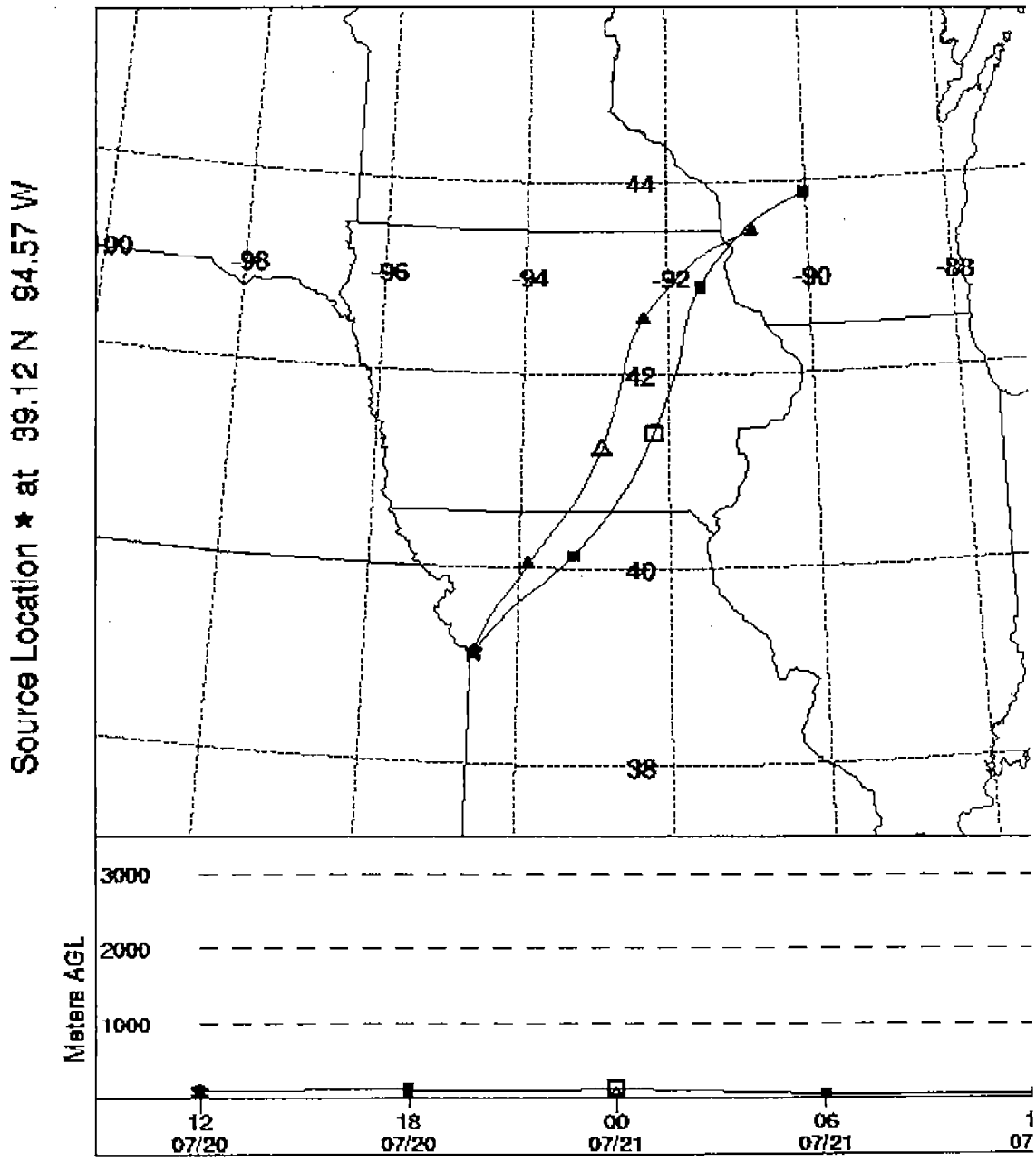
Watkins M.11 85

NOAA AIR RESOURCES LABORATORY

Forward Trajectories Starting- 12 UTC 20 JUL 98



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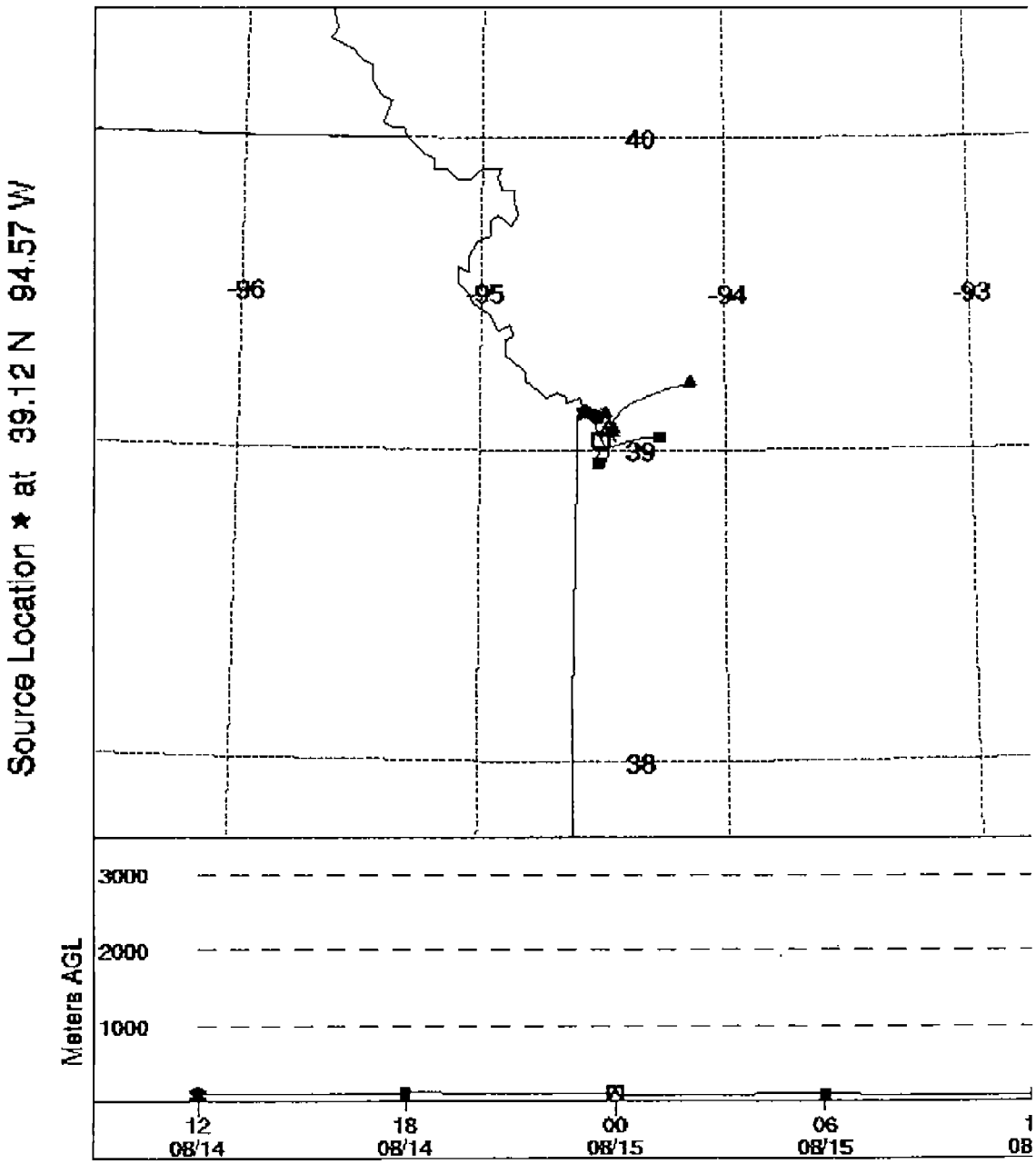
Worlds of Fun 91
Liberty 90
(Wyandotte 94)

NOAA AIR RESOURCES LABORATORY

Forward Trajectories Starting- 12 UTC 14 AUG 98



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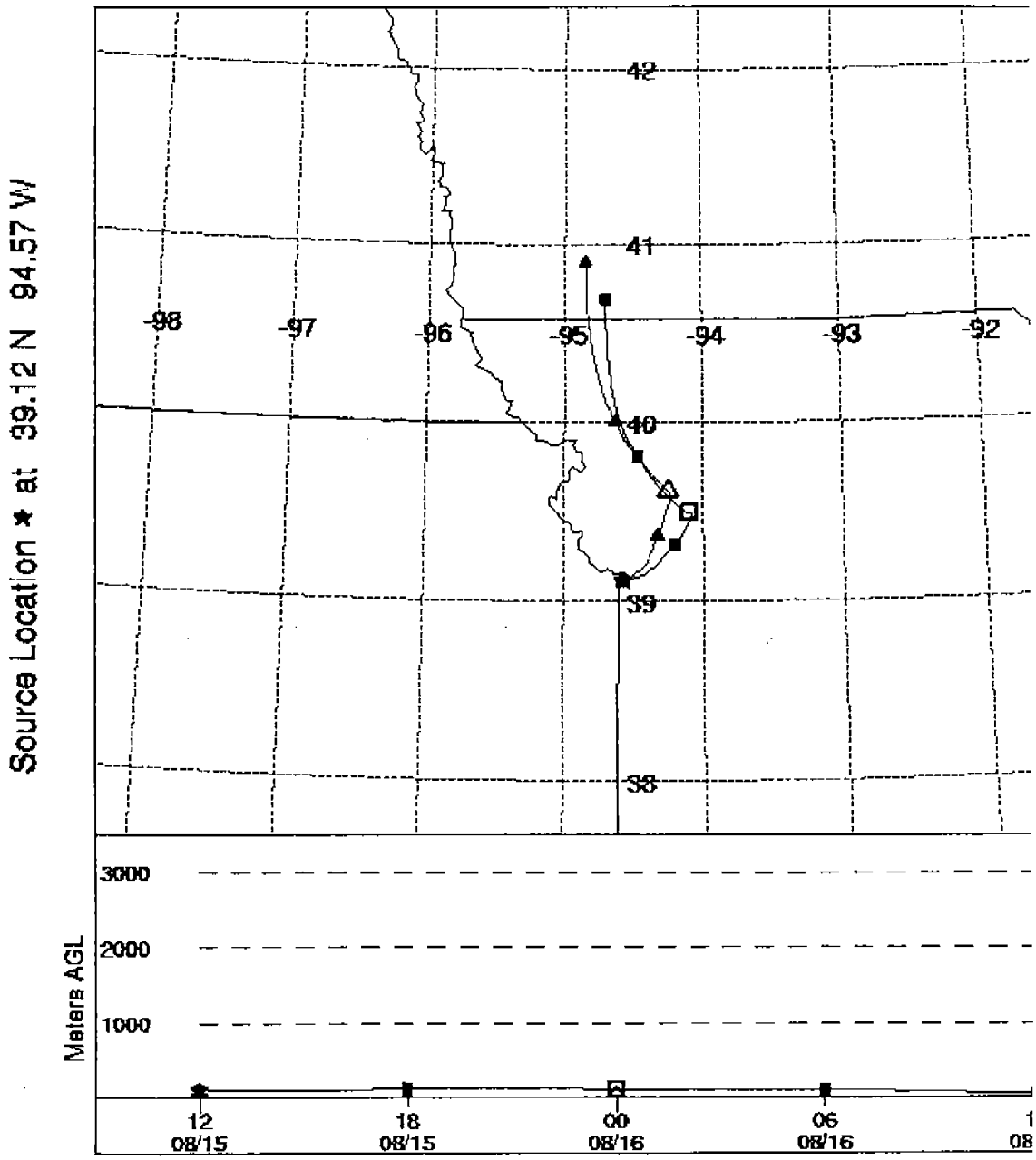
Liberty 103
Worlds of Fun 91
Watkins Mill 91
Wyandotte 89
KCI 89

NOAA AIR RESOURCES LABORATORY

Forward Trajectories Starting- 12 UTC 15 AUG 98



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Watkins Mill 88
Liberty 86

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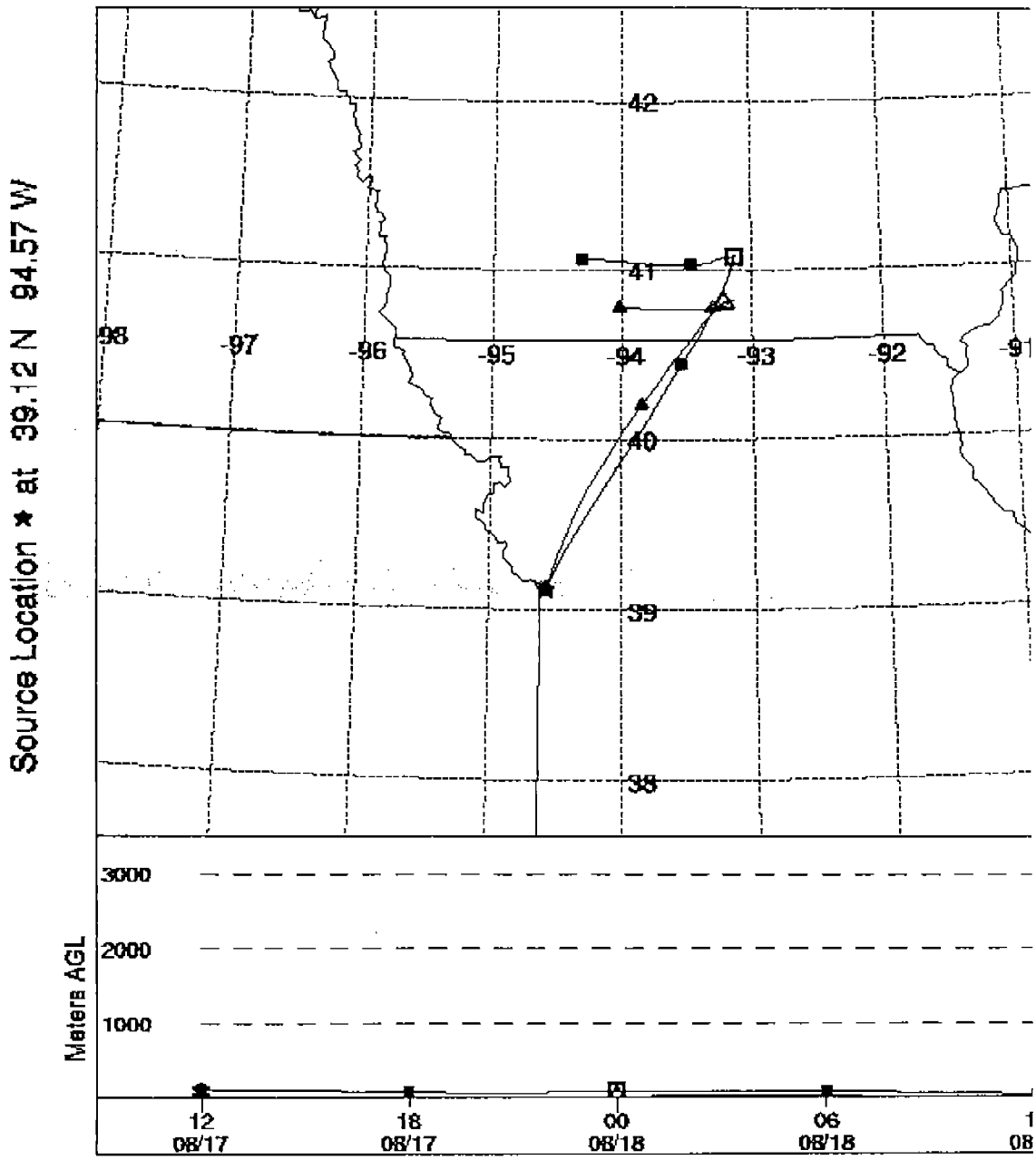
Forward Trajectories Starting- 12 UTC 17 AUG 98



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Liberty 94
Watkins Mill 91
Worlds of Fun 85

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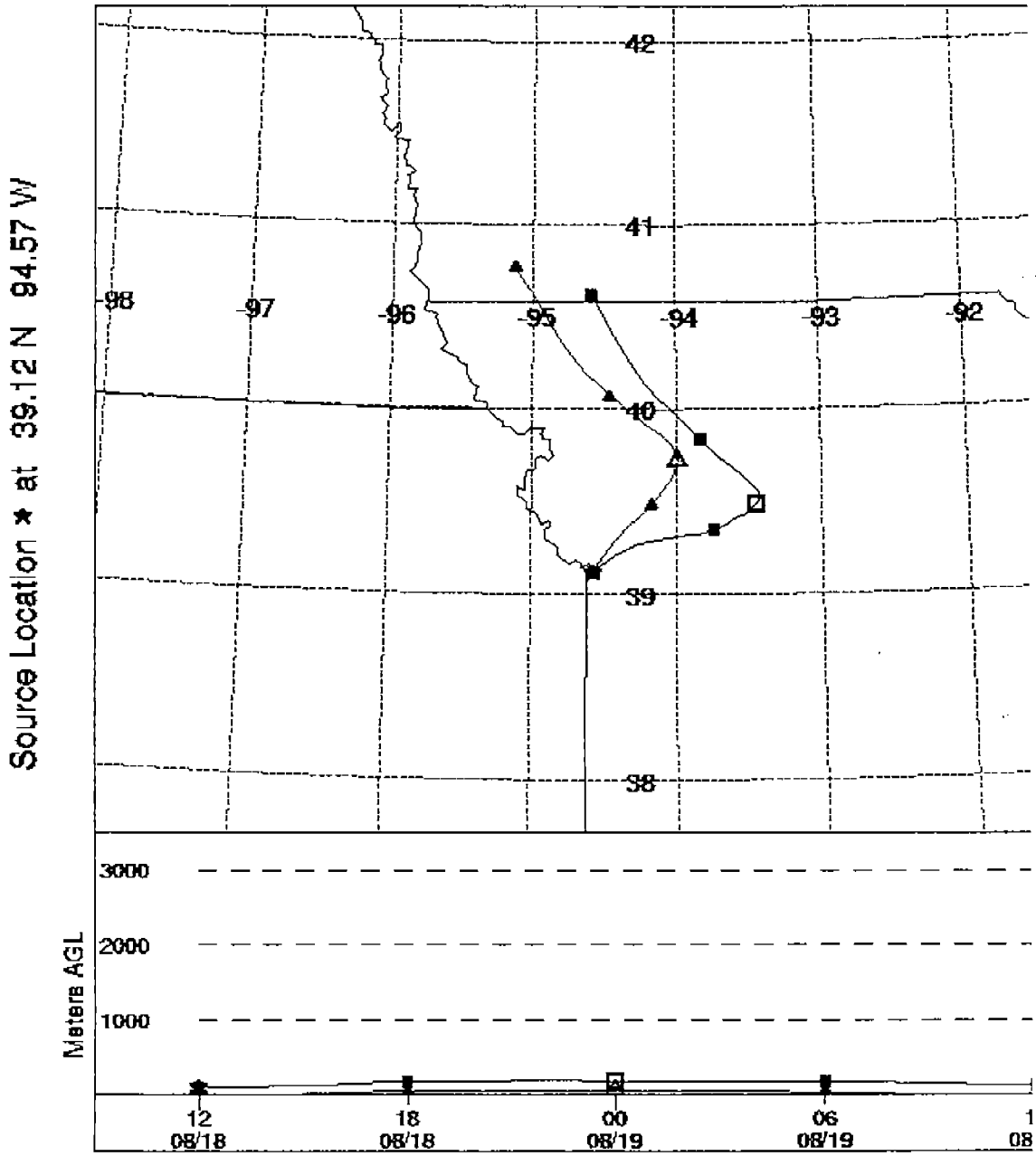
Forward Trajectories Starting- 12 UTC 18 AUG 98



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KCI 91
Wyandotte 91

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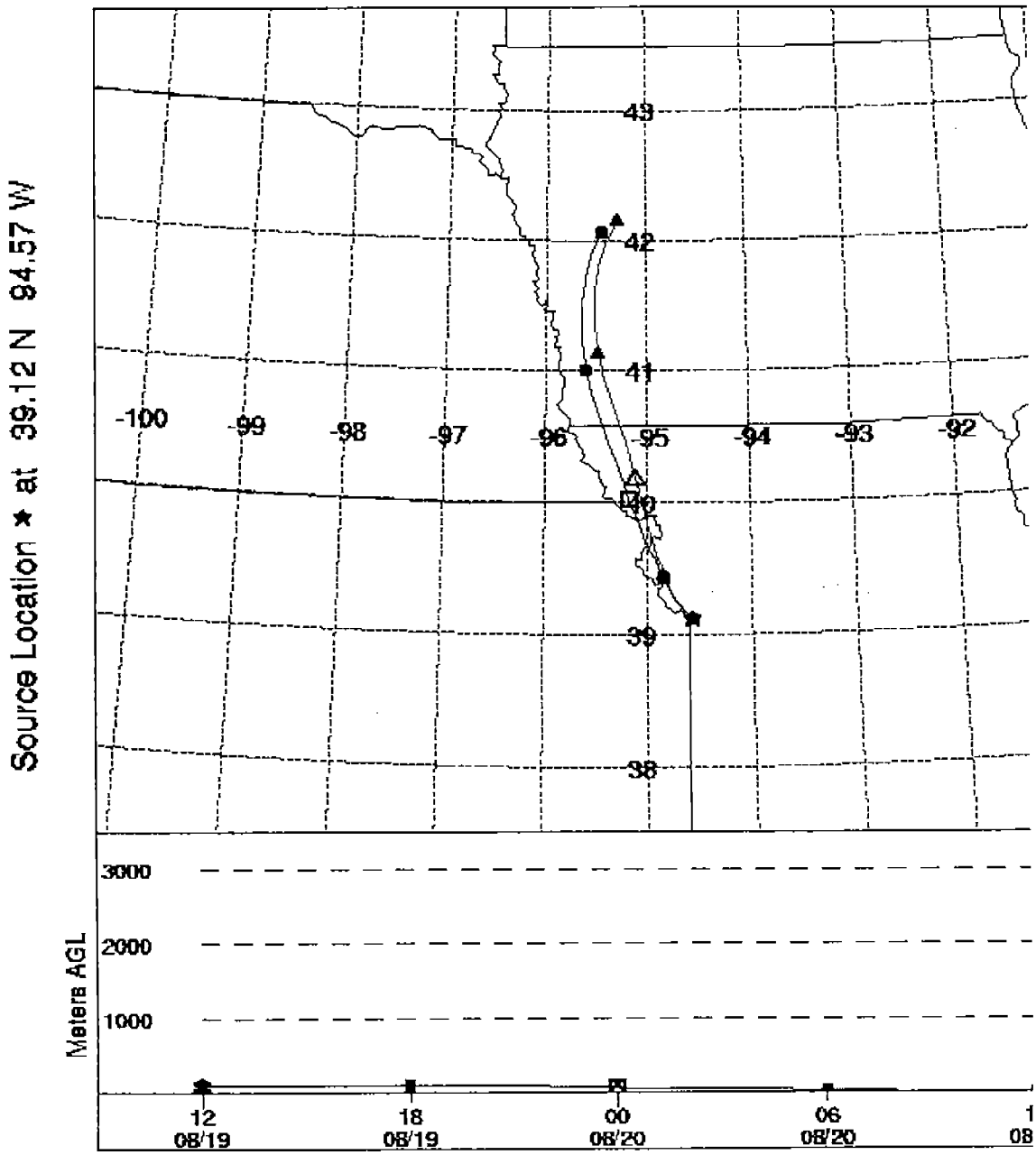
Forward Trajectories Starting- 12 UTC 19 AUG 98



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KCI 90
Wyandotte 86

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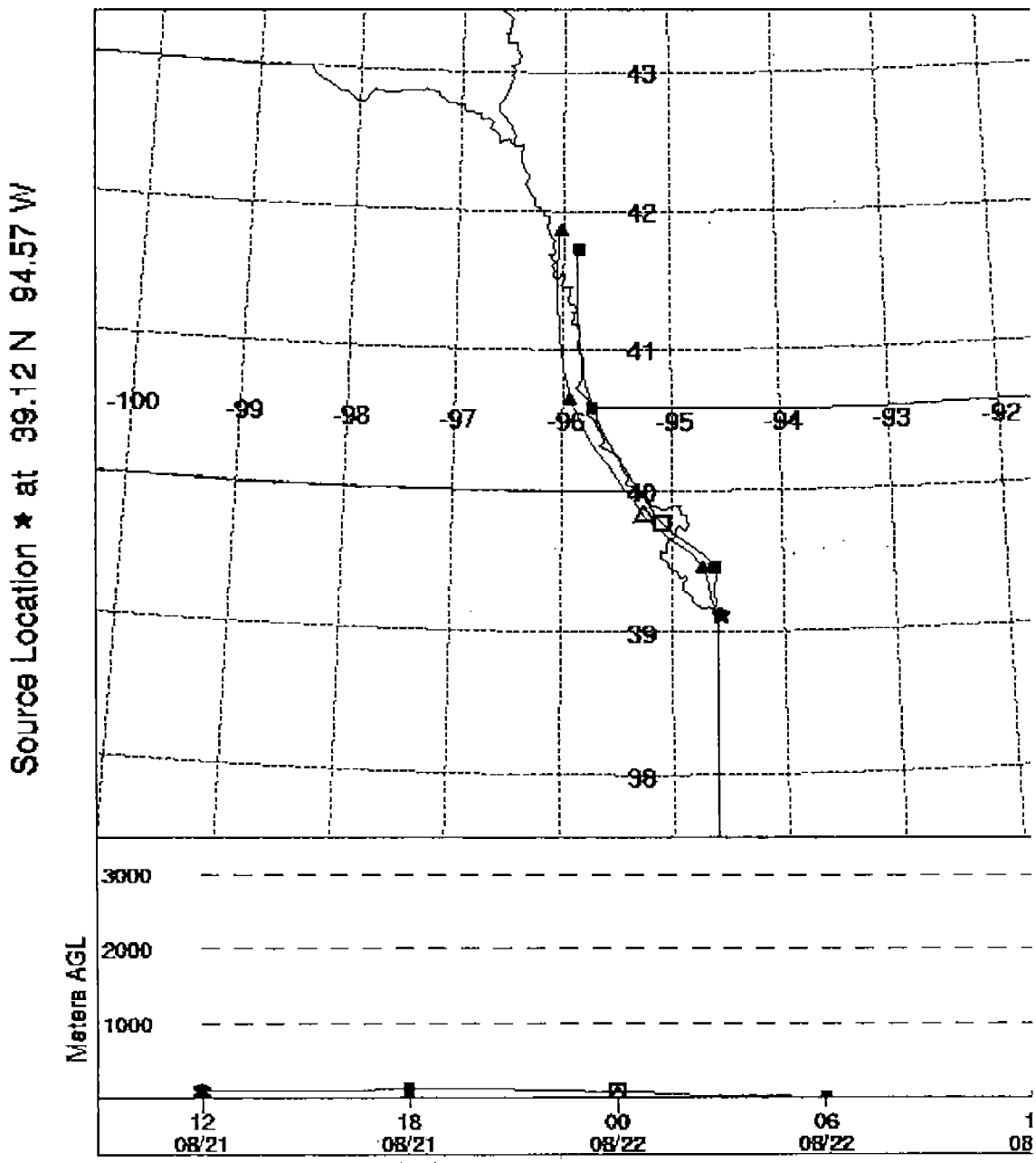
Forward Trajectories Starting- 12 UTC 21 AUG 98



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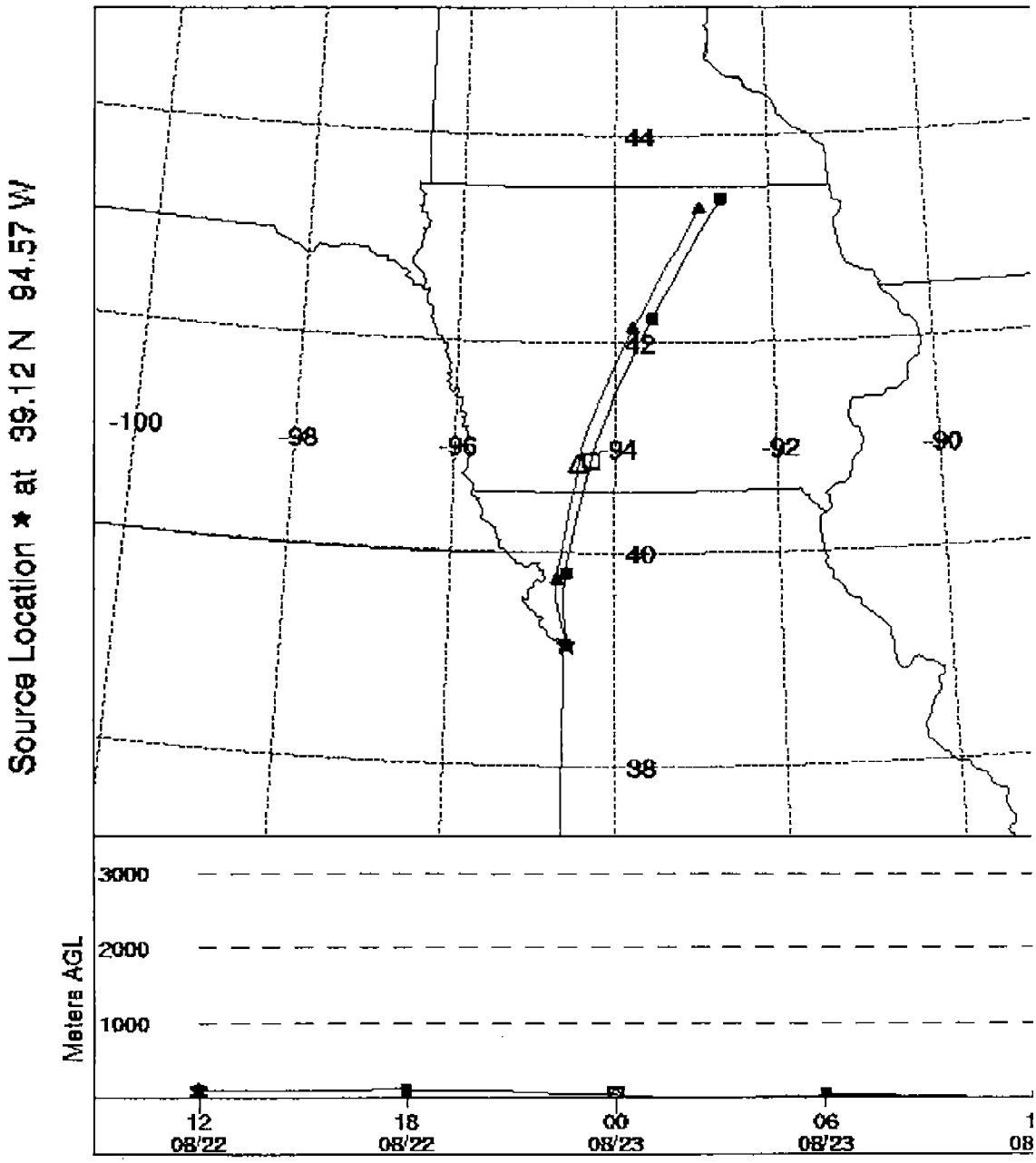
Liberty 95
Watkins Mill 93
Worlds of Fun 86

NOAA AIR RESOURCES LABORATORY

Forward Trajectories Starting- 12 UTC 22 AUG 98



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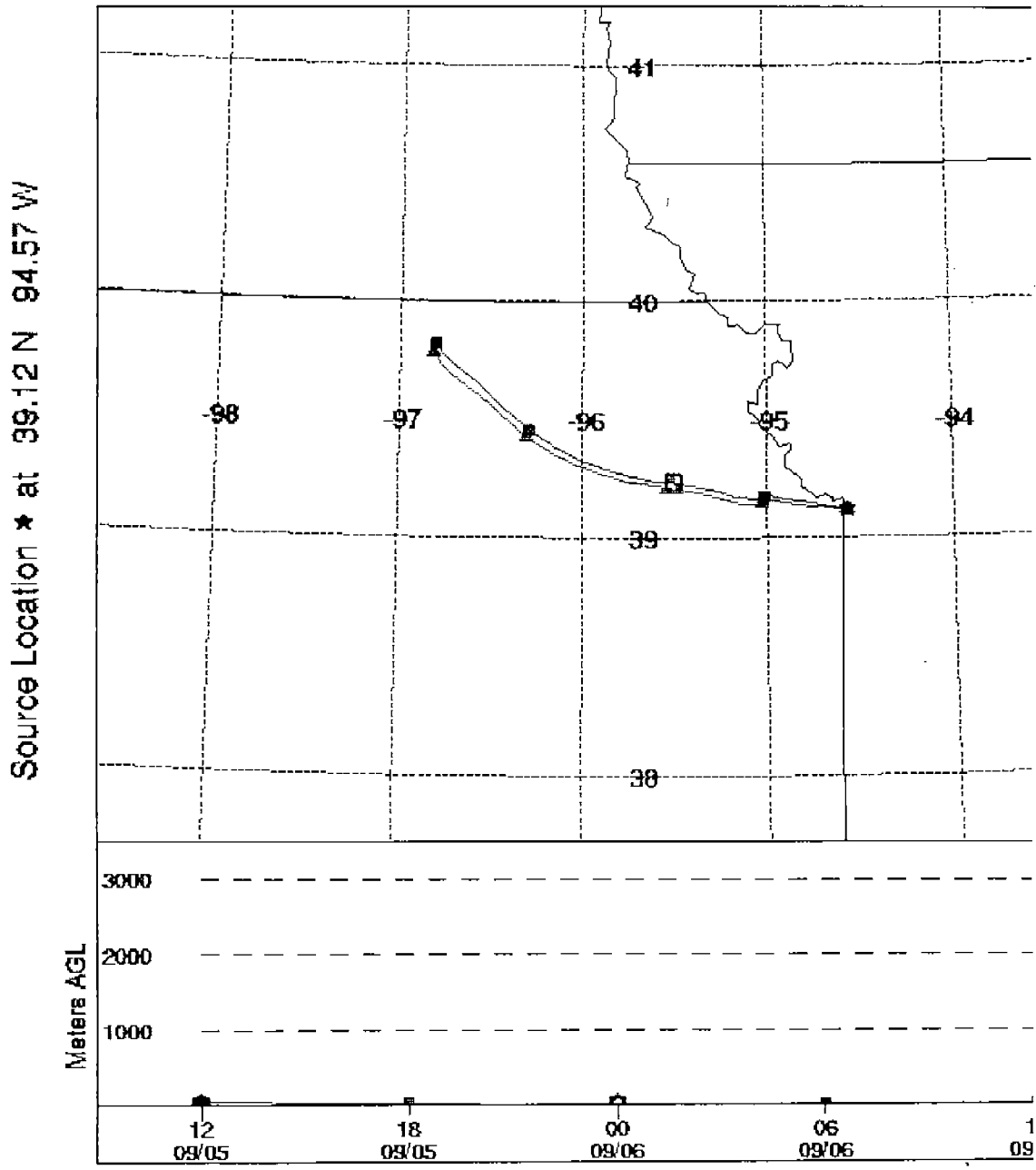
Wyandotte 113
KCI 97
Liberty 95
World's of Fun 91
Watkins Mill 88

NOAA AIR RESOURCES LABORATORY

Forward Trajectories Starting- 12 UTC 05 SEP 98



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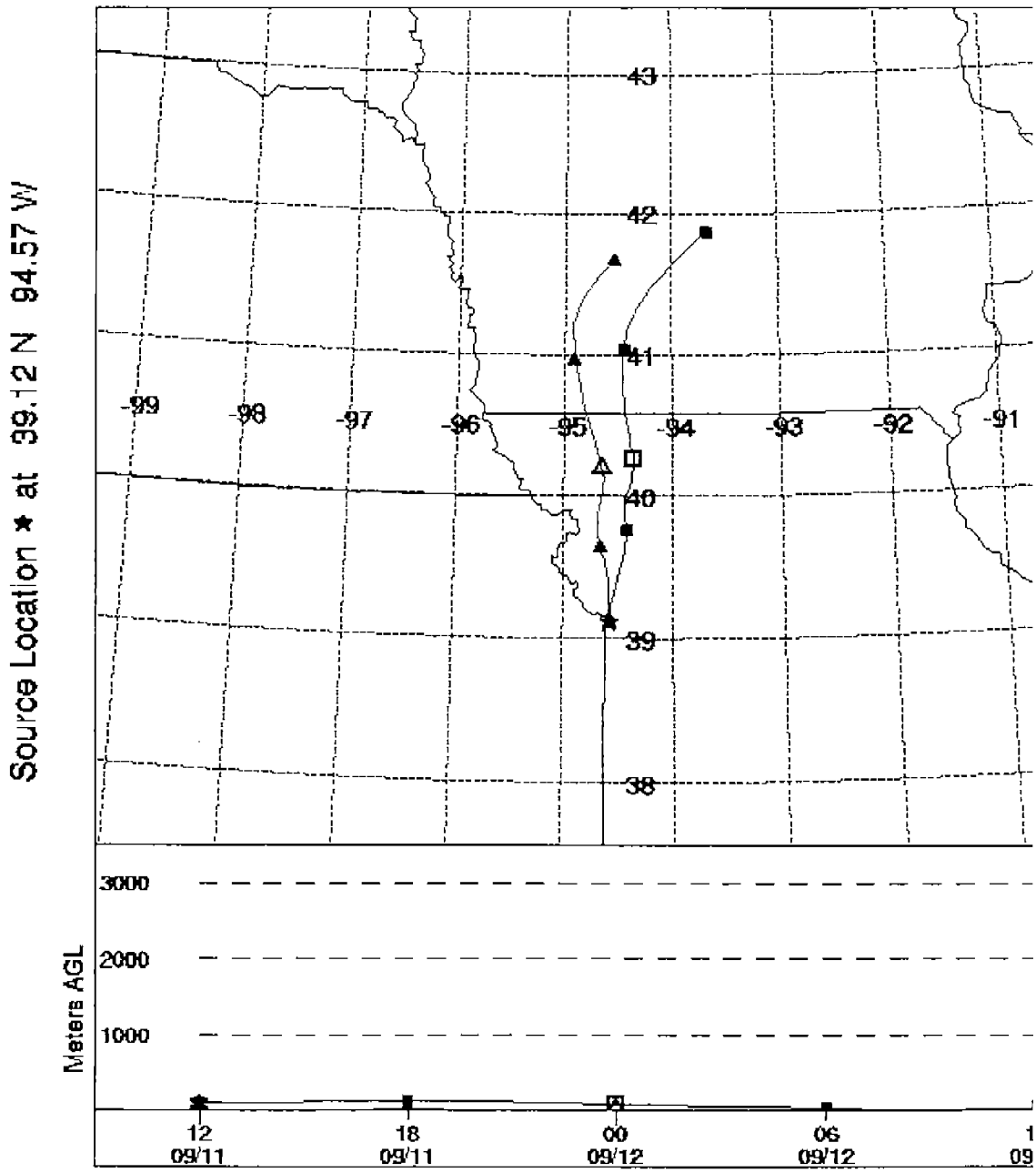
Liberty 109
Watkins Mill 102

NOAA AIR RESOURCES LABORATORY

Forward Trajectories Starting- 12 UTC 11 SEP 98



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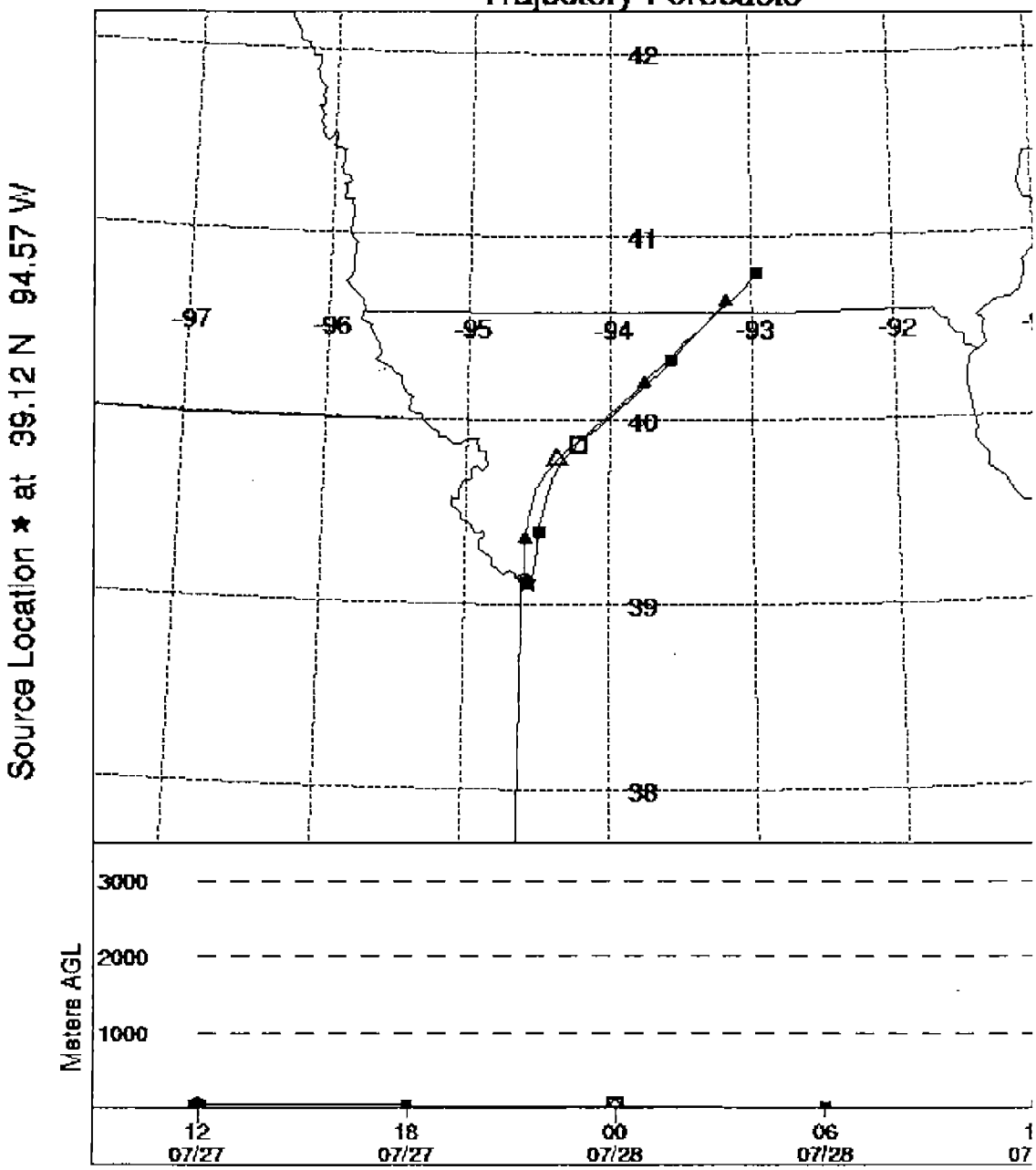
Liberty 87

NOAA AIR RESOURCES LABORATORY

Forward Trajectories Starting- 12 UTC 27 JUL 99

Trajectory Forecasts



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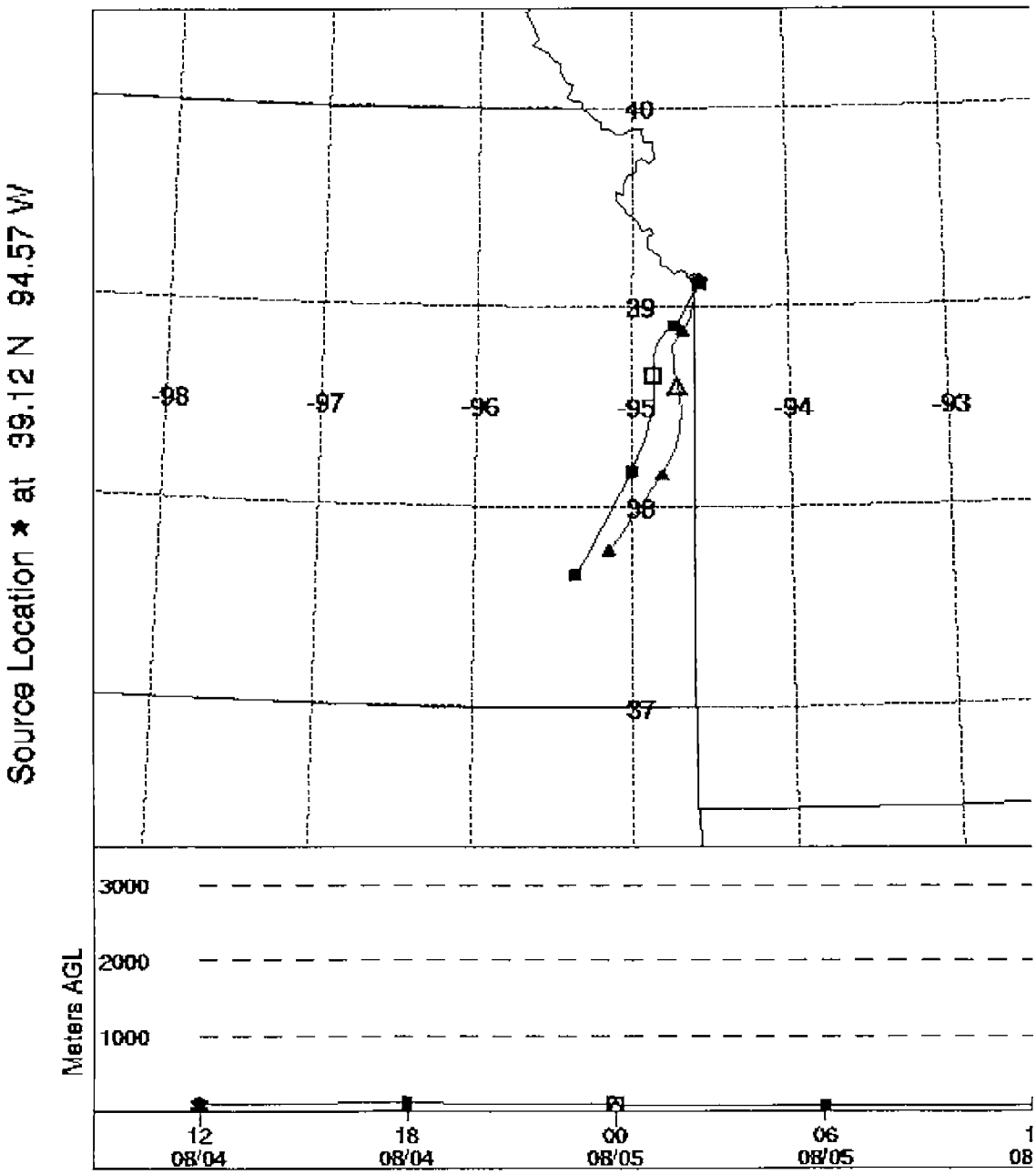
Richards-Gebauer 105

NOAA AIR RESOURCES LABORATORY

Forward Trajectories Starting- 12 UTC 04 AUG 99



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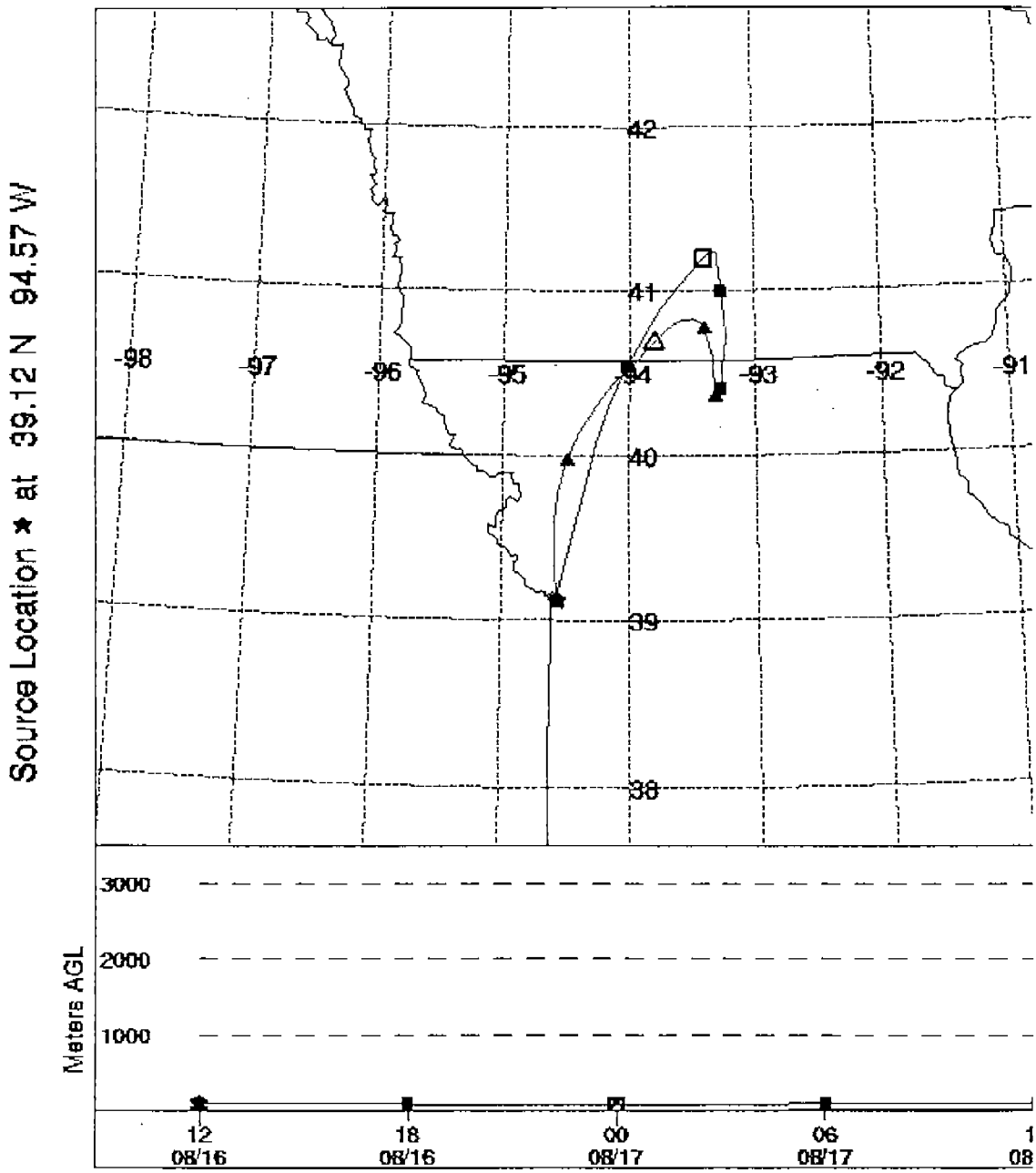
Watkins Mill 90
Liberty 89

NOAA AIR RESOURCES LABORATORY

Forward Trajectories Starting- 12 UTC 16 AUG 99



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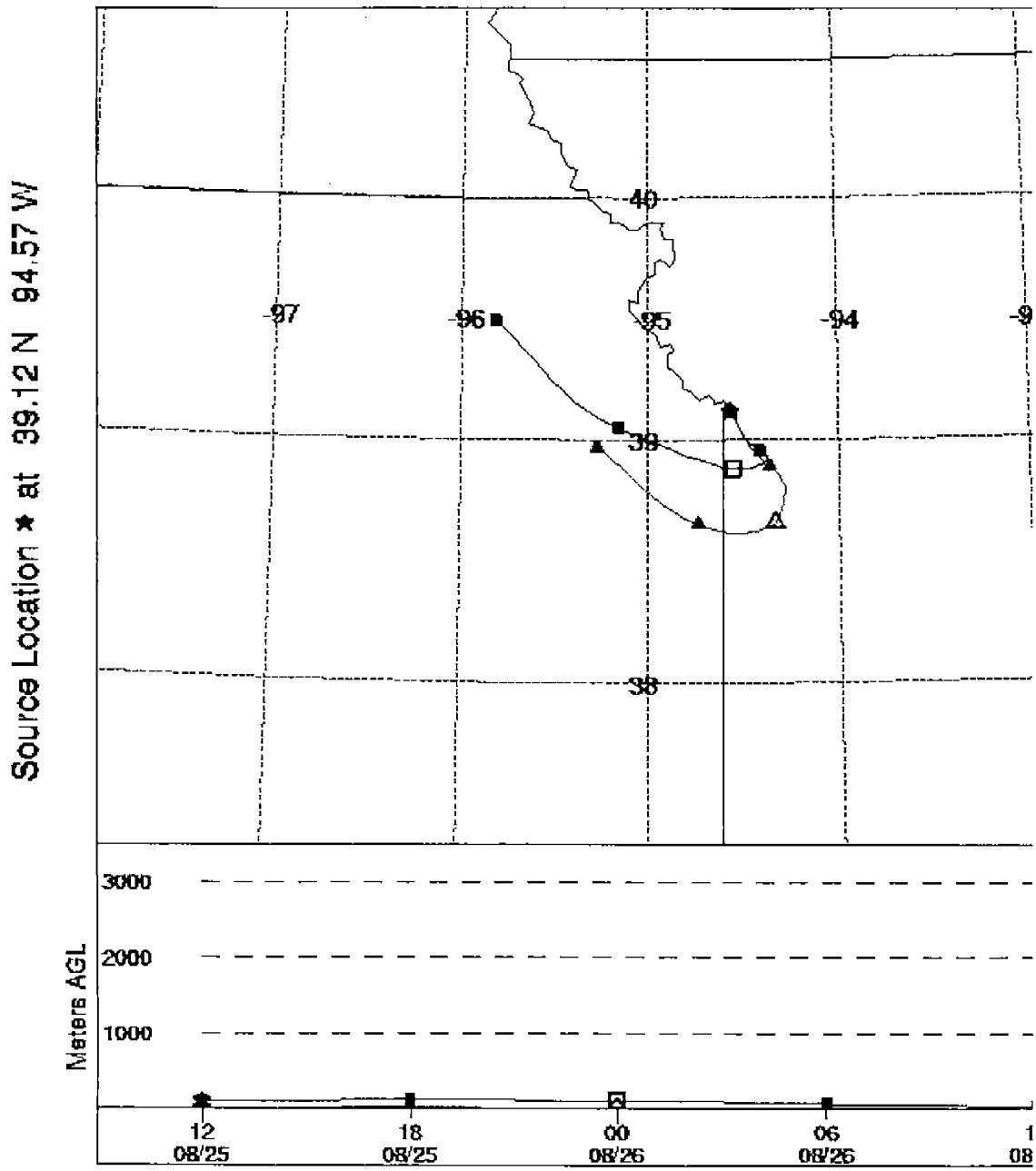
Richards-Gebaur 87

NOAA AIR RESOURCES LABORATORY

Forward Trajectories Starting- 12 UTC 25 AUG 99



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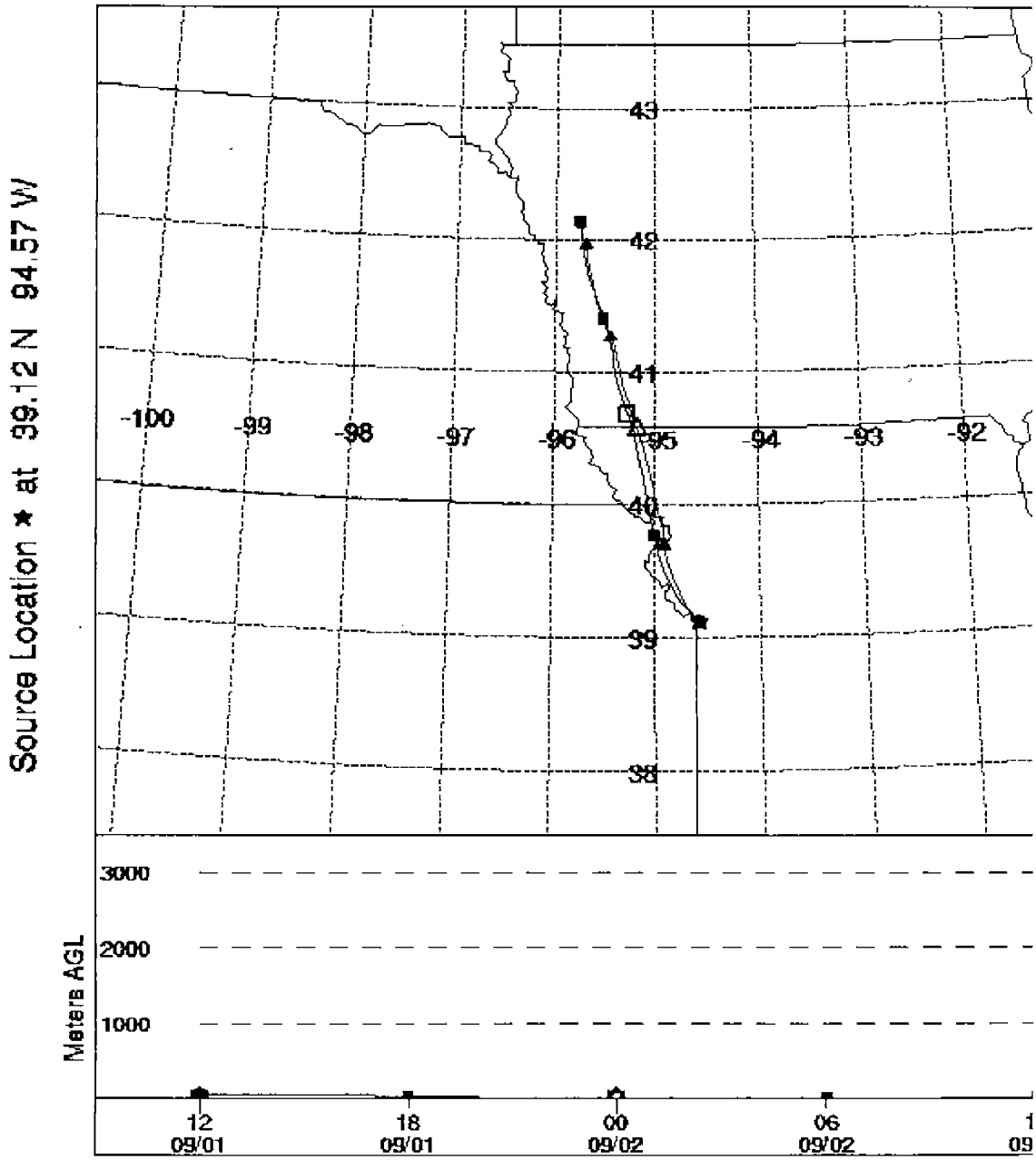
Liberty 95
Watkins Mill 92
World of Fun 86

NOAA AIR RESOURCES LABORATORY

Forward Trajectories Starting- 12 UTC 01 SEP 99



Mine Creek

8-Hour Exceedance

Back Trajectory

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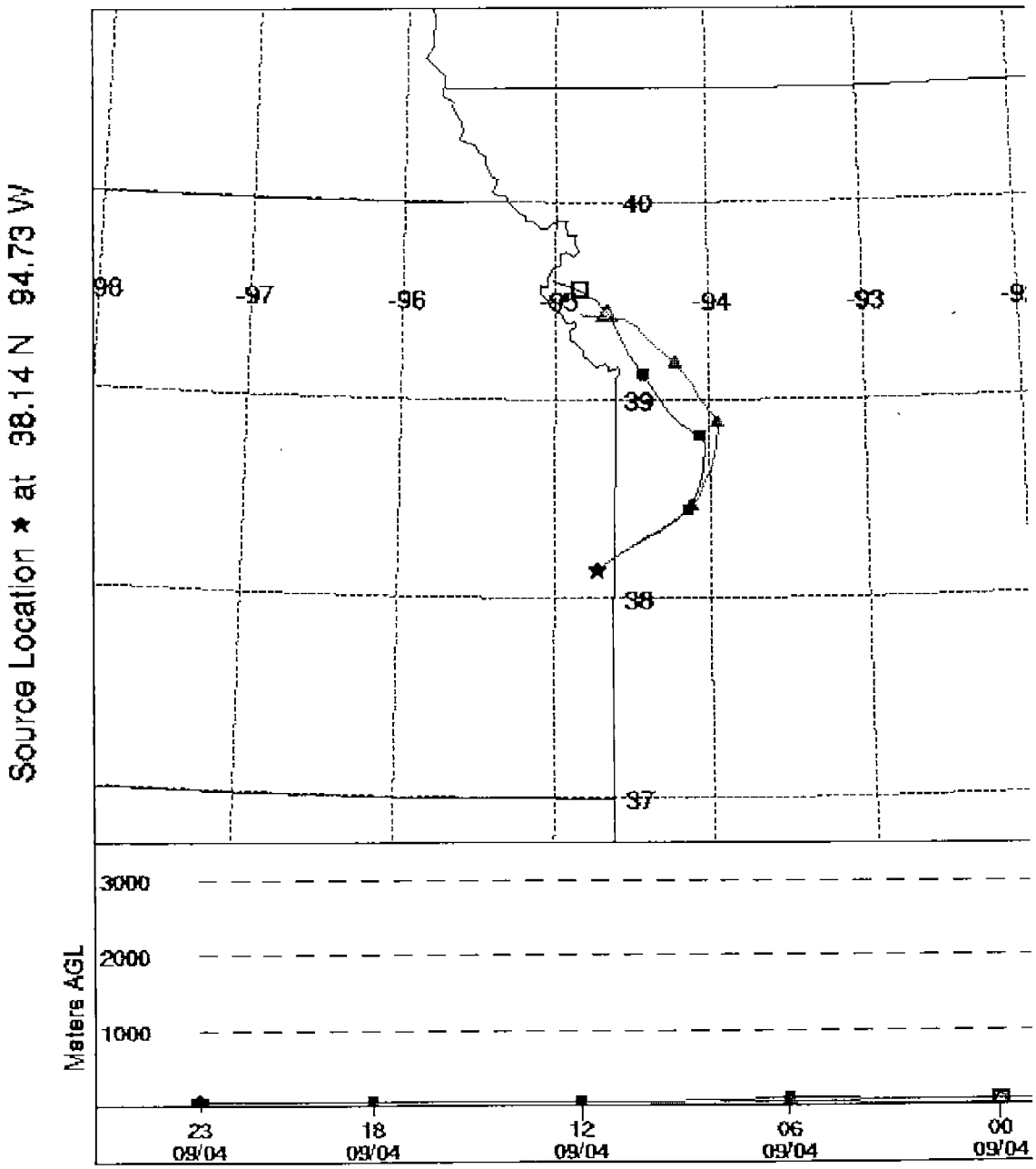
NOAA AIR RESOURCES LABORATORY

Backward Trajectories Ending- 23 UTC 04 SEP 98



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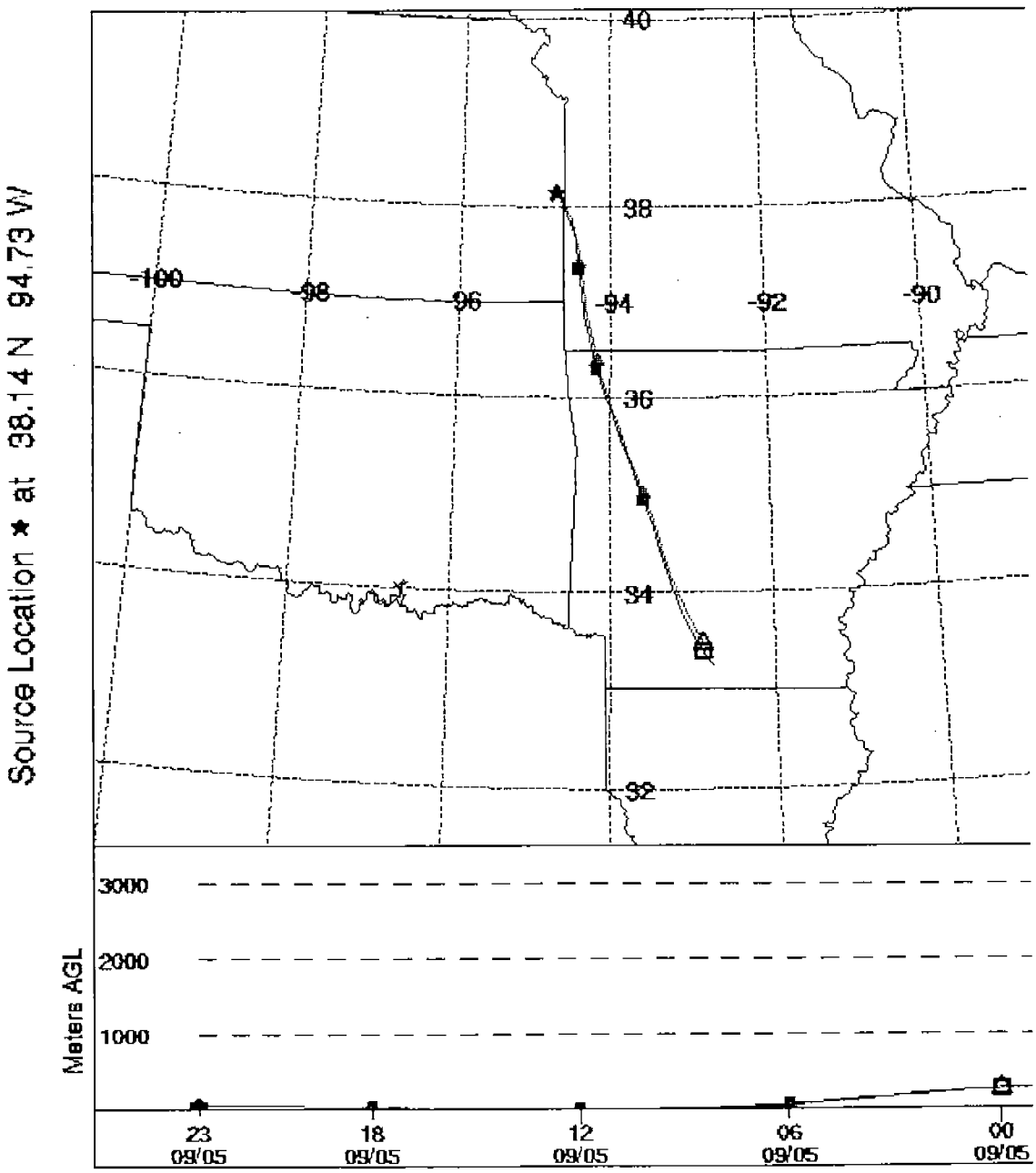
NOAA AIR RESOURCES LABORATORY

Backward Trajectories Ending- 23 UTC 05 SEP 98



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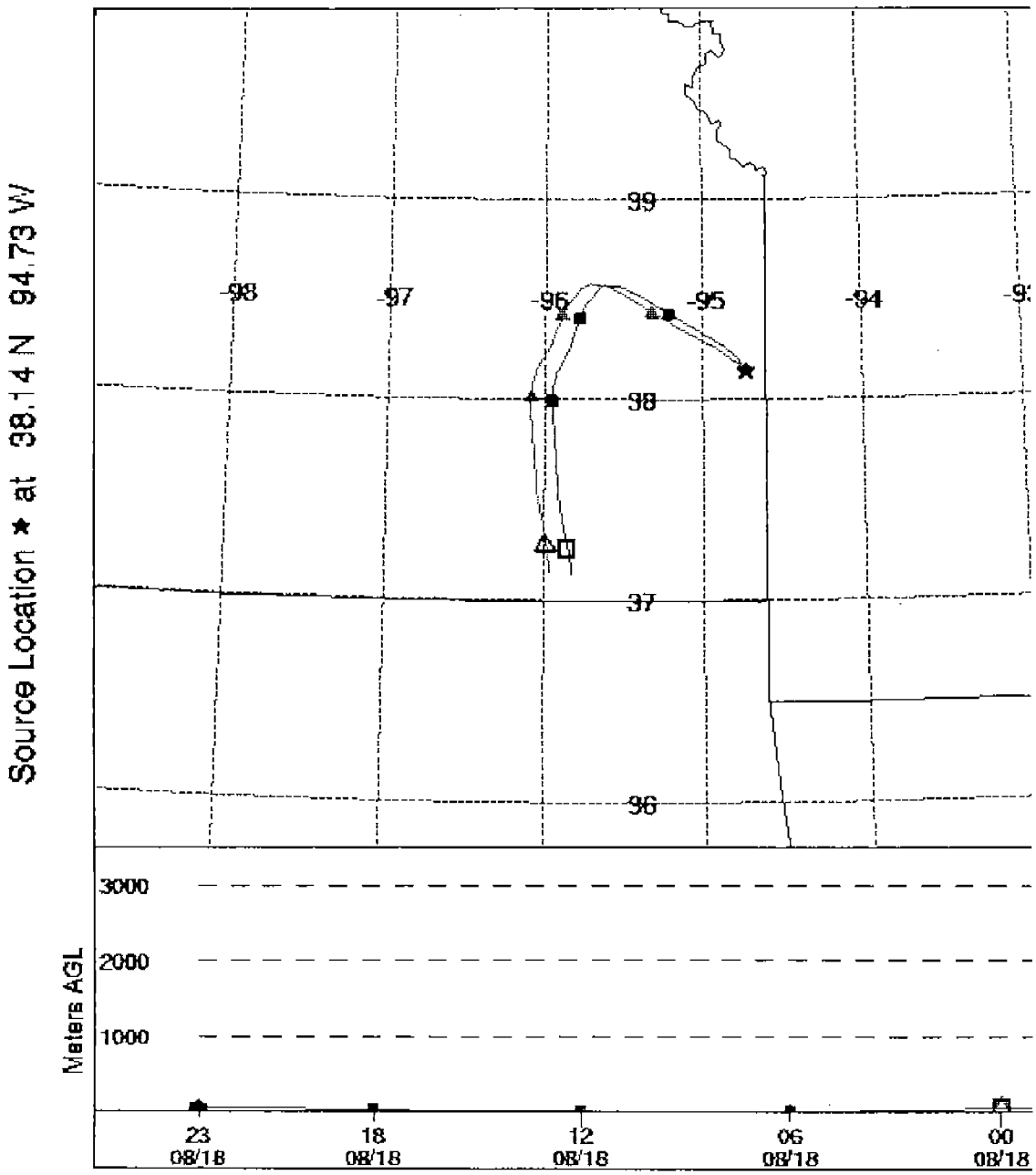
NOAA AIR RESOURCES LABORATORY

Backward Trajectories Ending- 23 UTC 18 AUG 99



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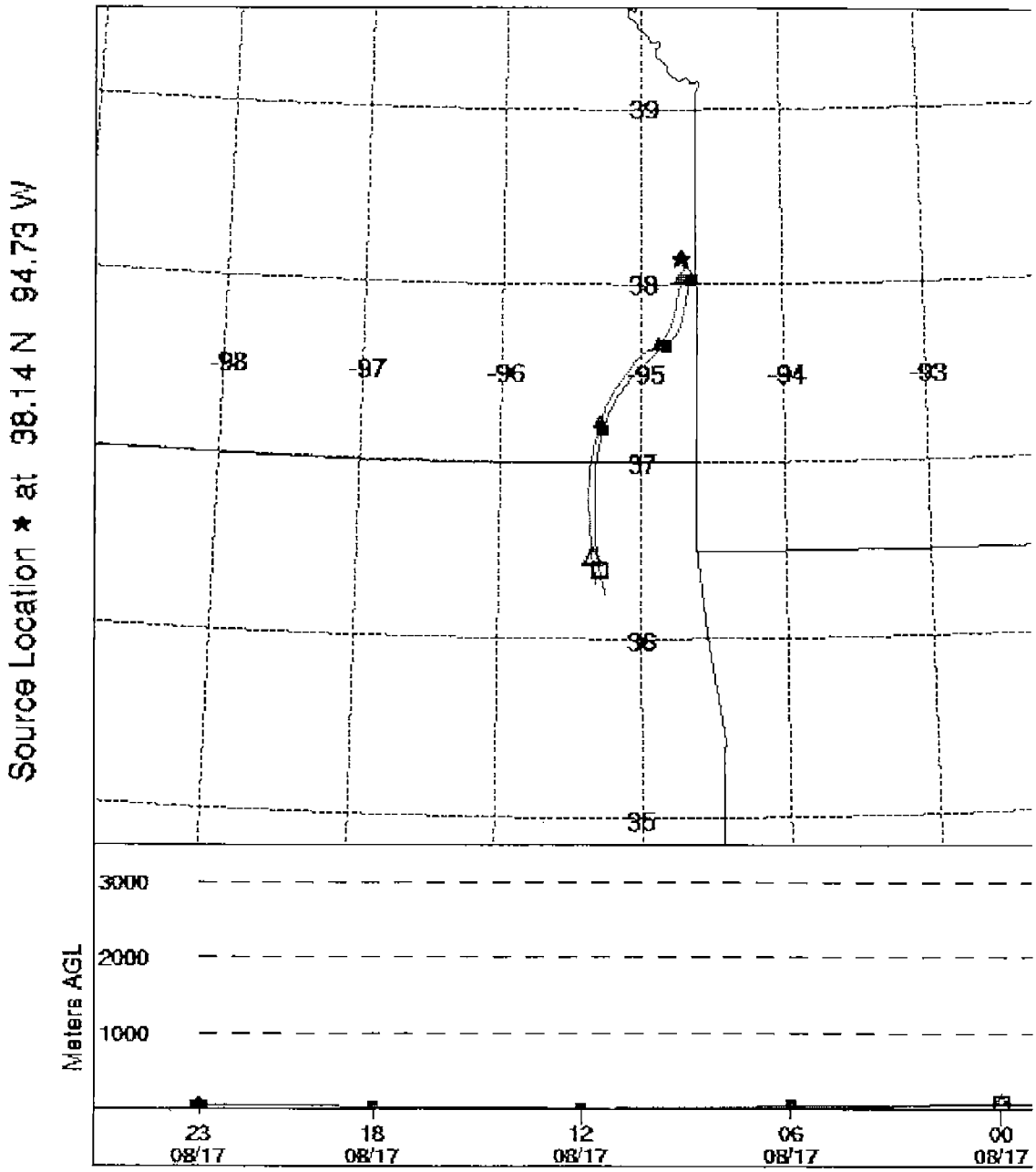
Backward Trajectories Ending- 23 UTC 17 AUG 99



El Dorado Springs

8-Hour Exceedance

Back Trajectory

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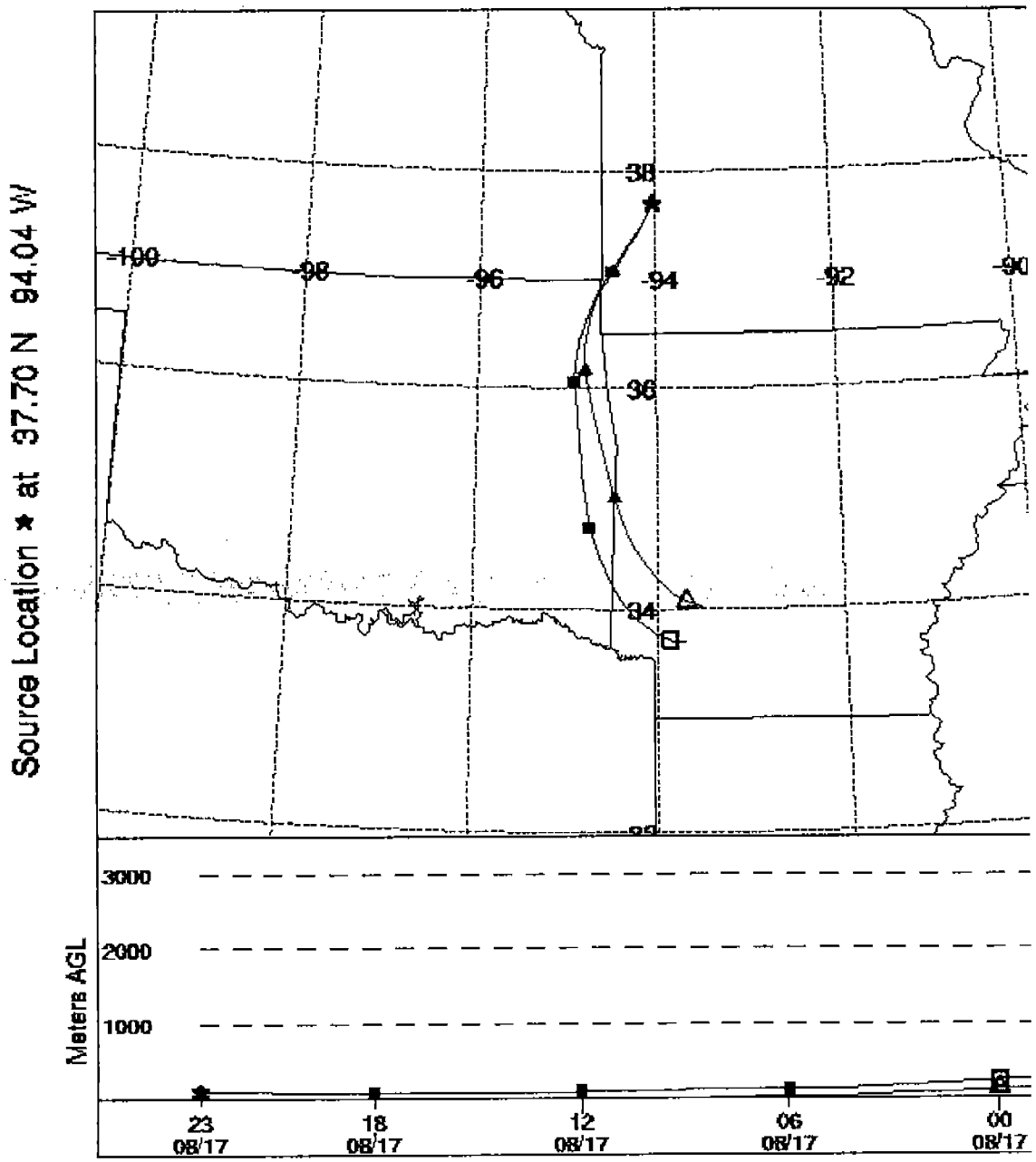
Backward Trajectories Ending- 23 UTC 17 AUG 98



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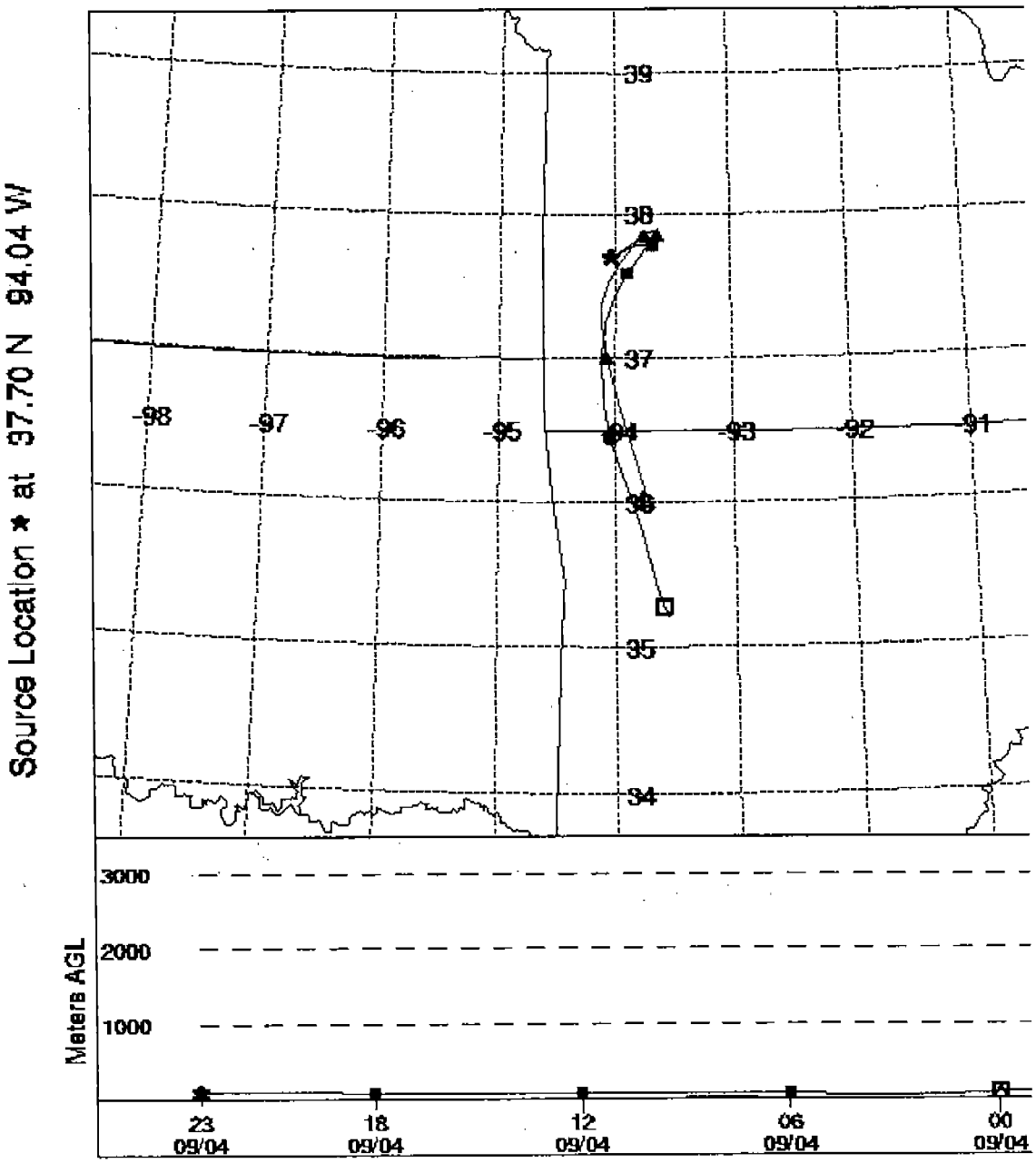
Backward Trajectories Ending- 23 UTC 04 SEP 98



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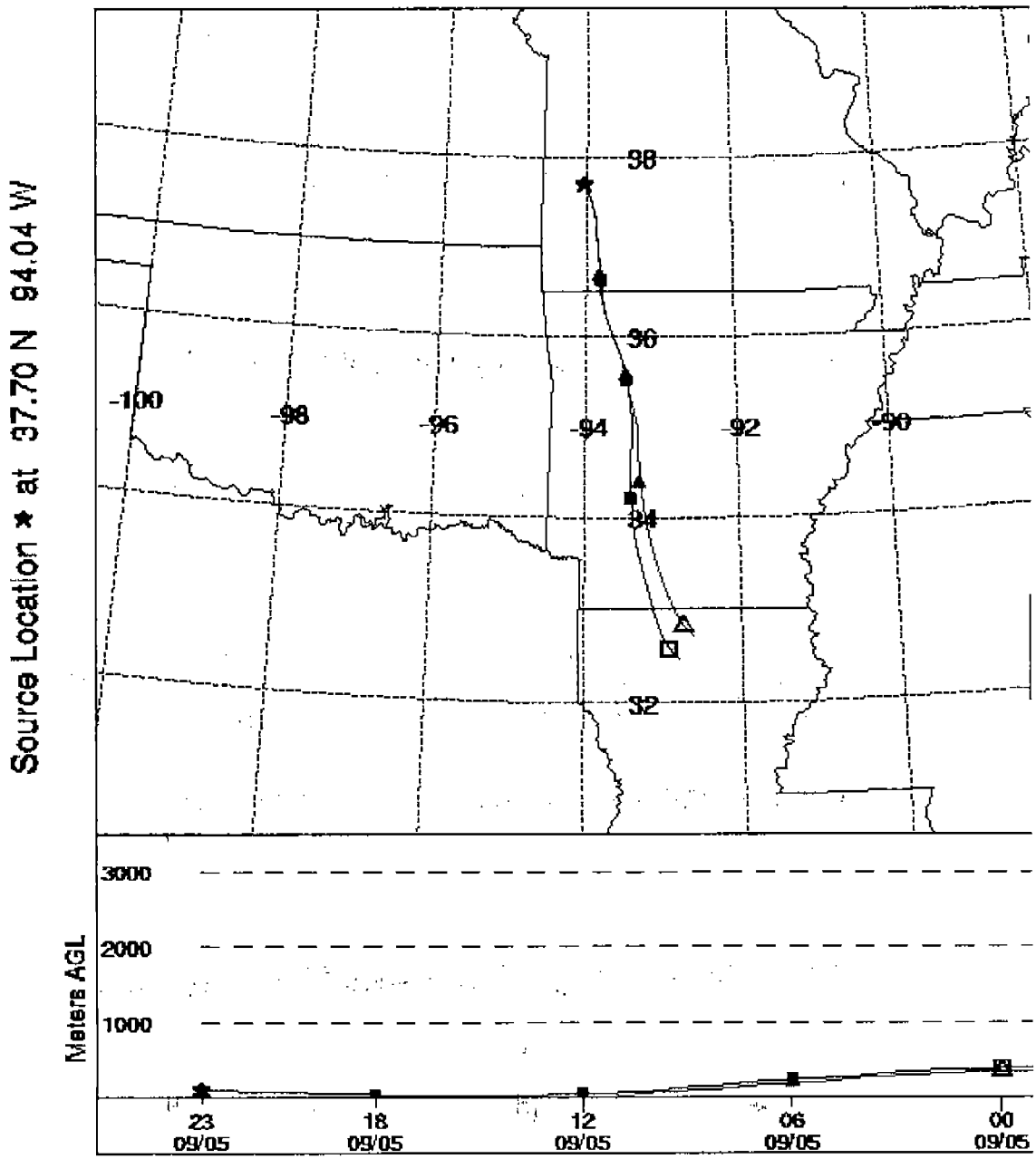
NOAA AIR RESOURCES LABORATORY

Backward Trajectories Ending- 23 UTC 05 SEP 98



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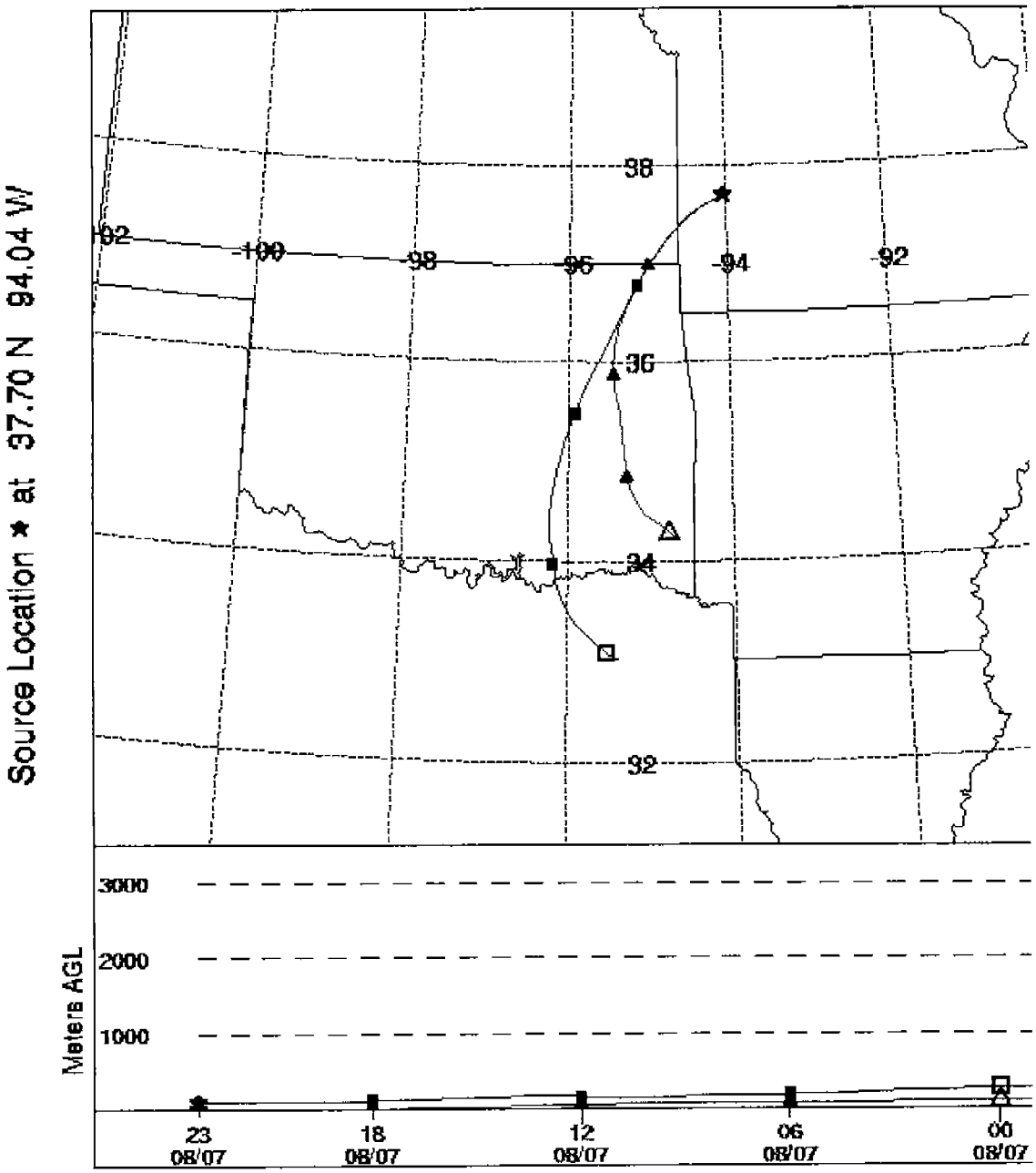
NOAA AIR RESOURCES LABORATORY

Backward Trajectories Ending- 23 UTC 07 AUG 99



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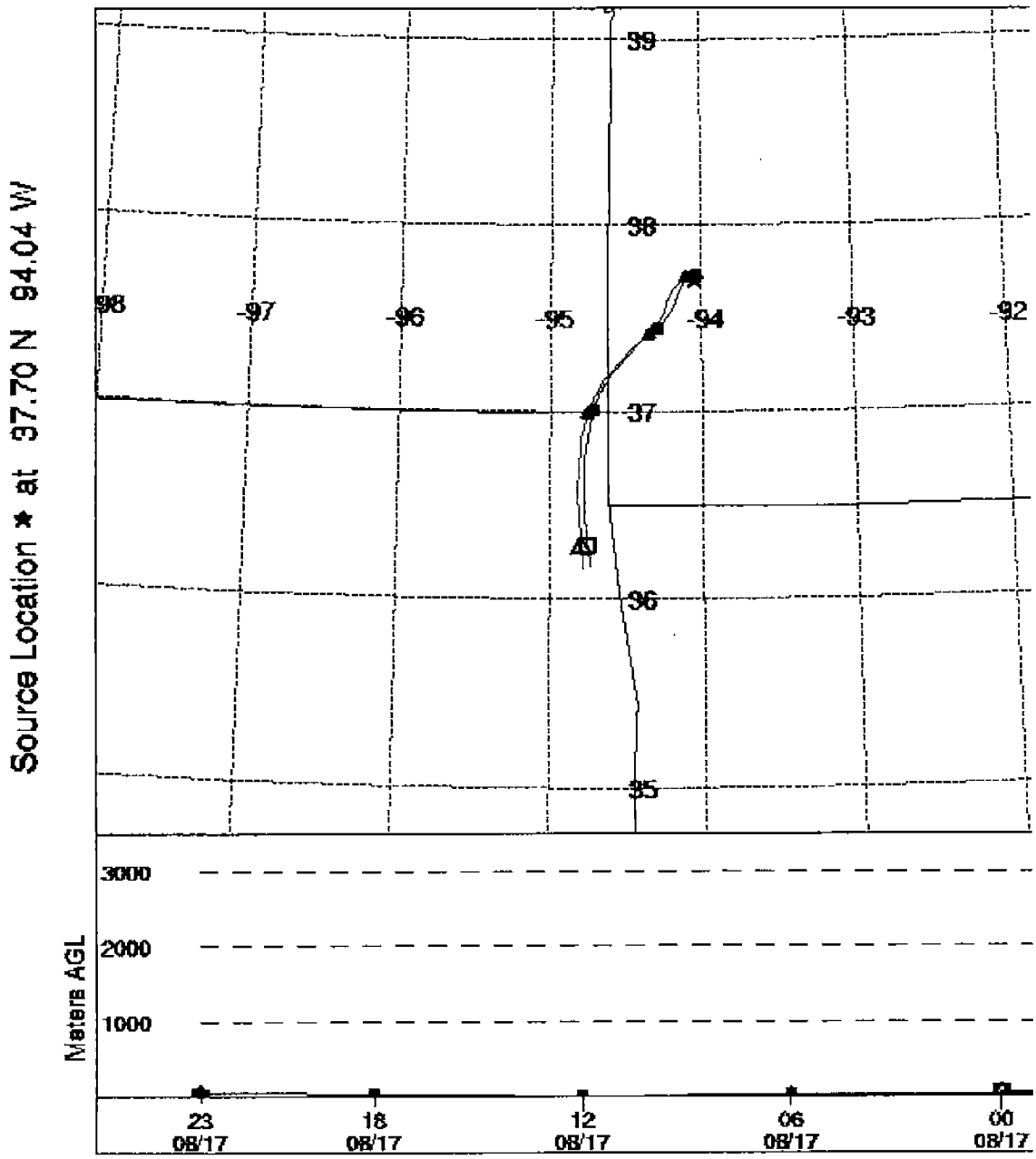
85

NOAA AIR RESOURCES LABORATORY

Backward Trajectories Ending- 23 UTC 17 AUG 99



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(94)

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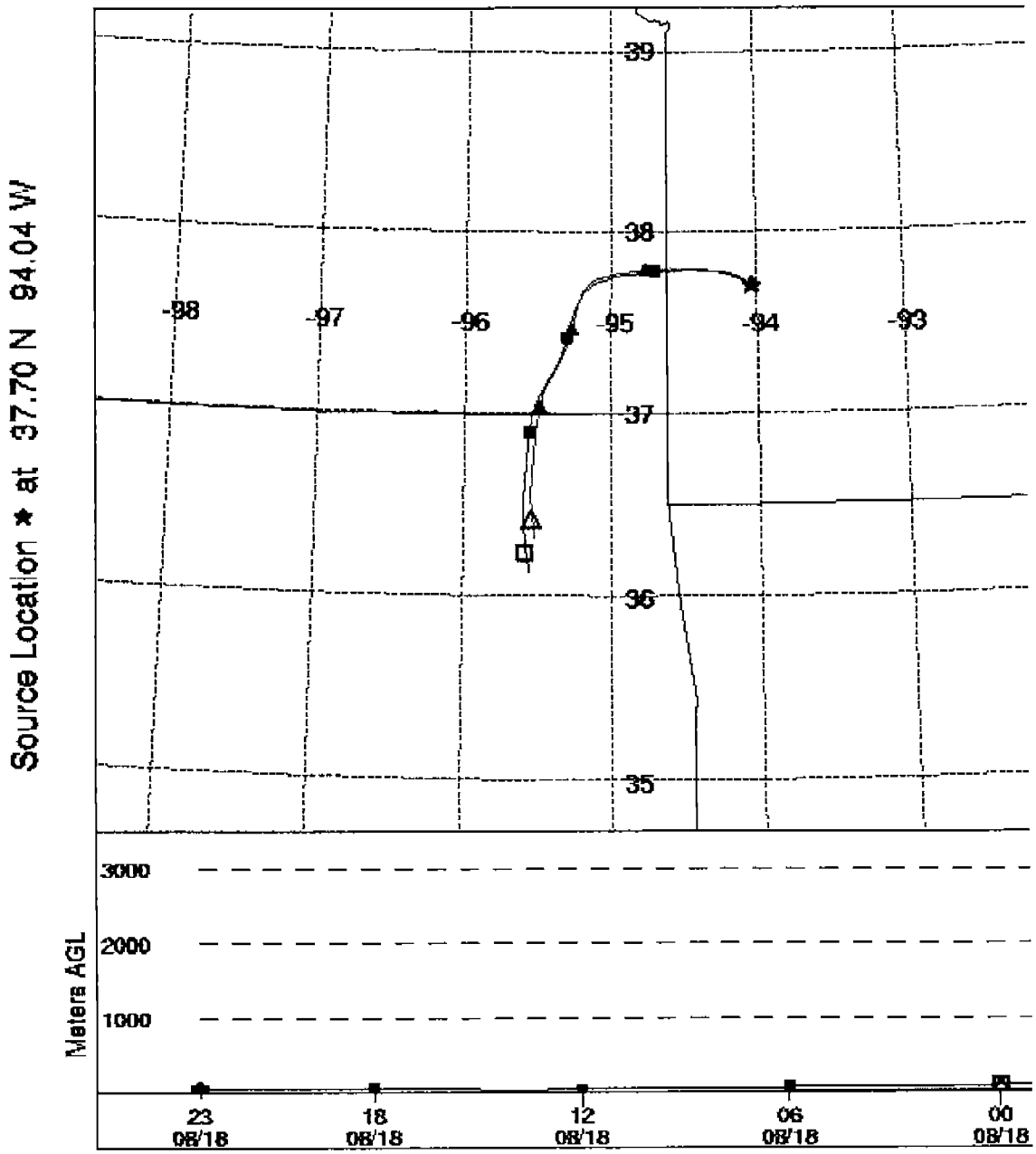
Backward Trajectories Ending- 23 UTC 18 AUG 99



St. Louis Area

8-Hour Exceedance

Forward Trajectory

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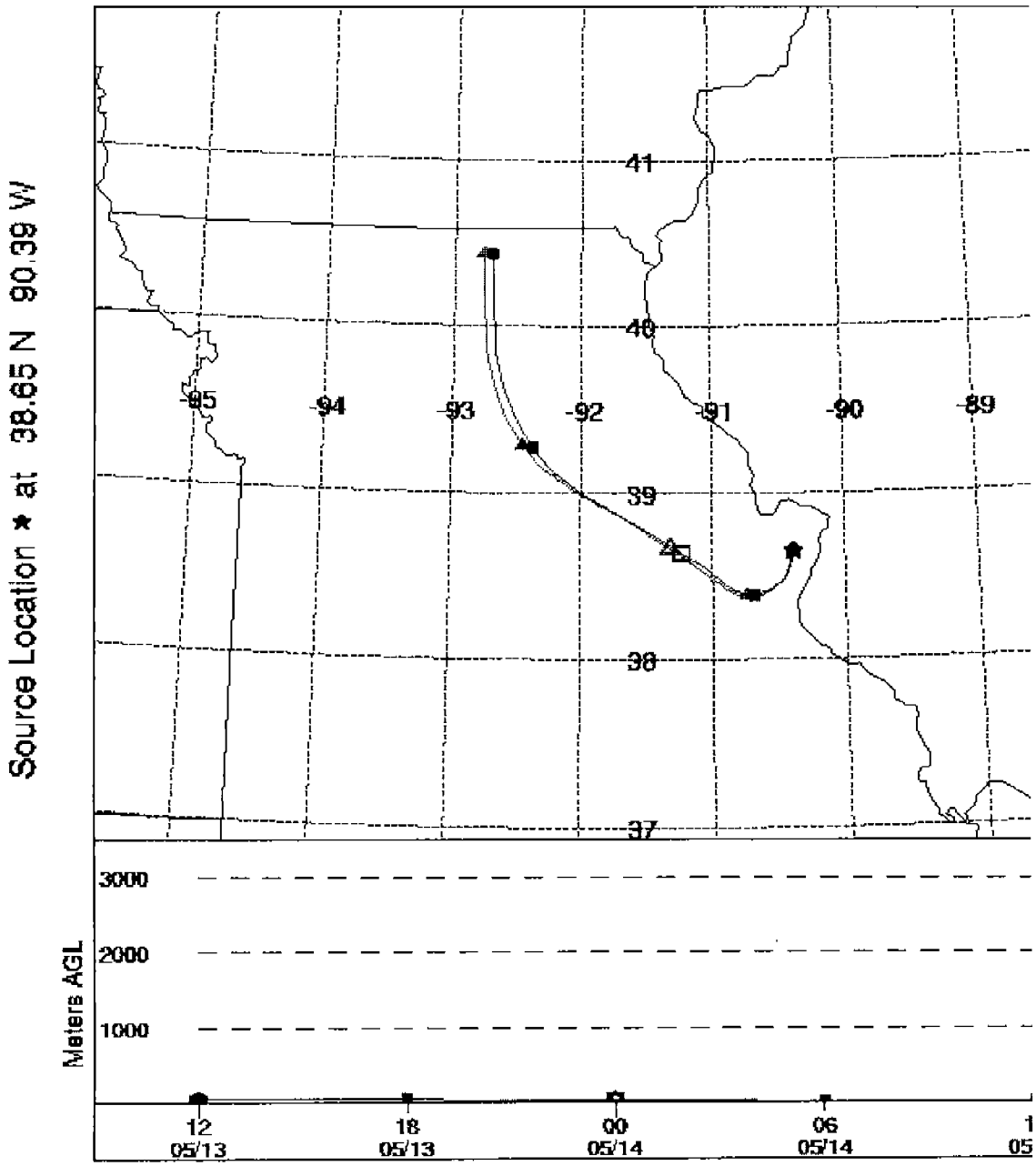
NOAA AIR RESOURCES LABORATORY

Forward Trajectories Starting- 12 UTC 13 MAY 98

Arnold
Lindbergh
Pro Valley
St. Ann
Queeny
Hunter
Newstead



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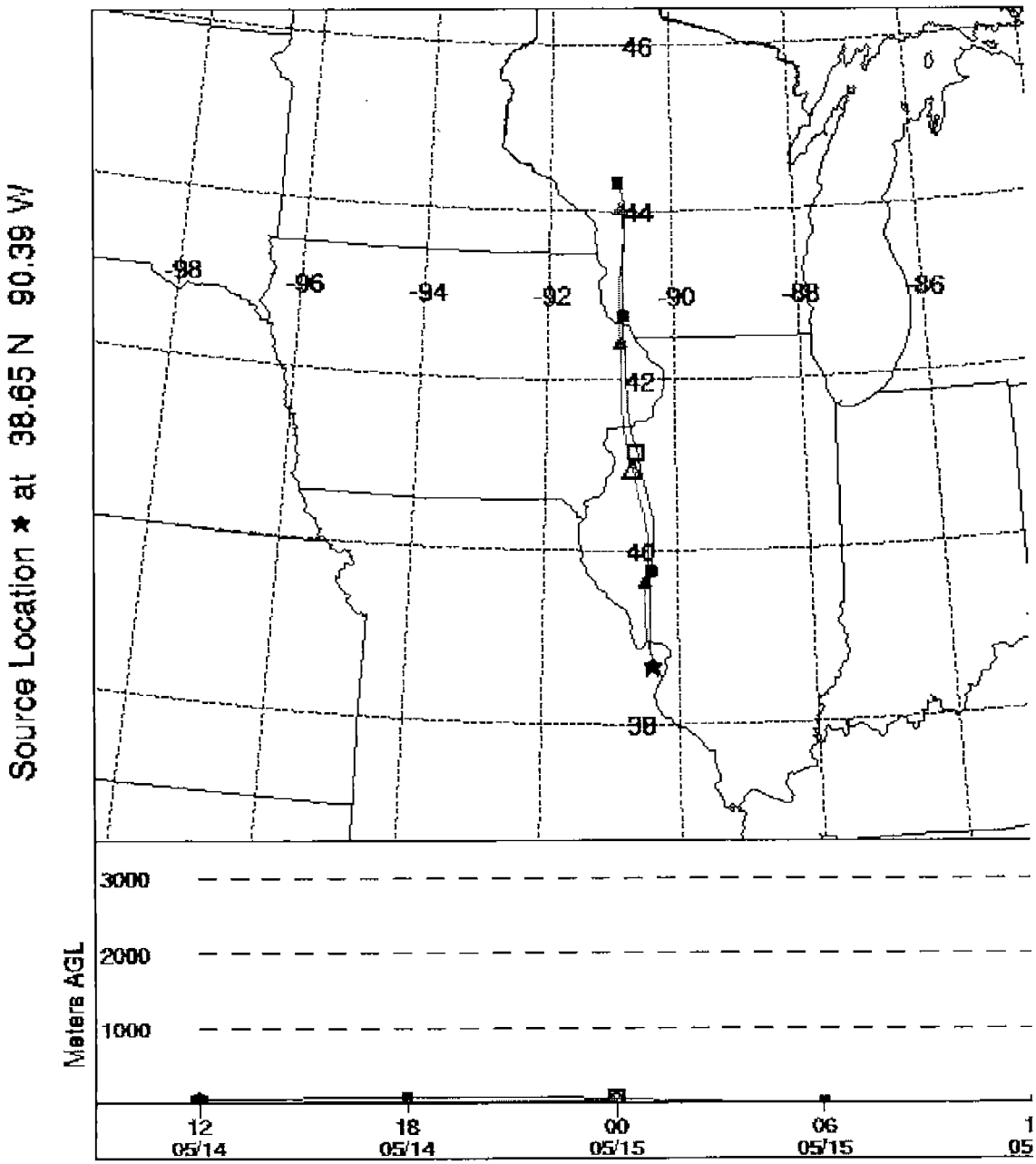
NOAA AIR RESOURCES LABORATORY

Forward Trajectories Starting- 12 UTC 14 MAY 98

West Alton
Orchard Farm



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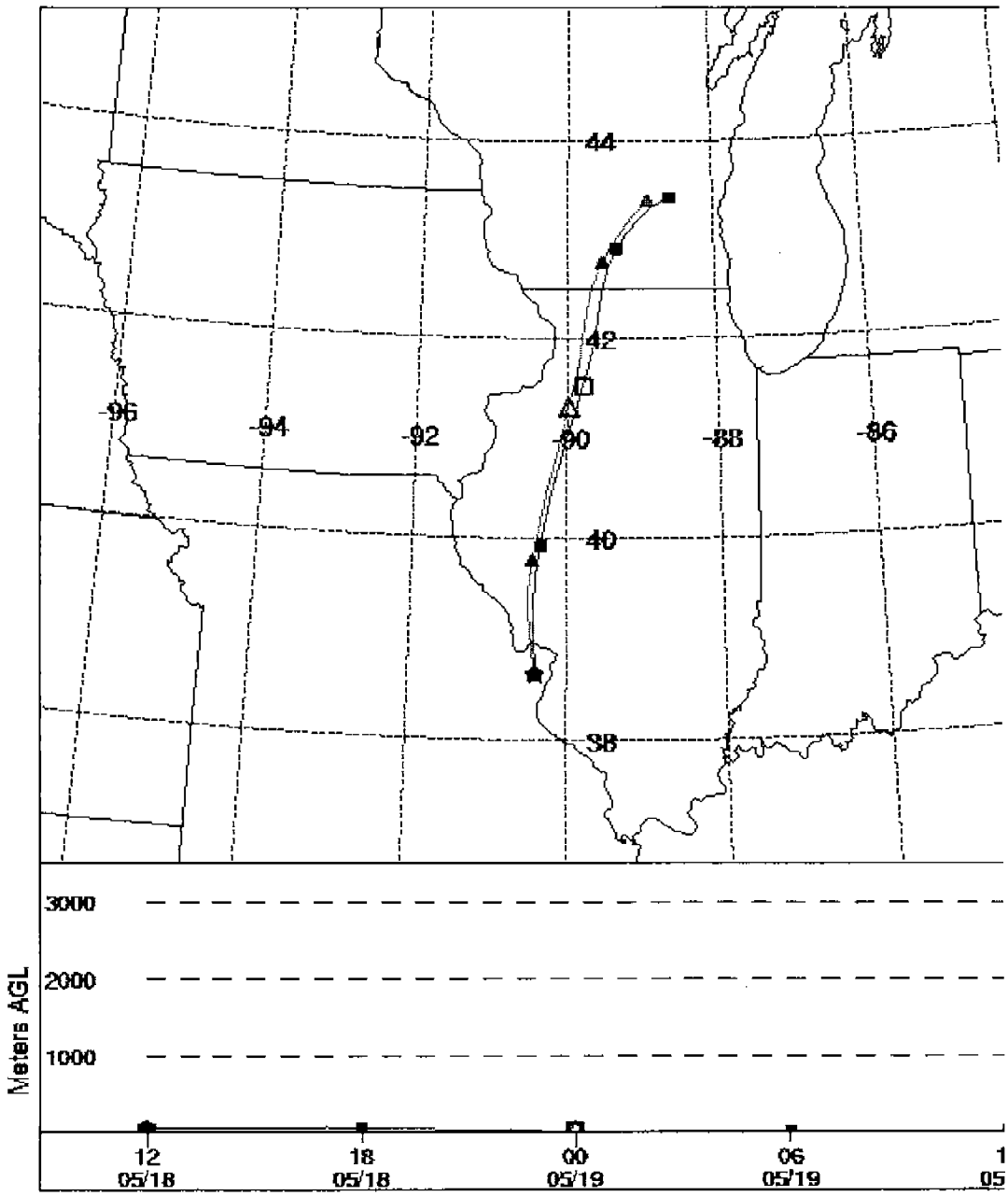
NOAA AIR RESOURCES LABORATORY

Forward Trajectories Starting- 12 UTC 18 MAY 98

West Alton
Orchard Farm

Source Location ★ at 38.65 N 90.39 W



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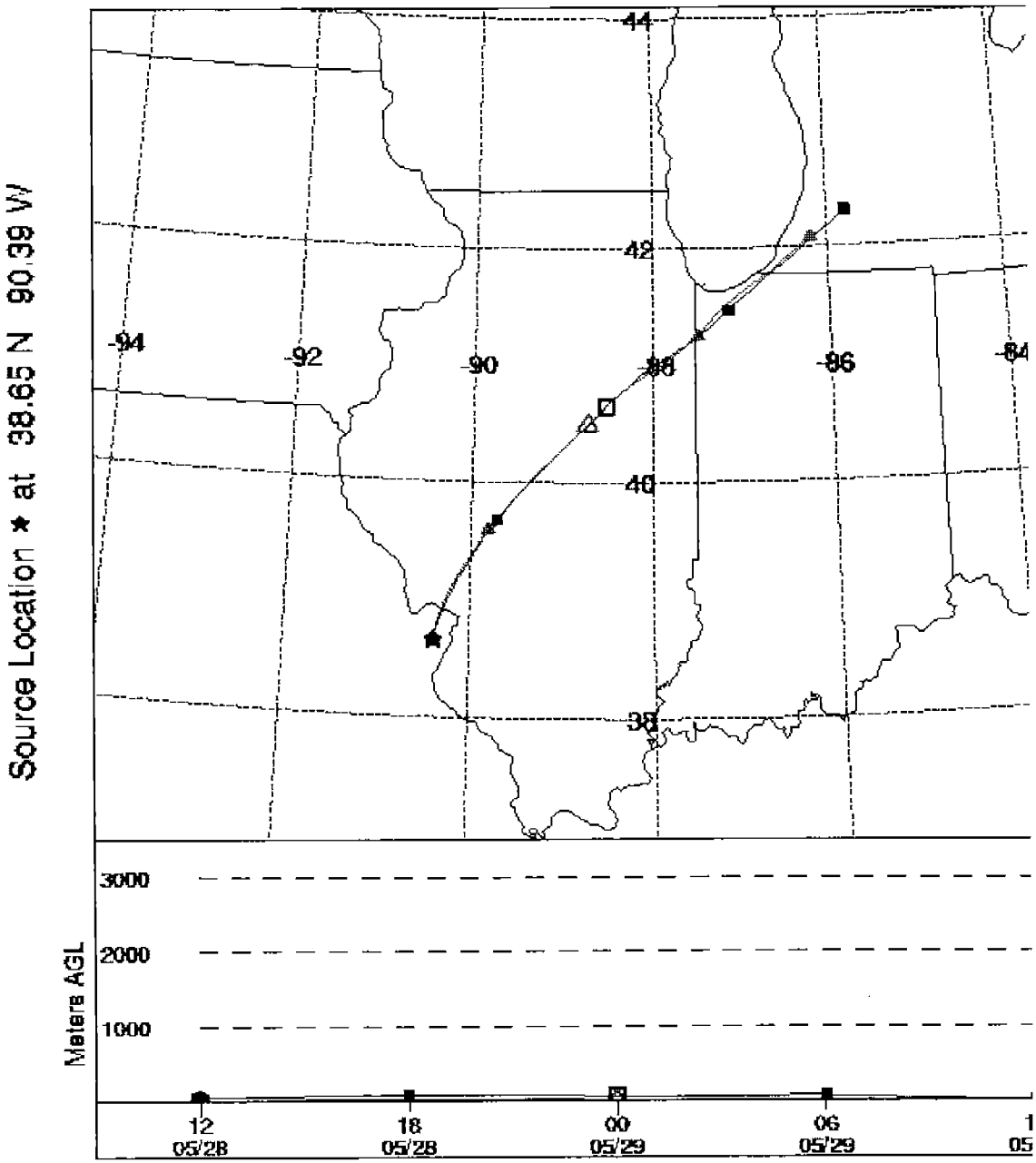
NOAA AIR RESOURCES LABORATORY

Forward Trajectories Starting- 12 UTC 28 MAY 98

West Alton



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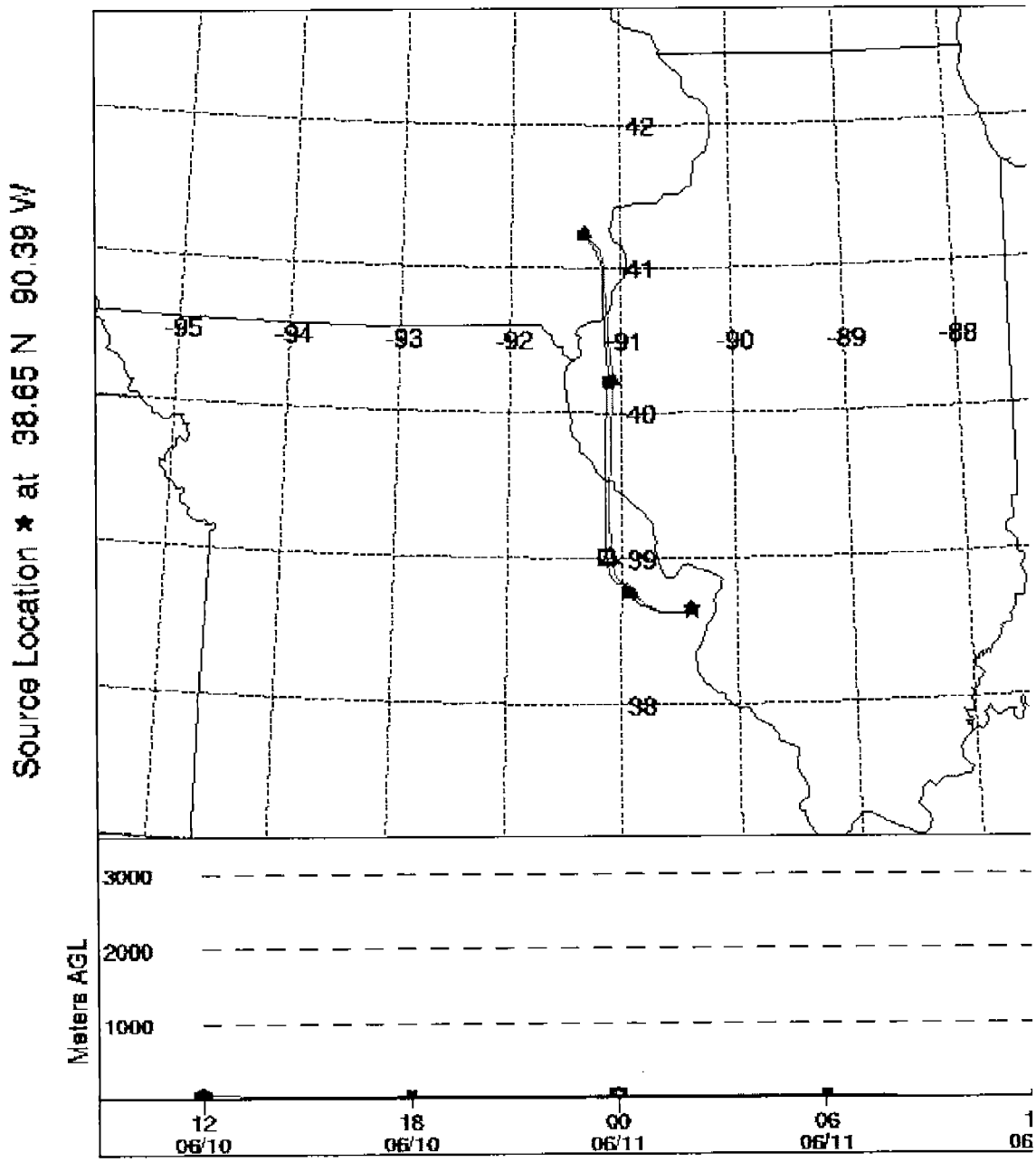
NOAA AIR RESOURCES LABORATORY

Forward Trajectories Starting- 12 UTC 10 JUN 98

Orchard Farm



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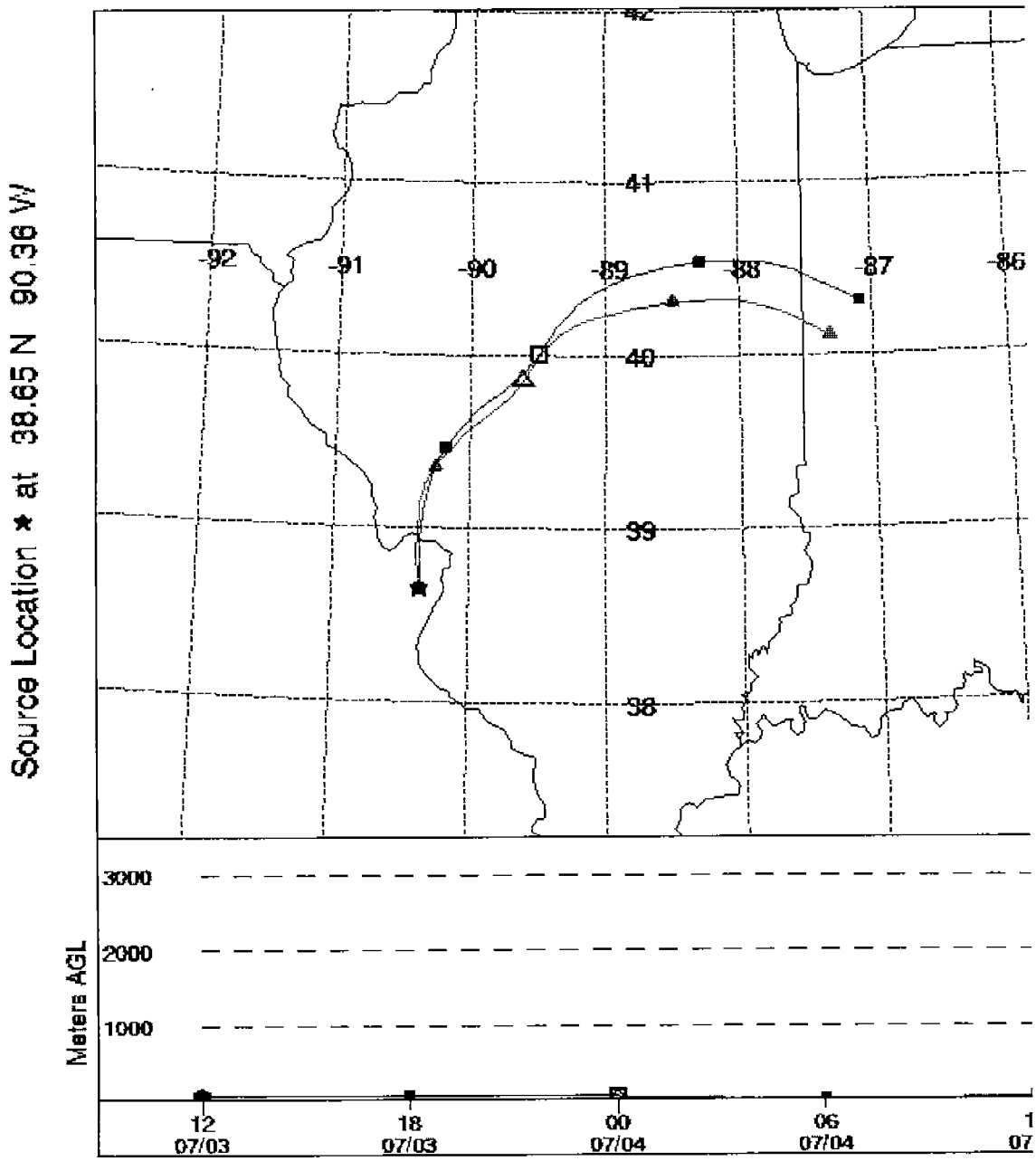
NOAA AIR RESOURCES LABORATORY

Forward Trajectories Starting- 12 UTC 03 JUL 98

West Alton



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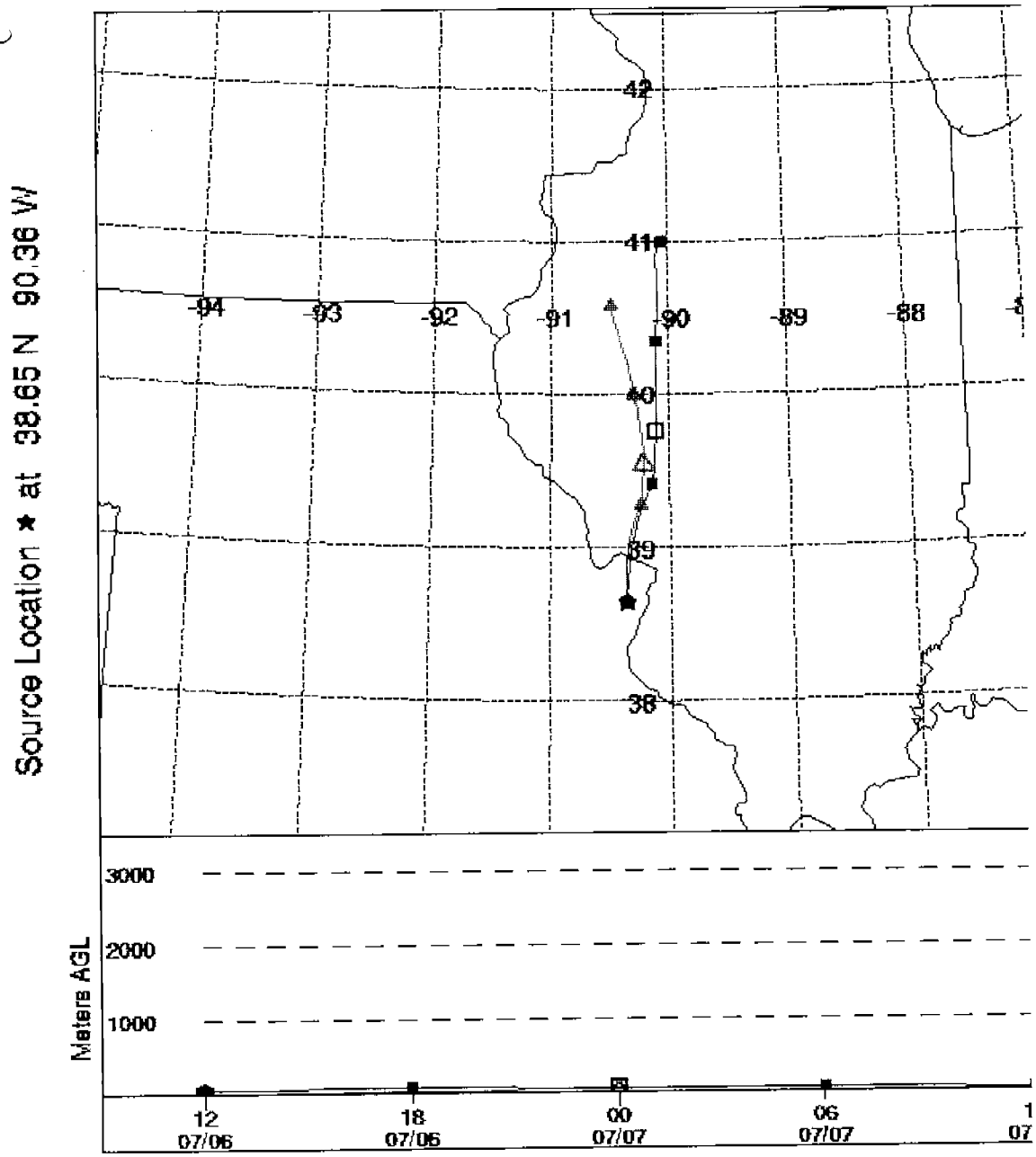
NOAA AIR RESOURCES LABORATORY

Forward Trajectories Starting- 12 UTC 06 JUL 98

West Alton



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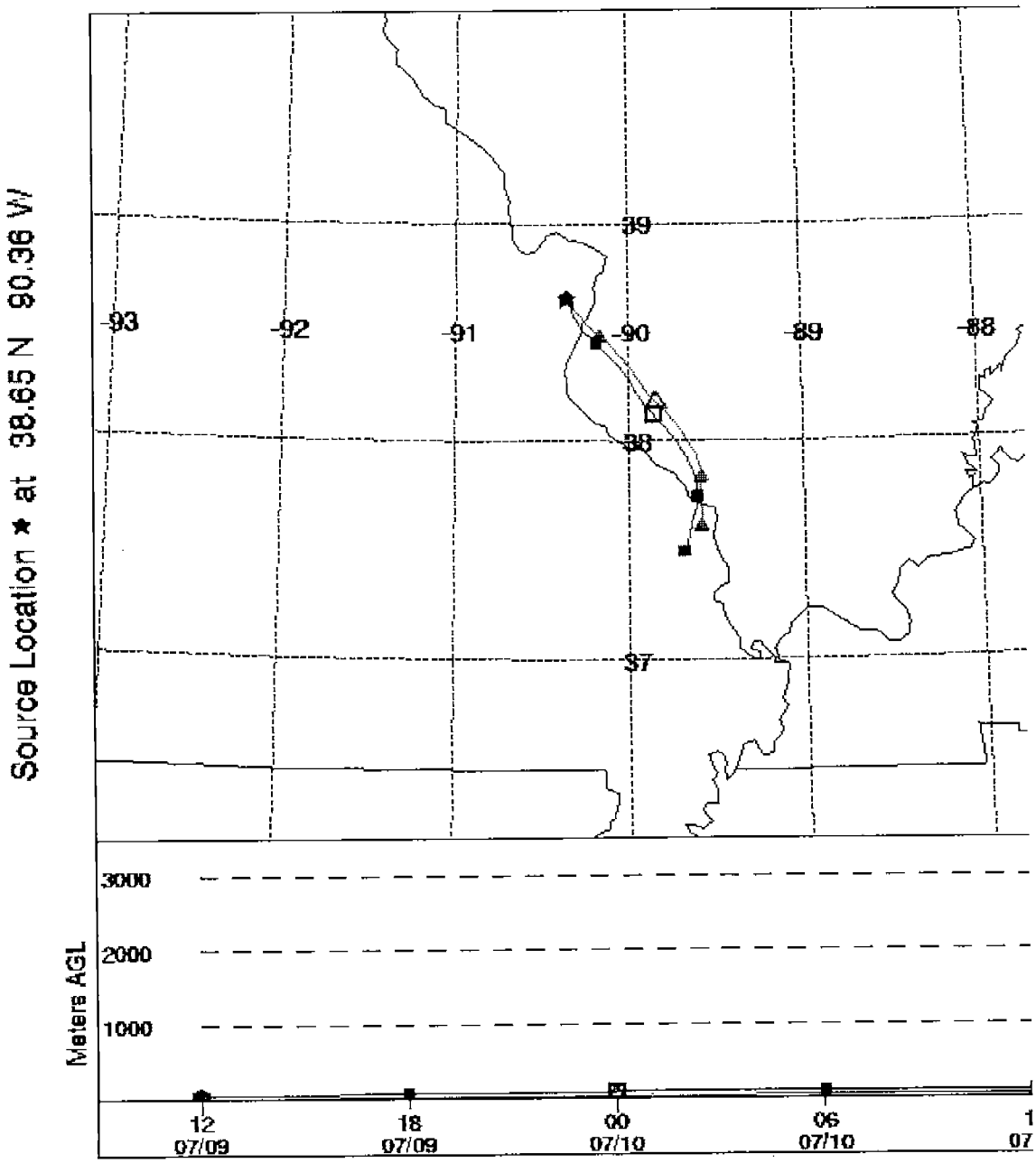
NOAA AIR RESOURCES LABORATORY

Forward Trajectories Starting- 12 UTC 09 JUL 98

Arnold



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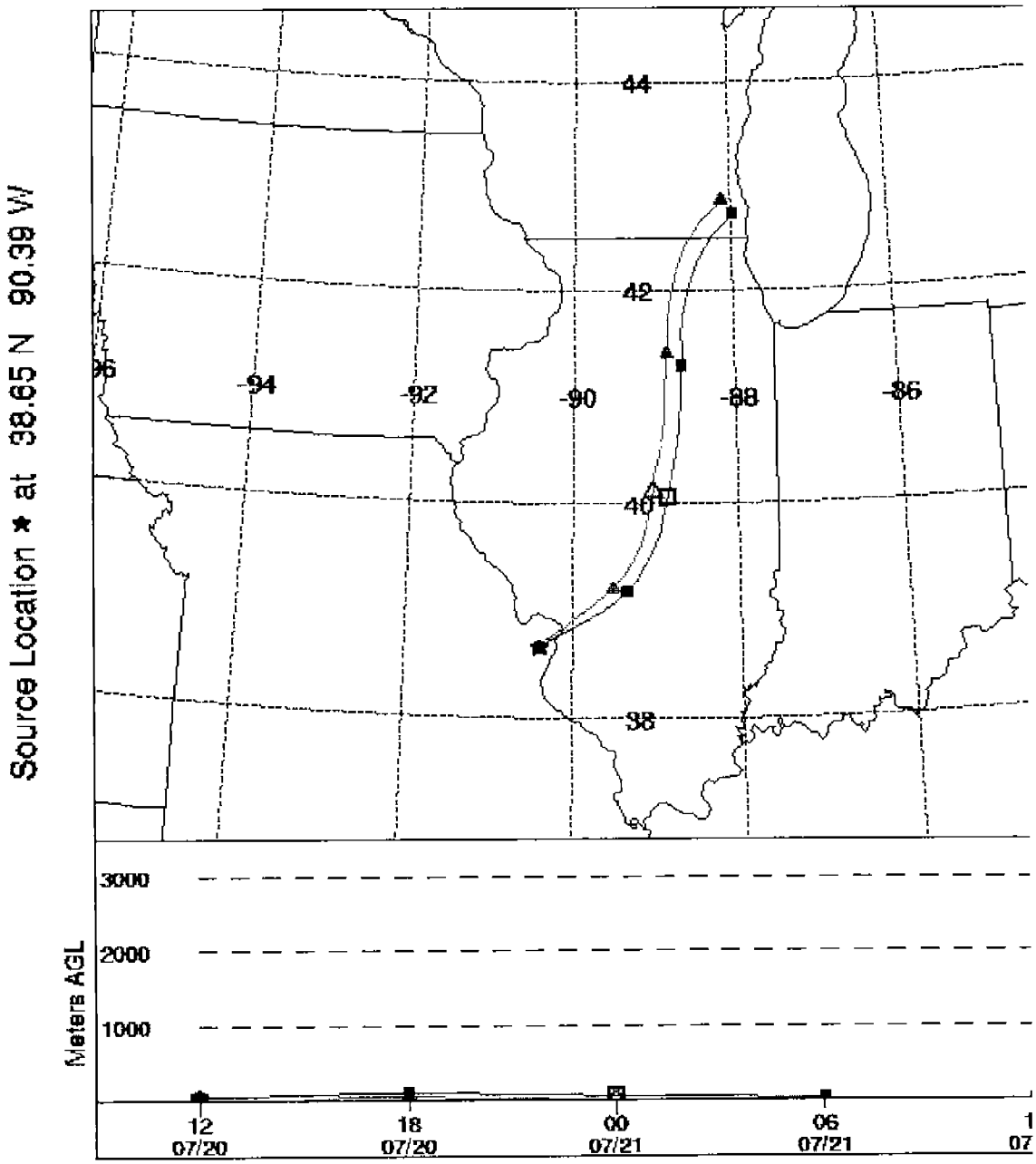
NOAA AIR RESOURCES LABORATORY

Forward Trajectories Starting- 12 UTC 20 JUL 98

West Alton
Flo Valley
Alton
Edwardsville
Wood River



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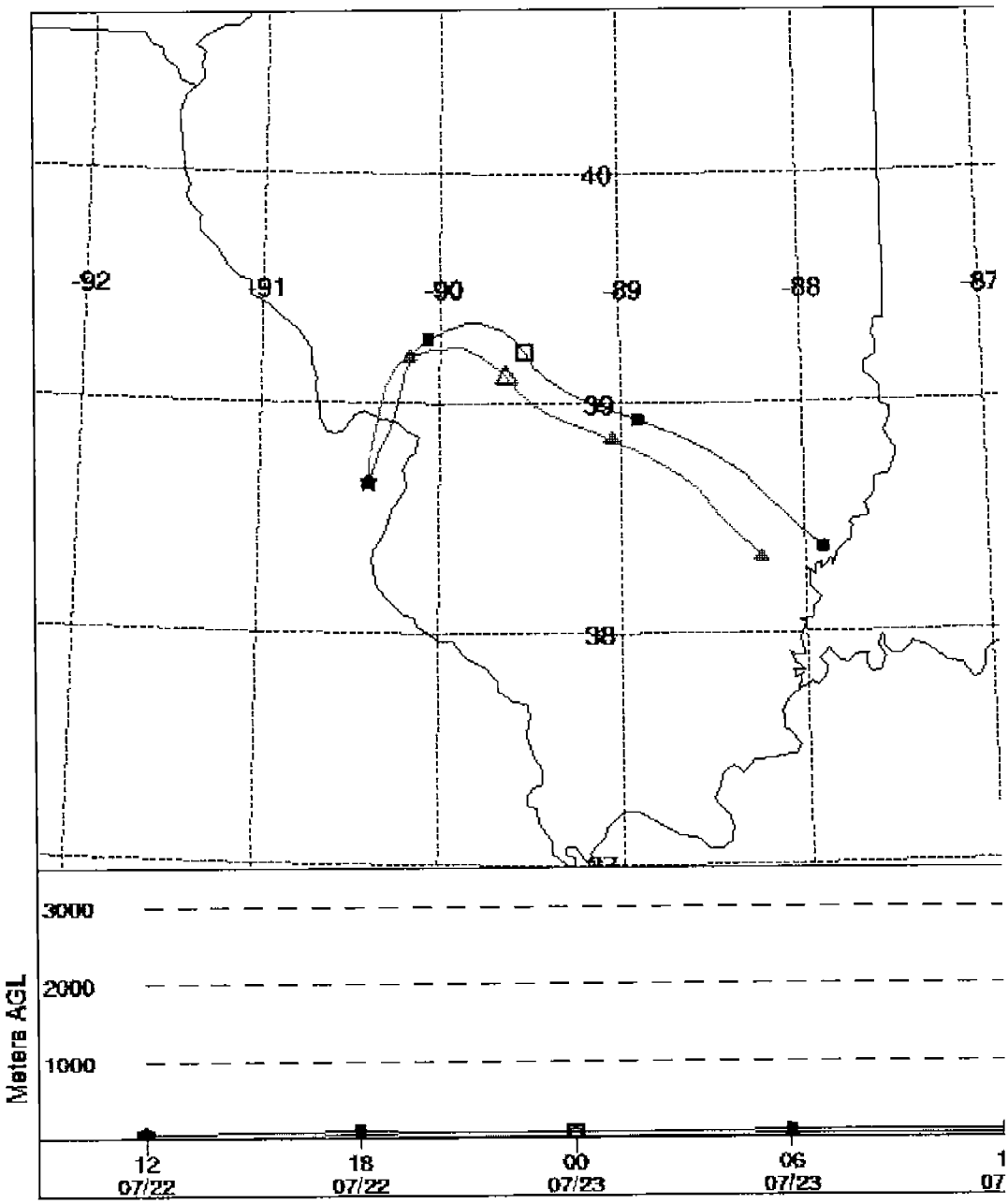
NOAA AIR RESOURCES LABORATORY

Forward Trajectories Starting- 12 UTC 22 JUL 98

Flo Valley
Alton
Edwardsville
Wood River

Source Location ★ at 38.65 N 90.39 W



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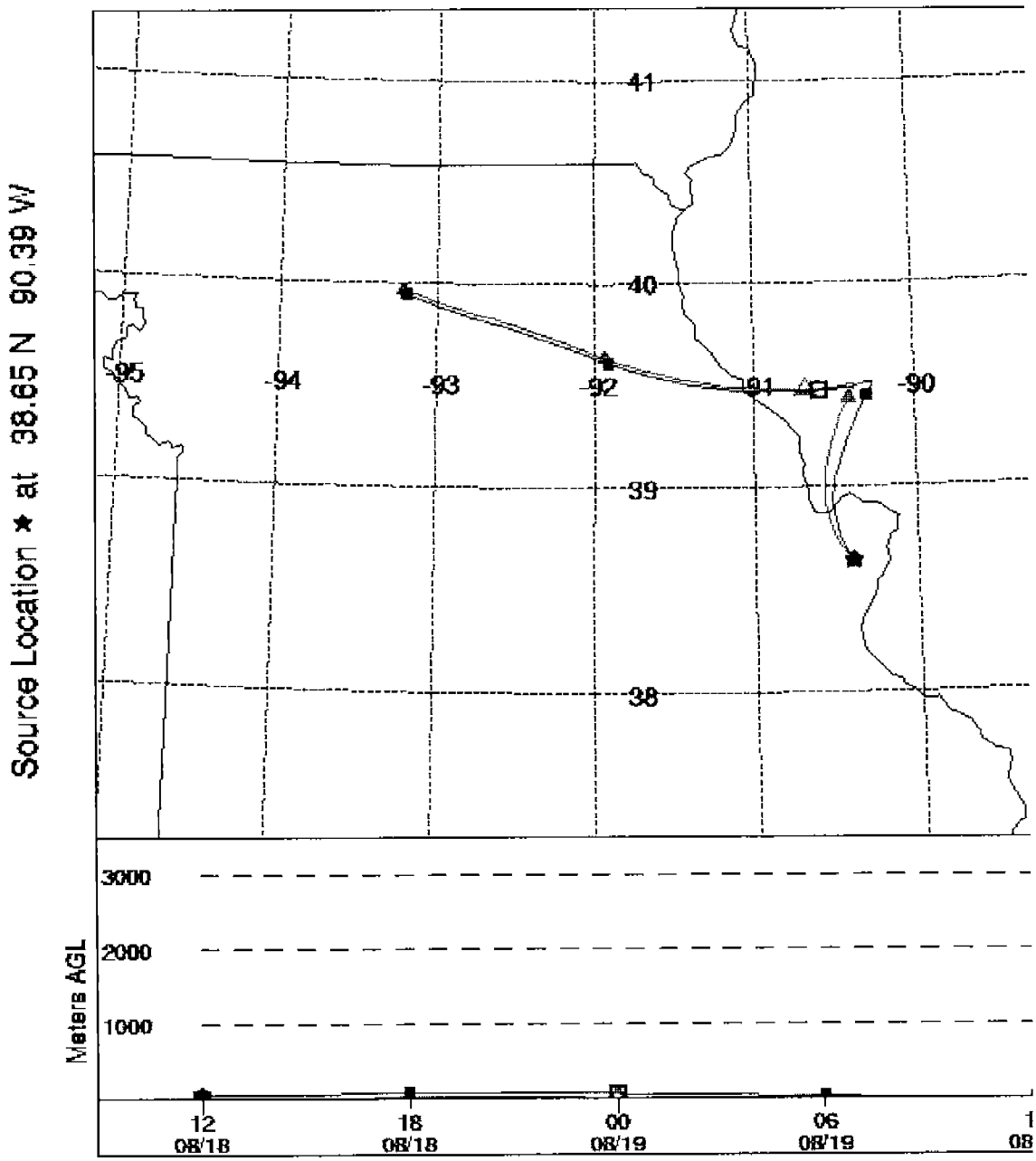
NOAA AIR RESOURCES LABORATORY

Forward Trajectories Starting- 12 UTC 18 AUG 98

West Alton



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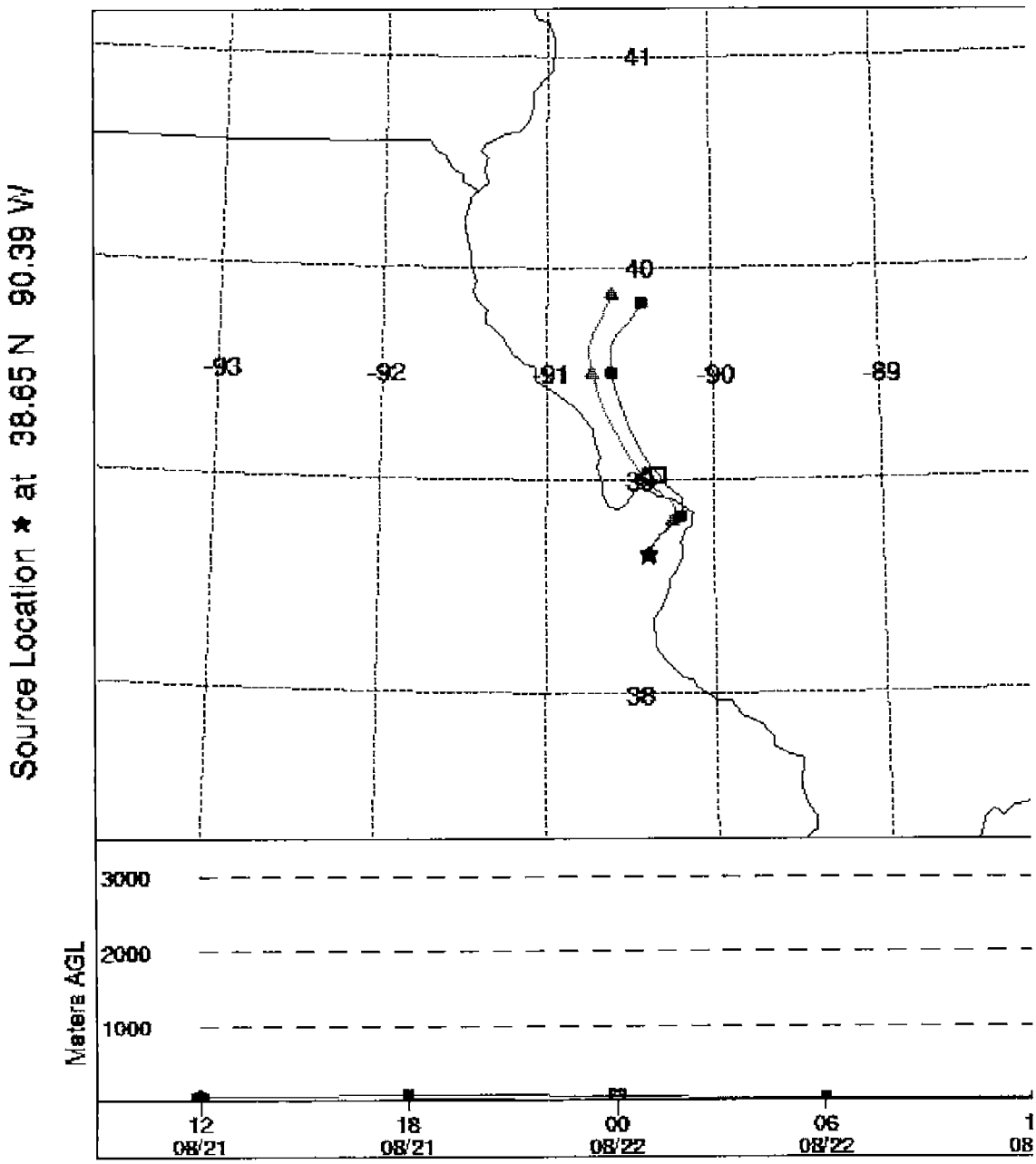
Forward Trajectories Starting- 12 UTC 21 AUG 98

West Alton
Orchard Farm
Lindbergh
St. Ann
Queeny
Bonne Terre



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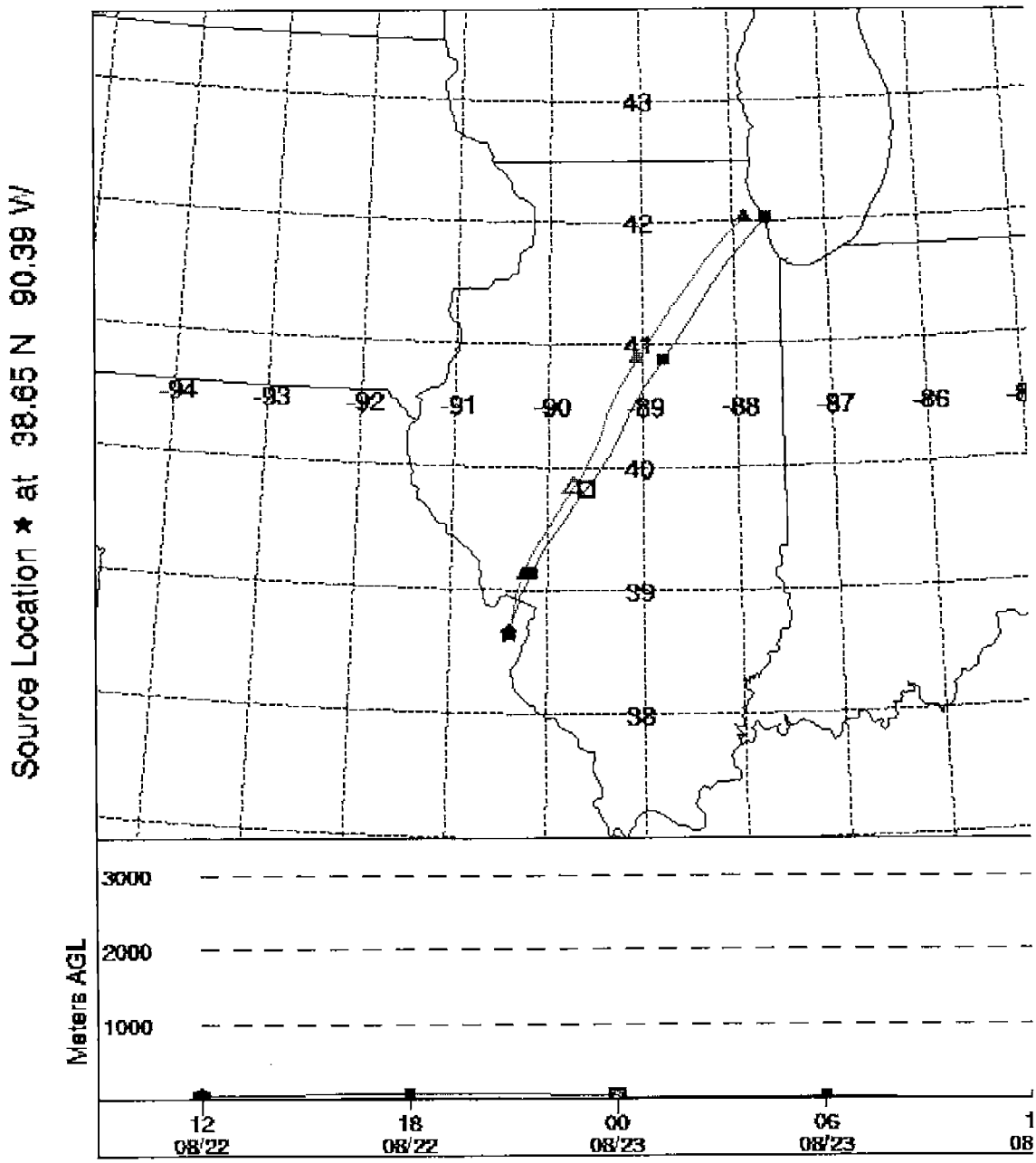
Forward Trajectories Starting- 12 UTC 22 AUG 98

West Alton



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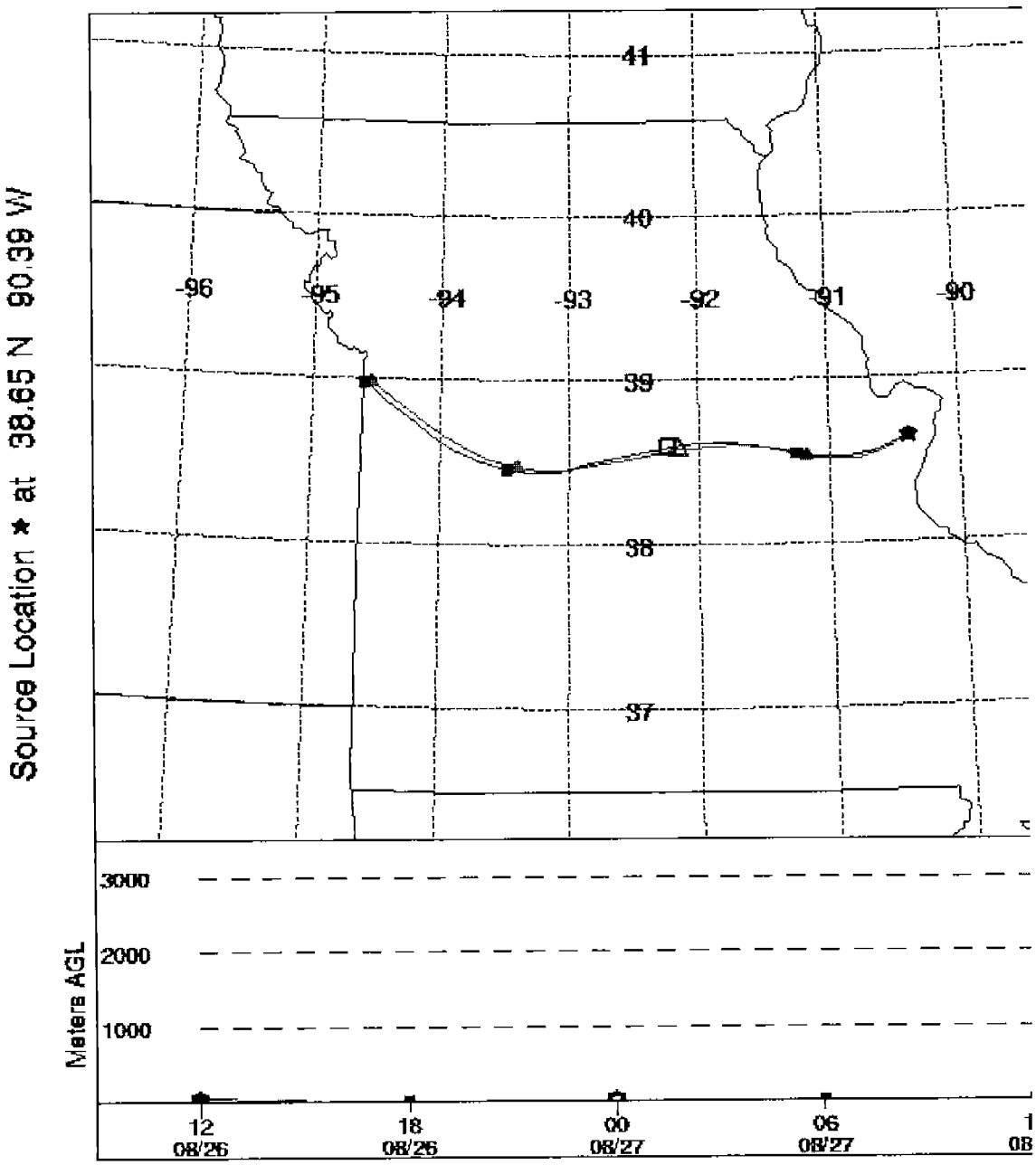
Forward Trajectories Starting- 12 UTC 26 AUG 98

Lindbergh



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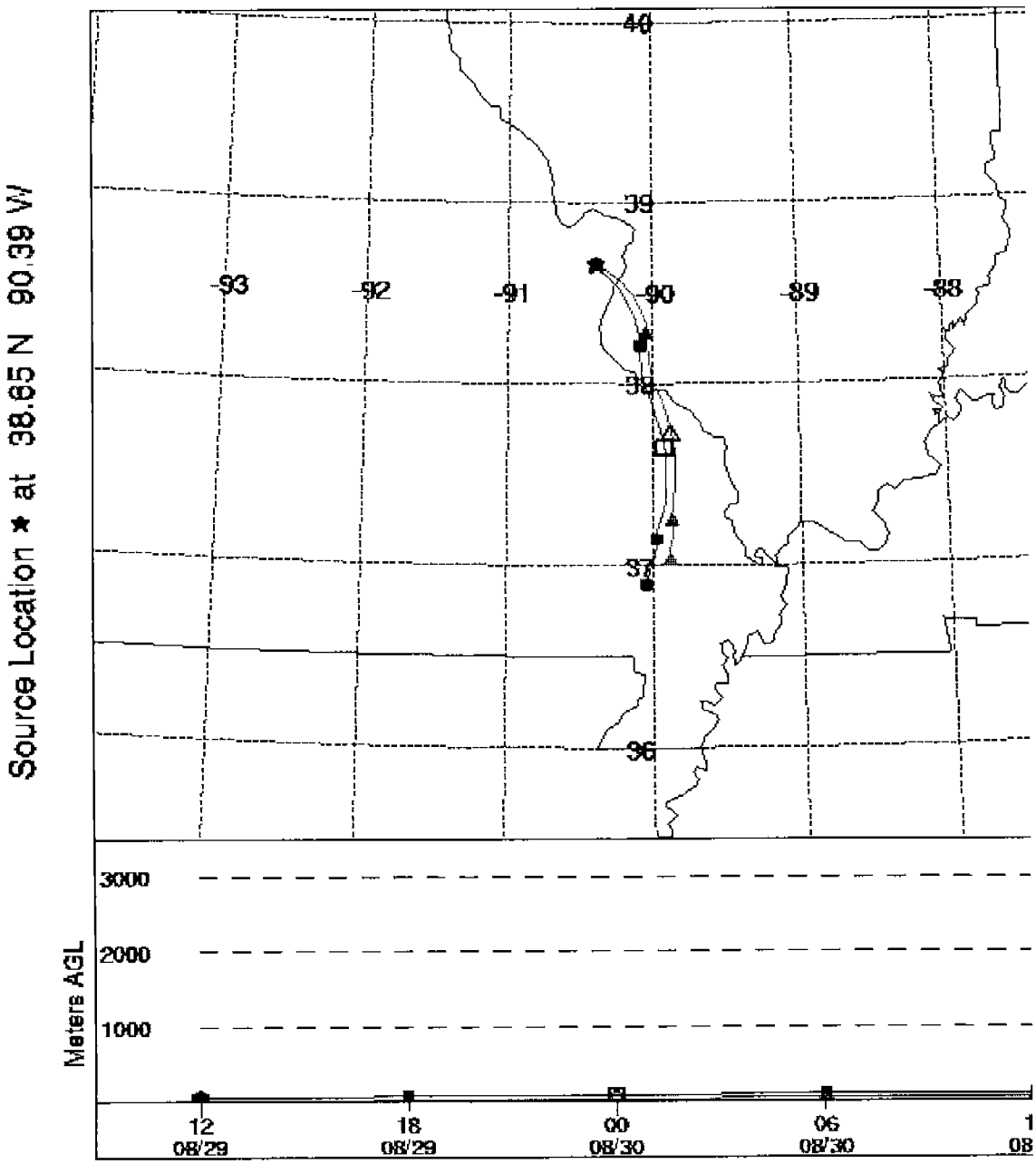
Forward Trajectories Starting- 12 UTC 29 AUG 98

Arnold



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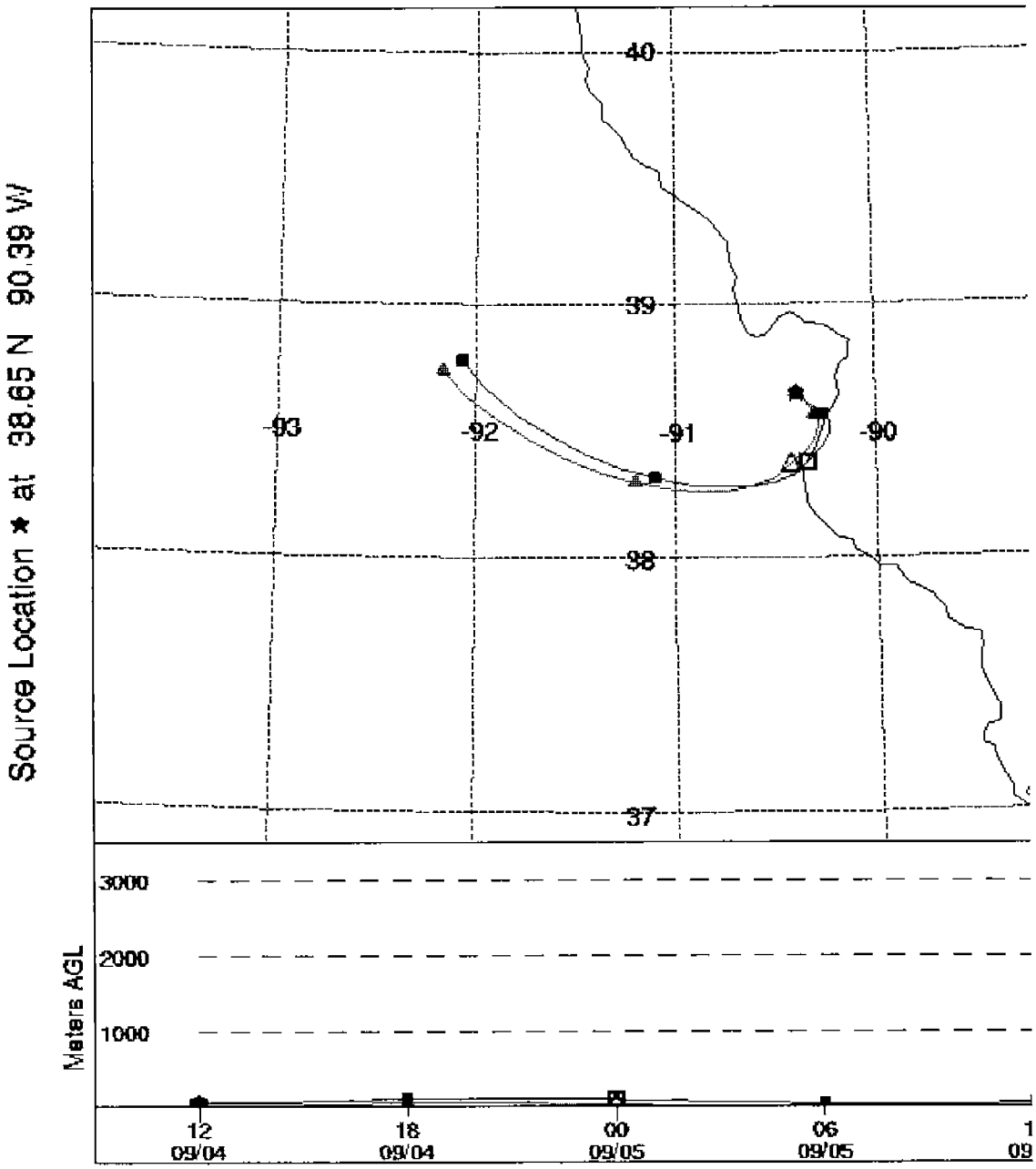
Forward Trajectories Starting- 12 UTC 04 SEP 98

Arnold
West Alton
Lindbergh
Flo Valley
St. Ann
Queeny
Hunter
Broadway
Clark
Newstead
Manyville
East St. Louis
Bonne Terre



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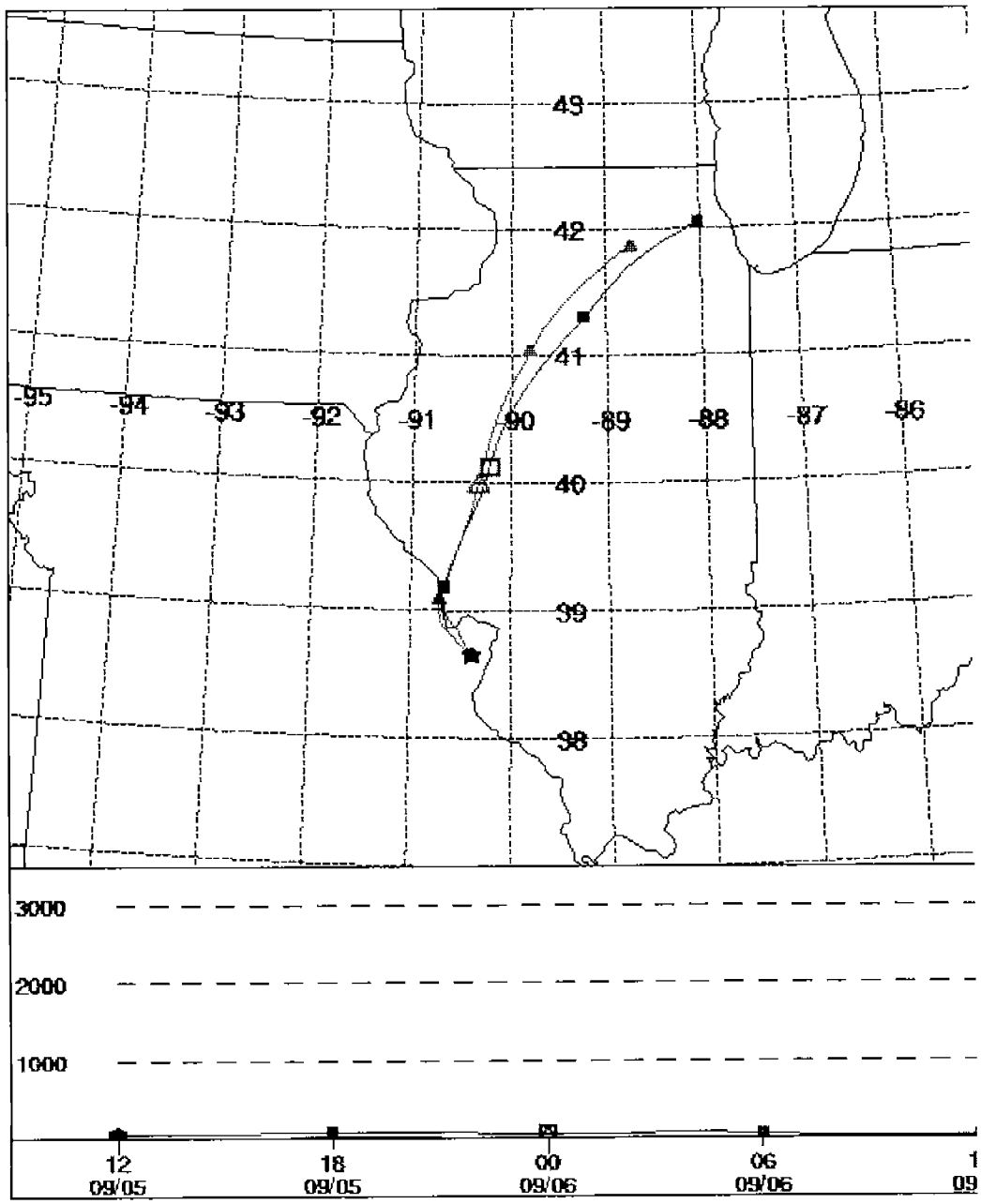
Forward Trajectories Starting- 12 UTC 05 SEP 98

West Alton
Flo Valley
Jerseyville

Source Location ★ at 38.65 N 90.39 W



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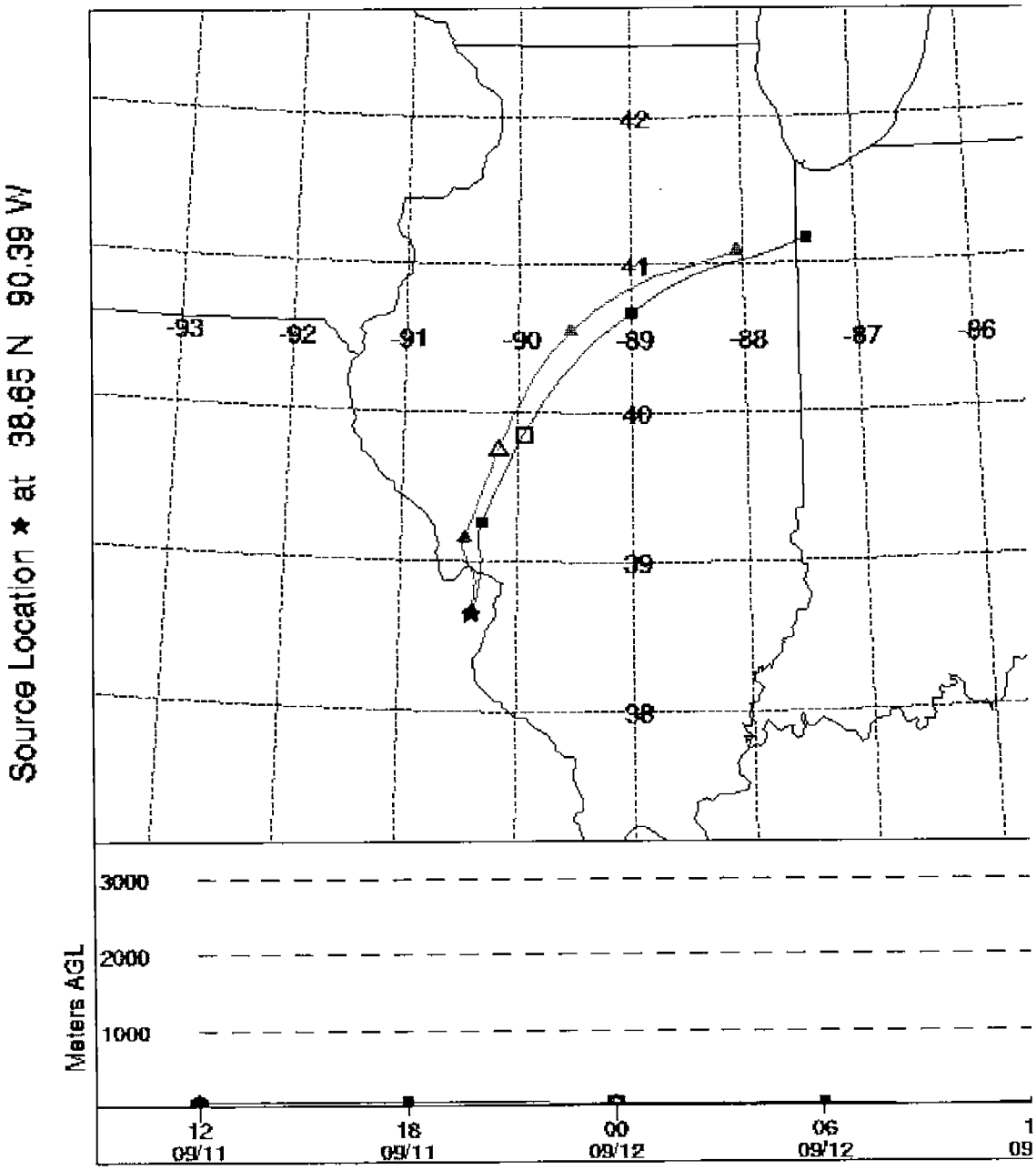
Forward Trajectories Starting- 12 UTC 11 SEP 98

Arnold
West Alton
Lindbergh
Flo Valley
Queeny
Jerseyville
Bonne Terre



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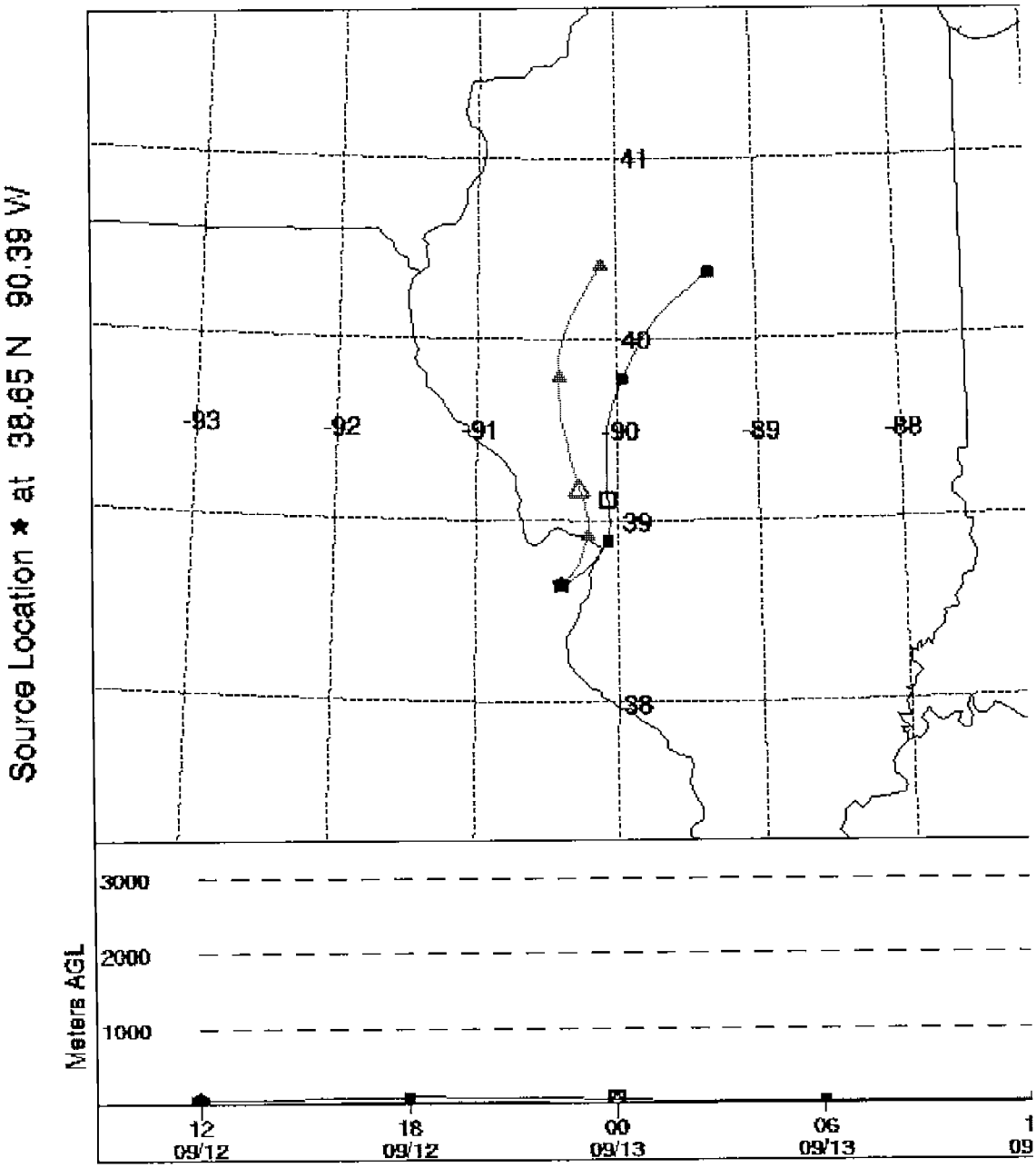
Forward Trajectories Starting- 12 UTC 12 SEP 98

West Alton
Flo Valley
Jerseyville
Bonne Terre



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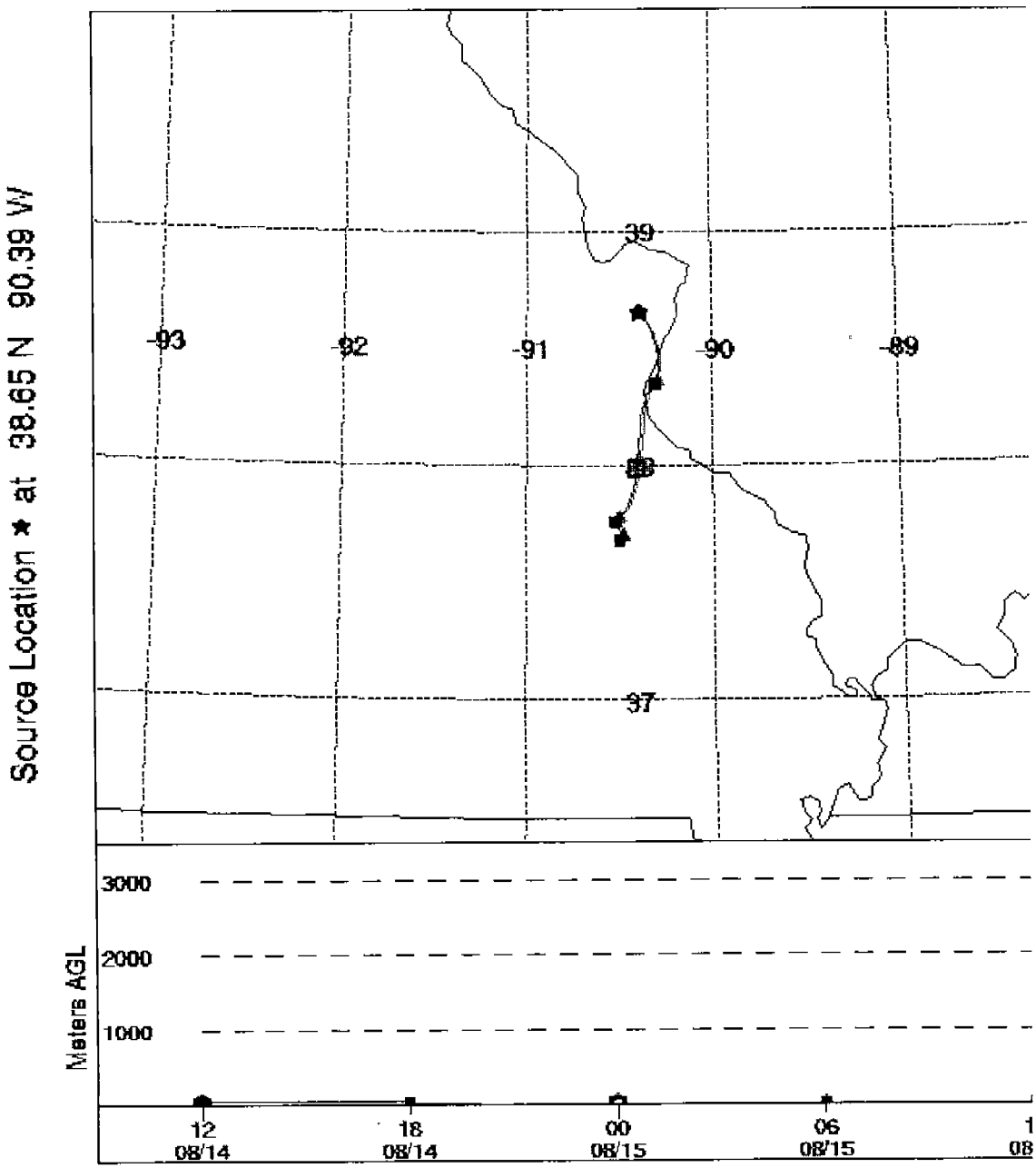
Forward Trajectories Starting- 12 UTC 14 AUG 98

Arnold
Bonne Terre



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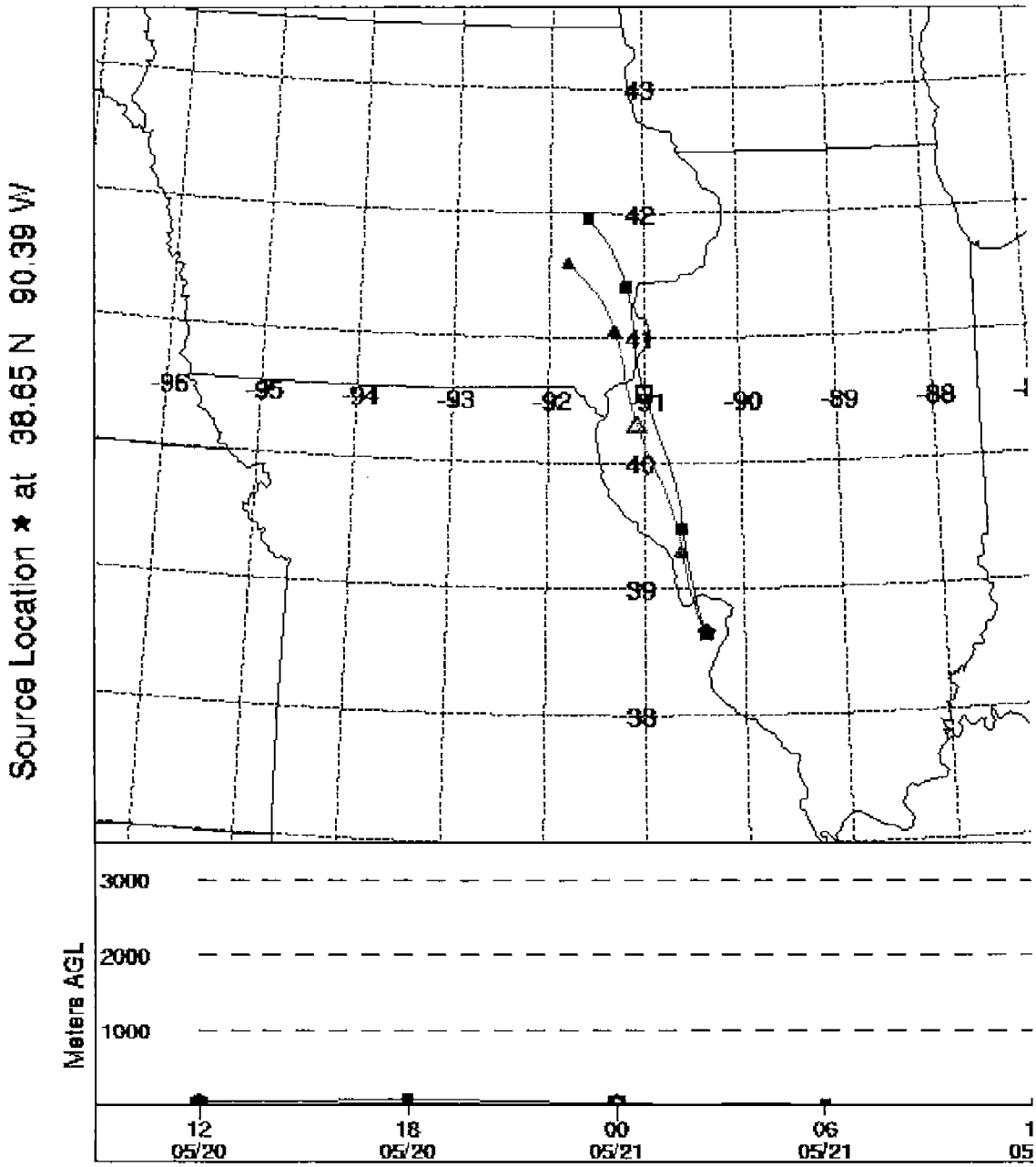
Forward Trajectories Starting- 12 UTC 20 MAY 99

Arnold



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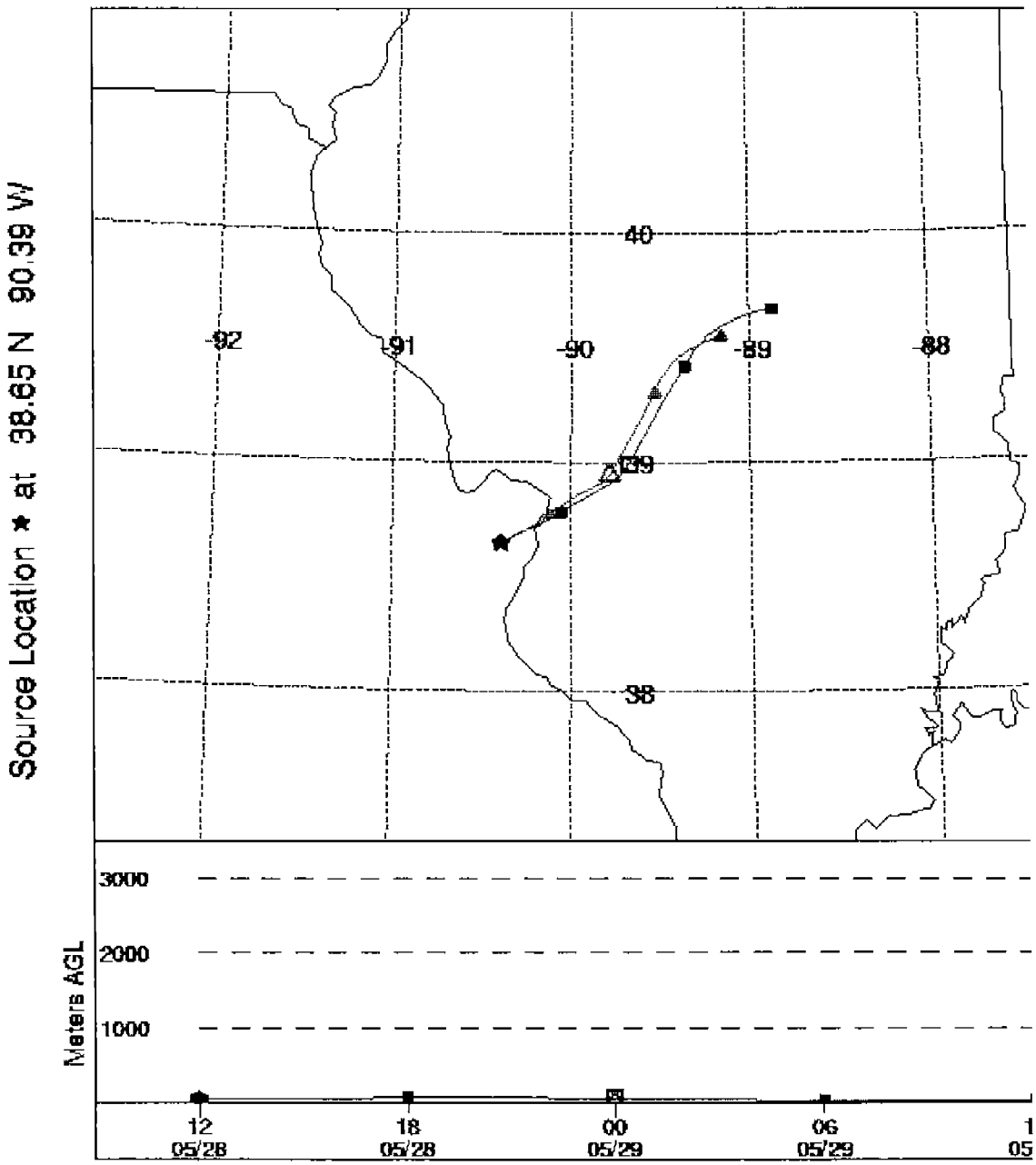
Forward Trajectories Starting- 12 UTC 28 MAY 99

West Alton
Arnold
Flo Valley
Effingham



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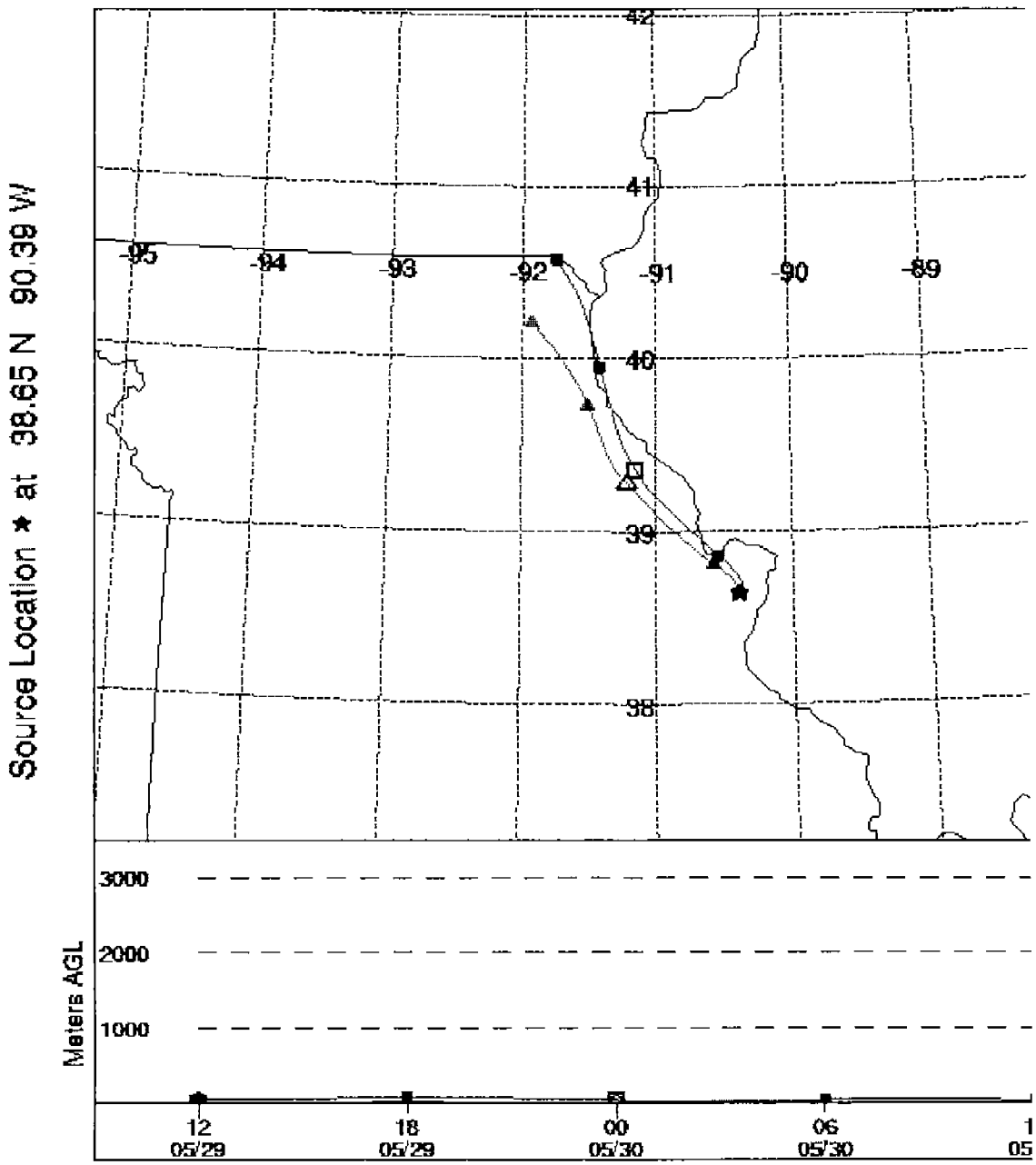
Forward Trajectories Starting- 12 UTC 29 MAY 99

West Alton
Arnold
Orchard Farm
Bonne Terre
Queeny Park
St. Ann
Flo Valley
Hunter
Lindbergh
Broadway
Newstead
Houston
Effingham
Poag
Mahynile
Alton



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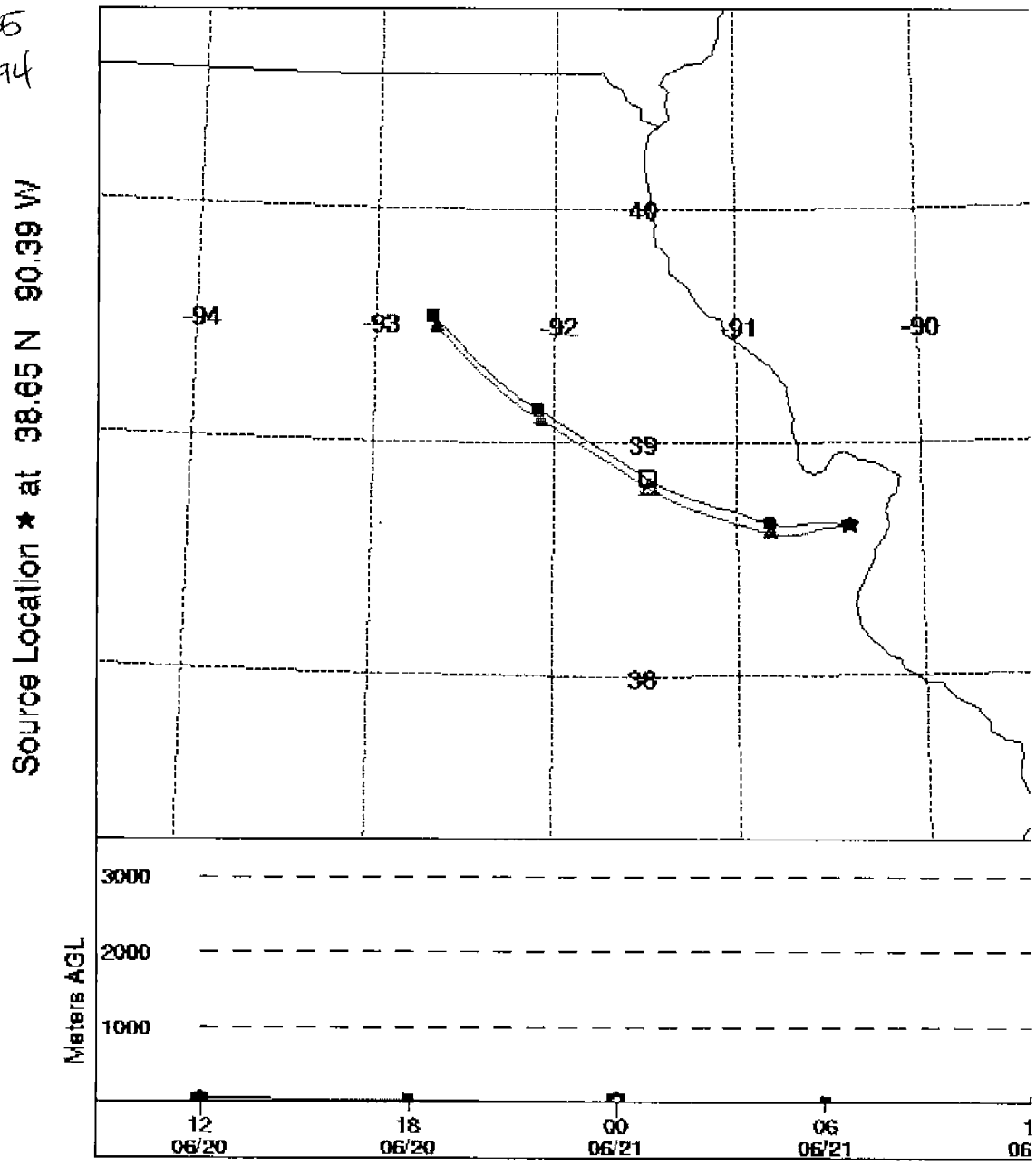
Forward Trajectories Starting- 12 UTC 20 JUN 99

West Alton .086
Orchard Farm .094
St. Ann .088
Hunter .085



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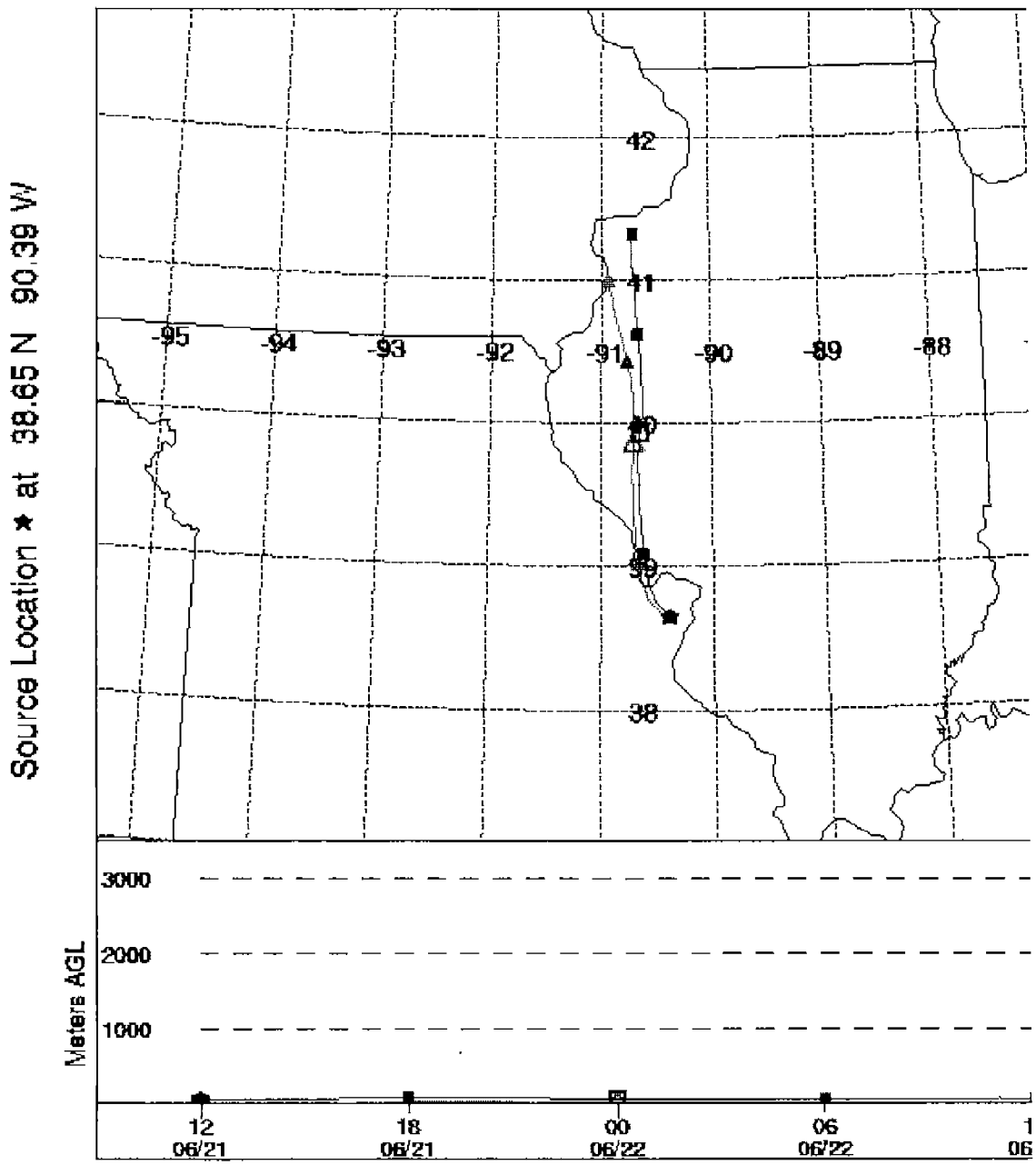
Forward Trajectories Starting- 12 UTC 21 JUN 99

West Alton .086



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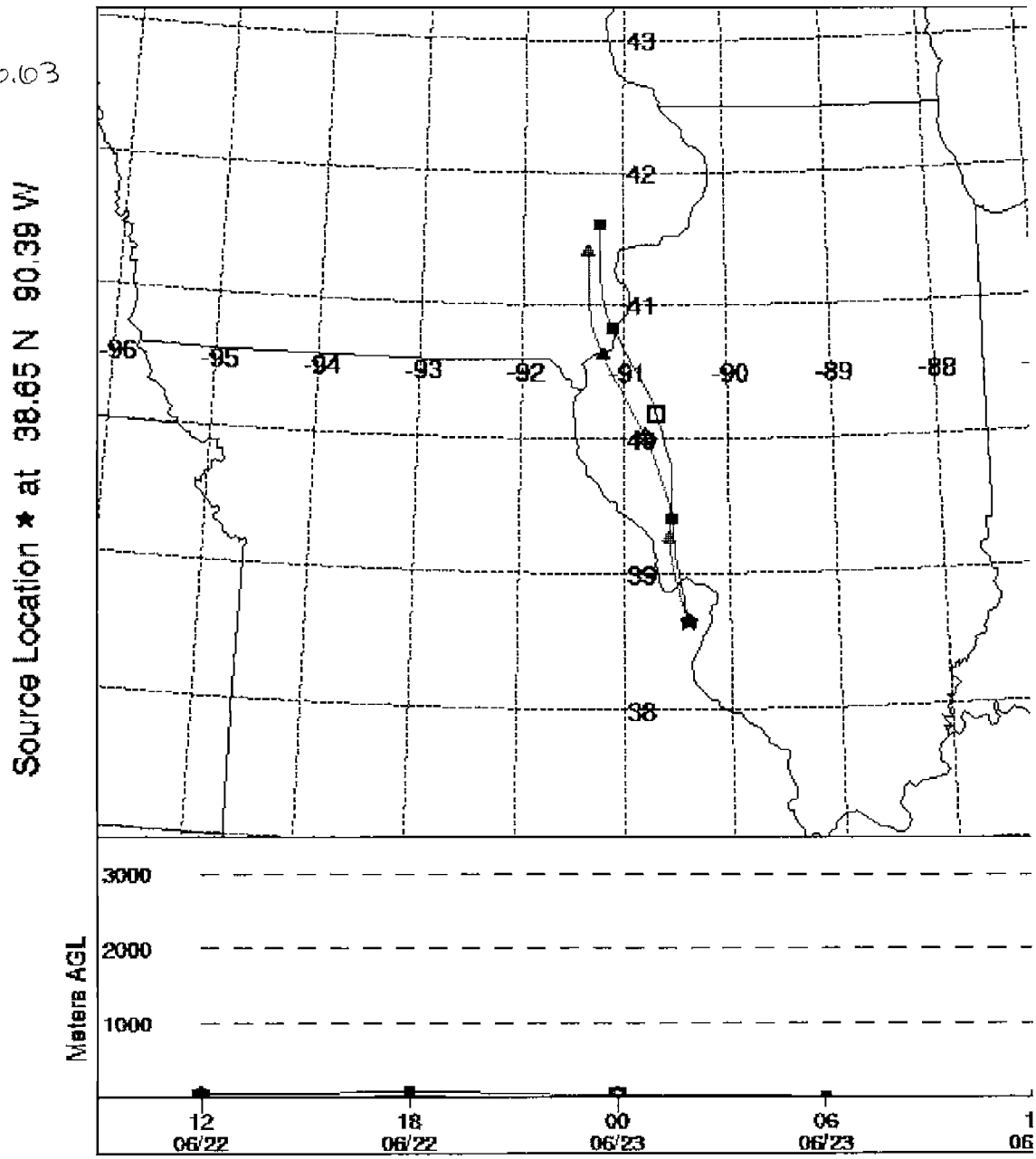
Forward Trajectories Starting- 12 UTC 22 JUN 99

West Alton .091
Effingham 86.03
Houston 88.25



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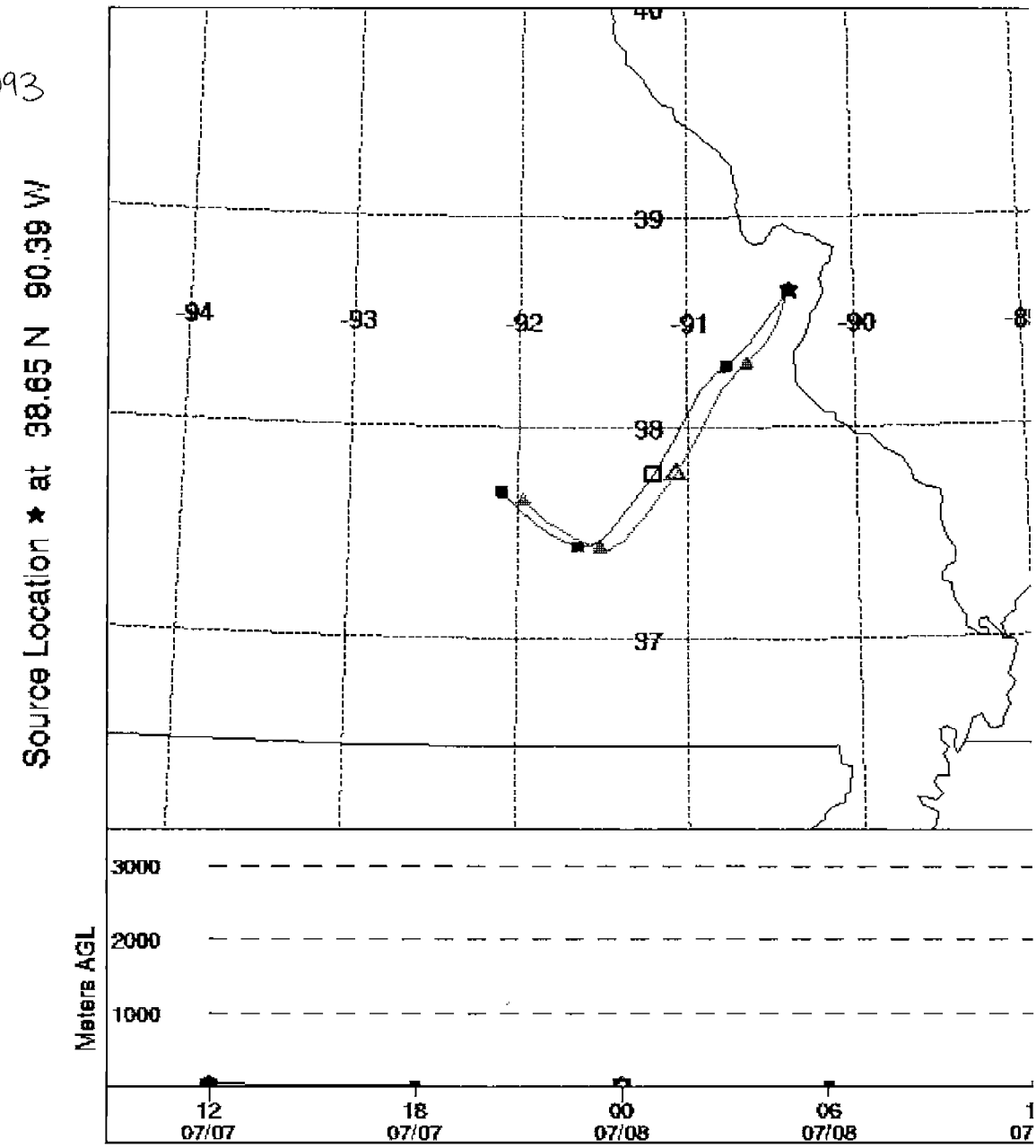
NOAA AIR RESOURCES LABORATORY

Forward Trajectories Starting- 12 UTC 07 JUL 99

Arnold .089
Bonne Terre .093



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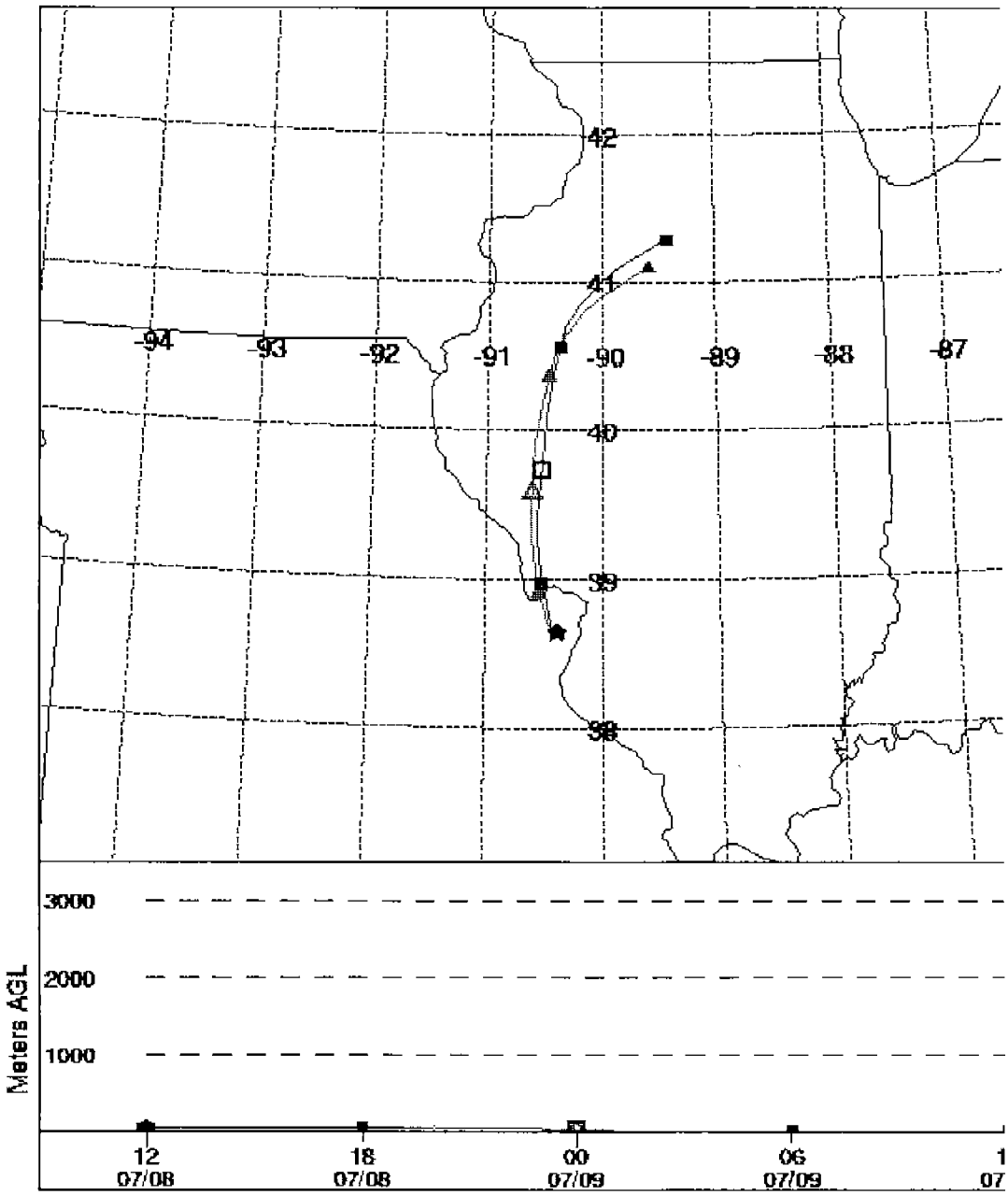
Forward Trajectories Starting- 12 UTC 08 JUL 99

West Alton .095
Arnold .098
Orchard Farm .095
Queeny .088
St. Ann .087
Flo Valley .092
Lindbergh .086

Source Location ★ at 38.65 N 90.39 W



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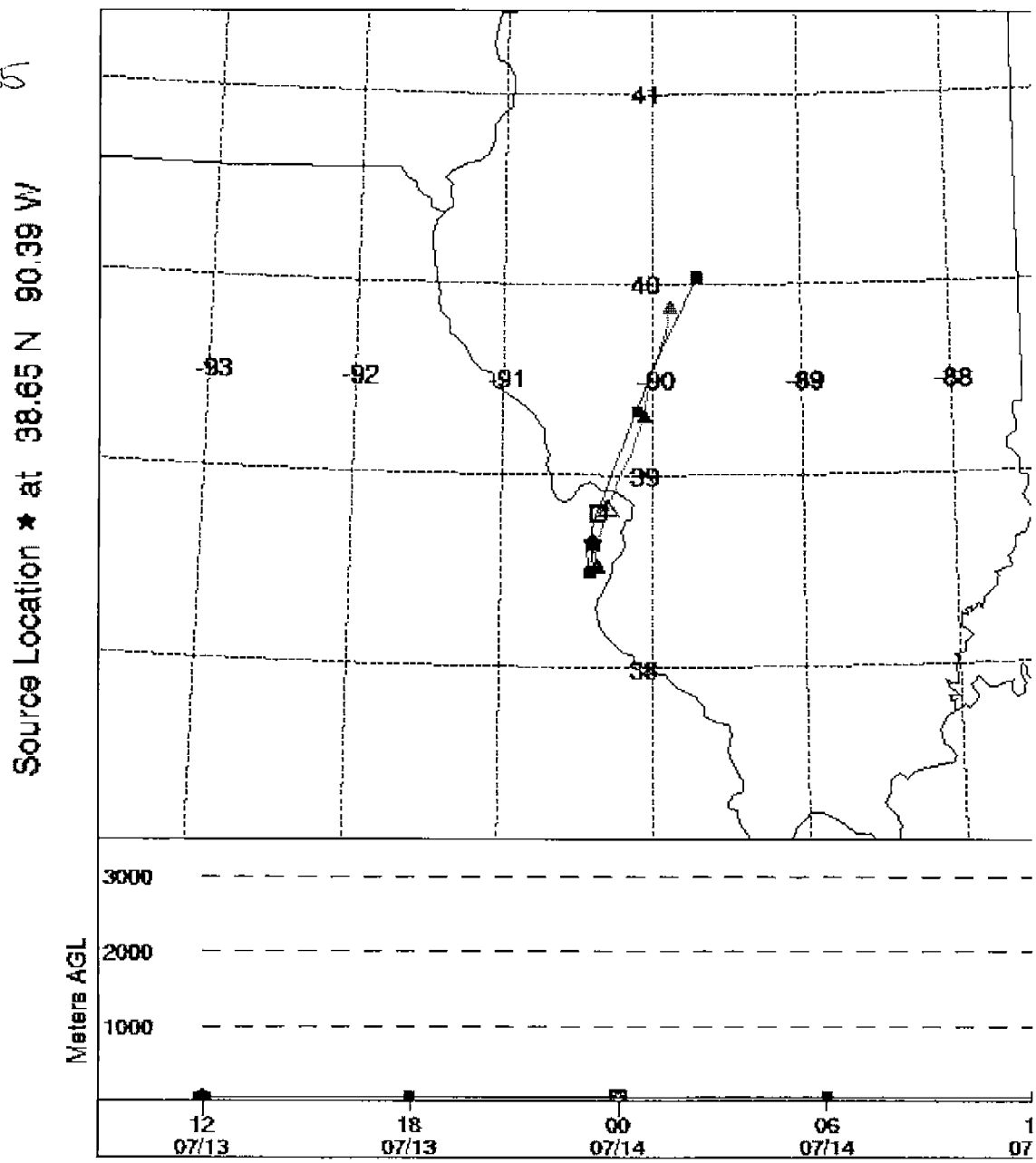
Forward Trajectories Starting- 12 UTC 13 JUL 99

West Alton .091
Orchard Farm .085
Bonne Terre .086
Quelny .088
St Ann .087



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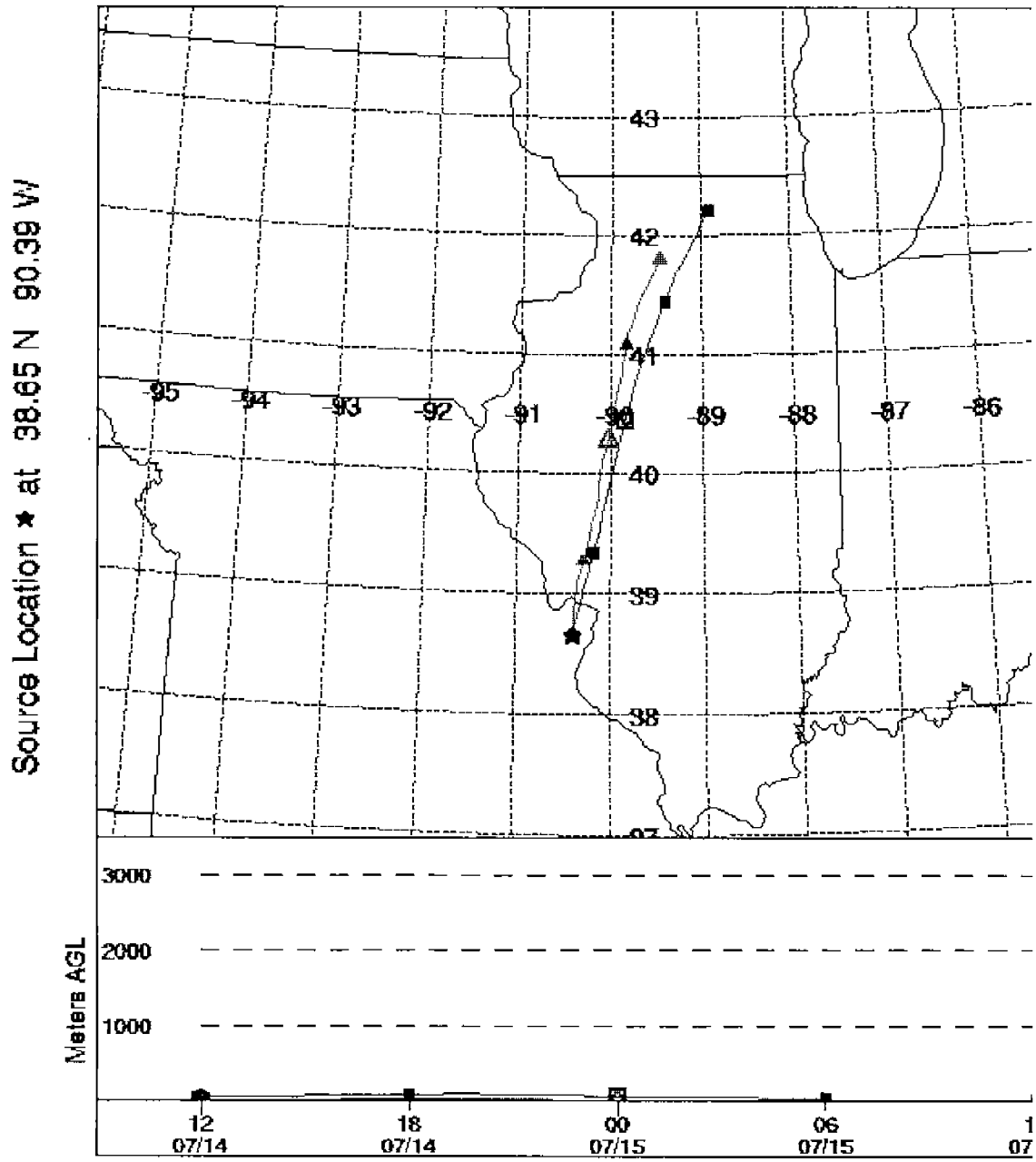
Forward Trajectories Starting- 12 UTC 14 JUL 99

West Alton .085



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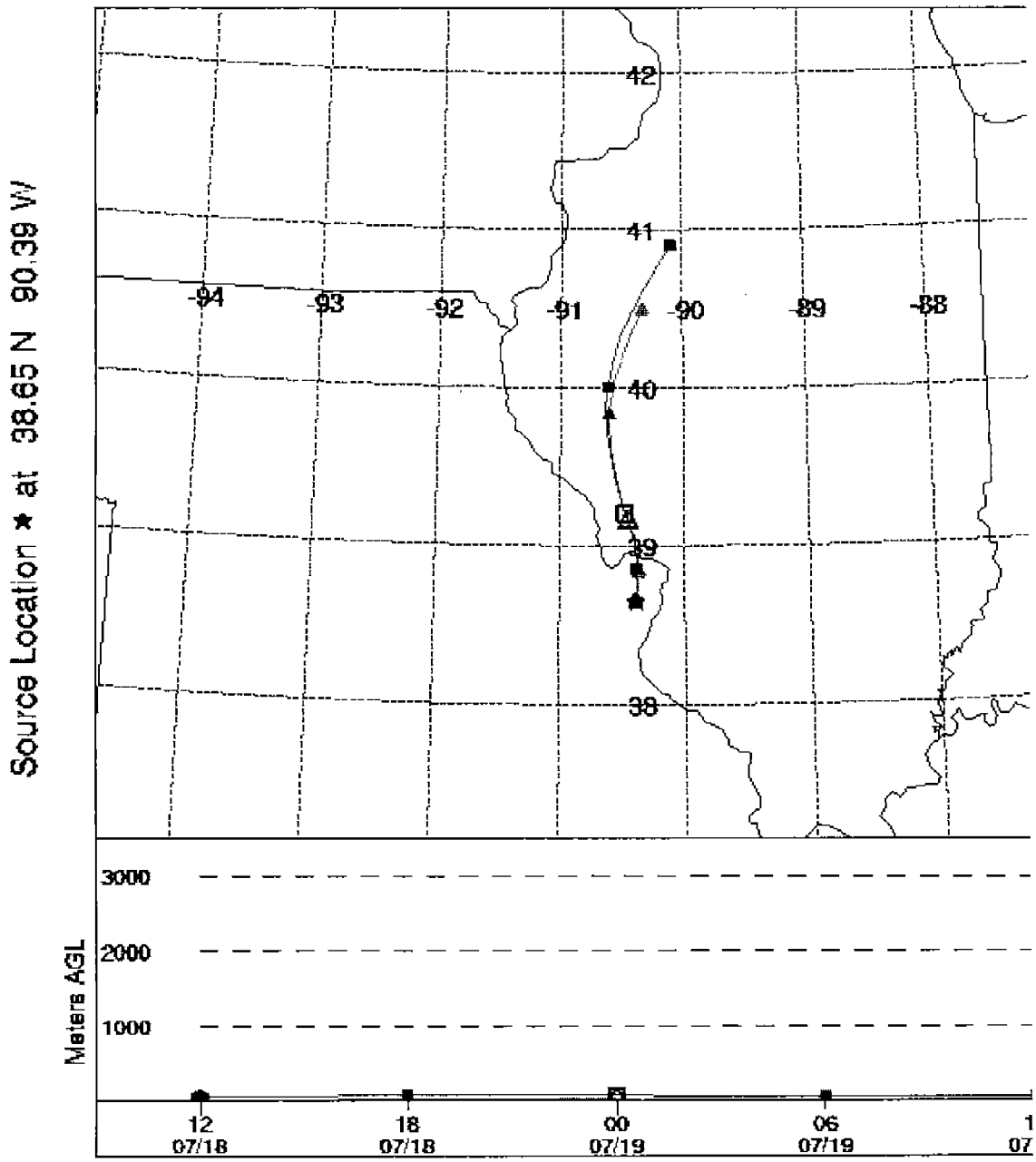
Forward Trajectories Starting- 12 UTC 18 JUL 99

West Alton .087



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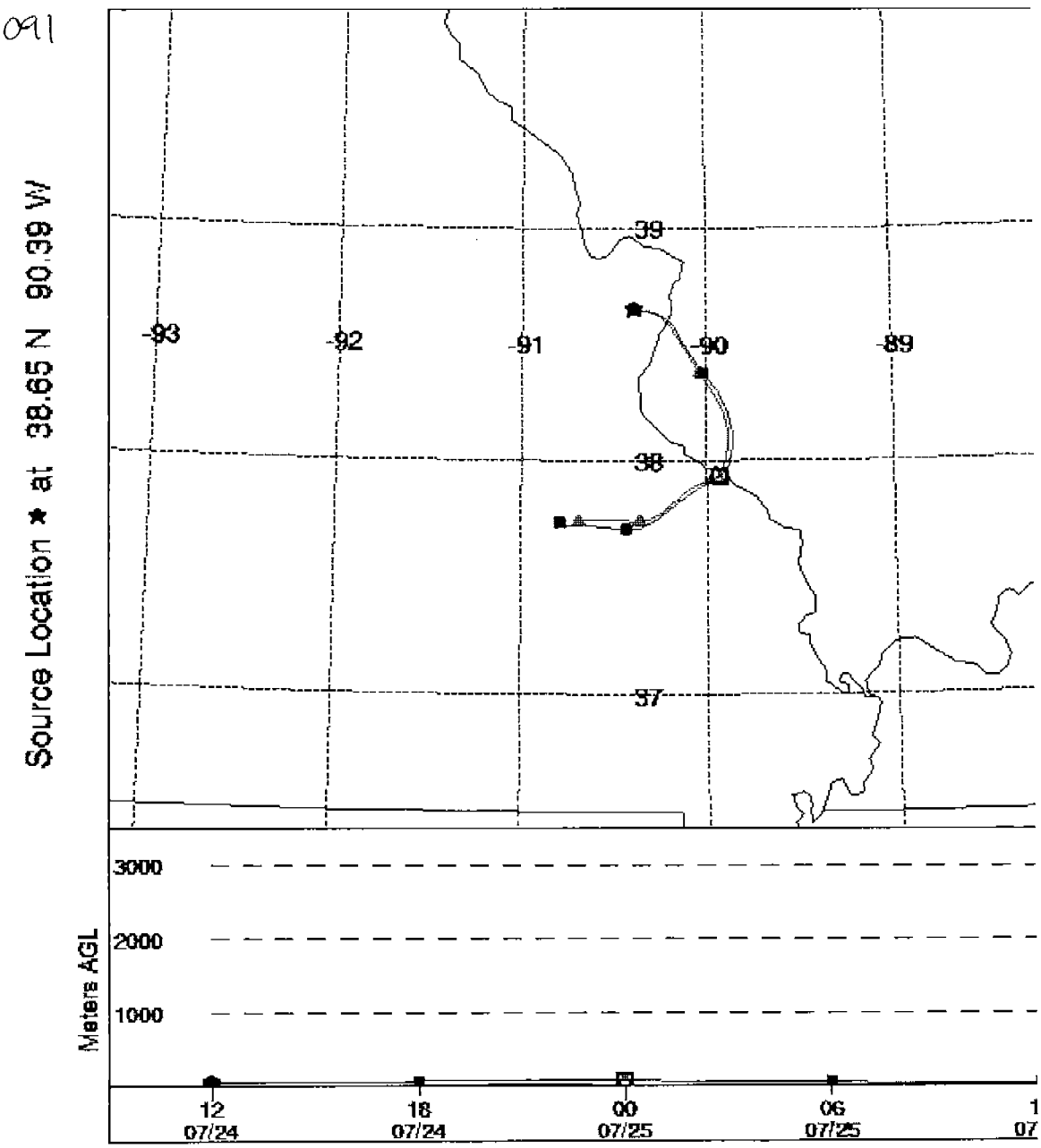
Forward Trajectories Starting- 12 UTC 24 JUL 99

Bonne Terre .091



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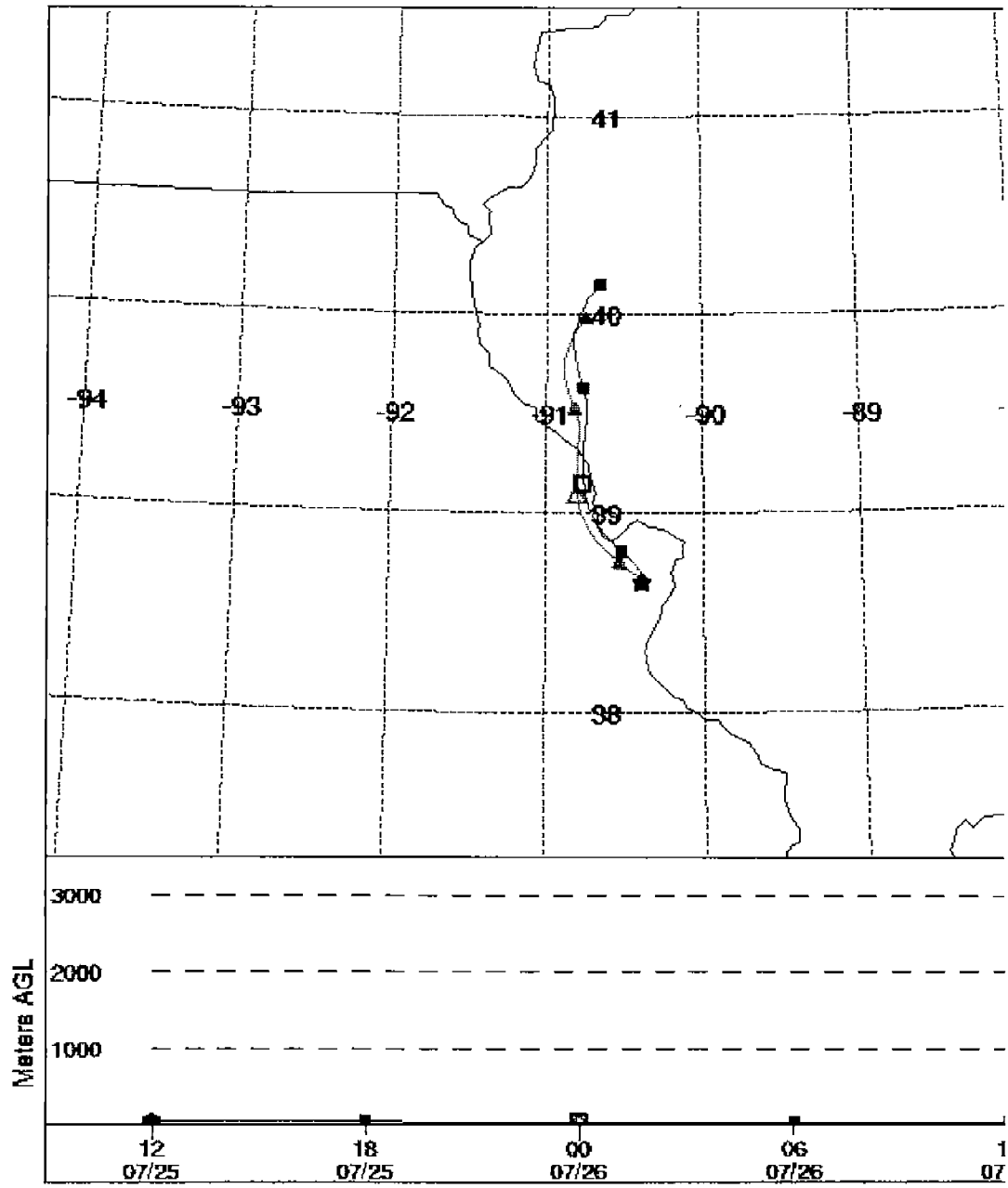
Forward Trajectories Starting- 12 UTC 25 JUL 99

W. Alton .110
Orchard Farm .098
Queeny .096
St. Ann .097
Flo Valley .095
Lindbergh .086
Wood River 91.13
Edwardsville 85.5
Alton 97.13



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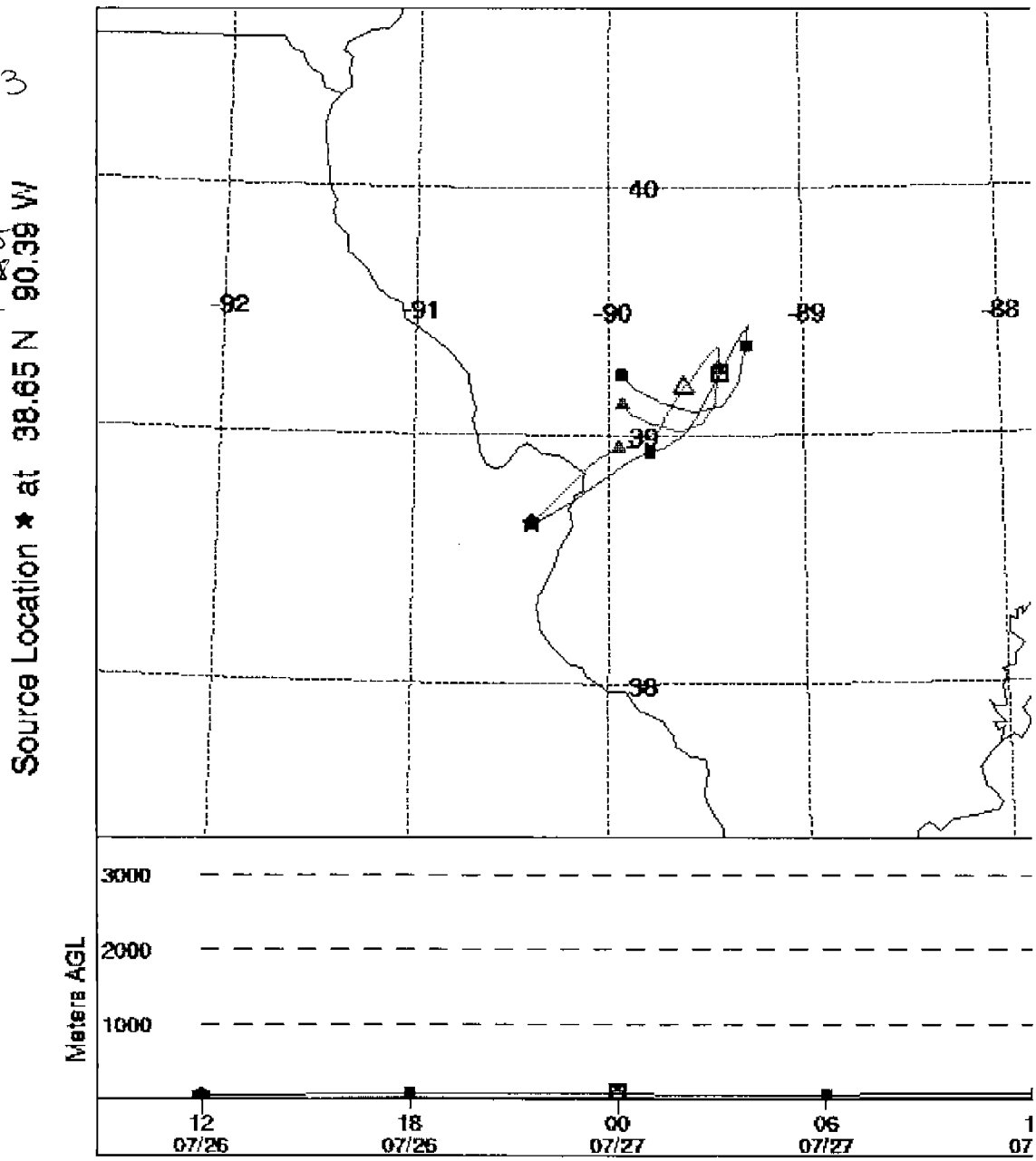
Forward Trajectories Starting- 12 UTC 26 JUL 99

St. Ann .087
Flo Valley .093
Clark .090
Newstead .087
East St. Louis ~~[illegible]~~ 89.88
Edwardsville 88.75
Maryville 85.13



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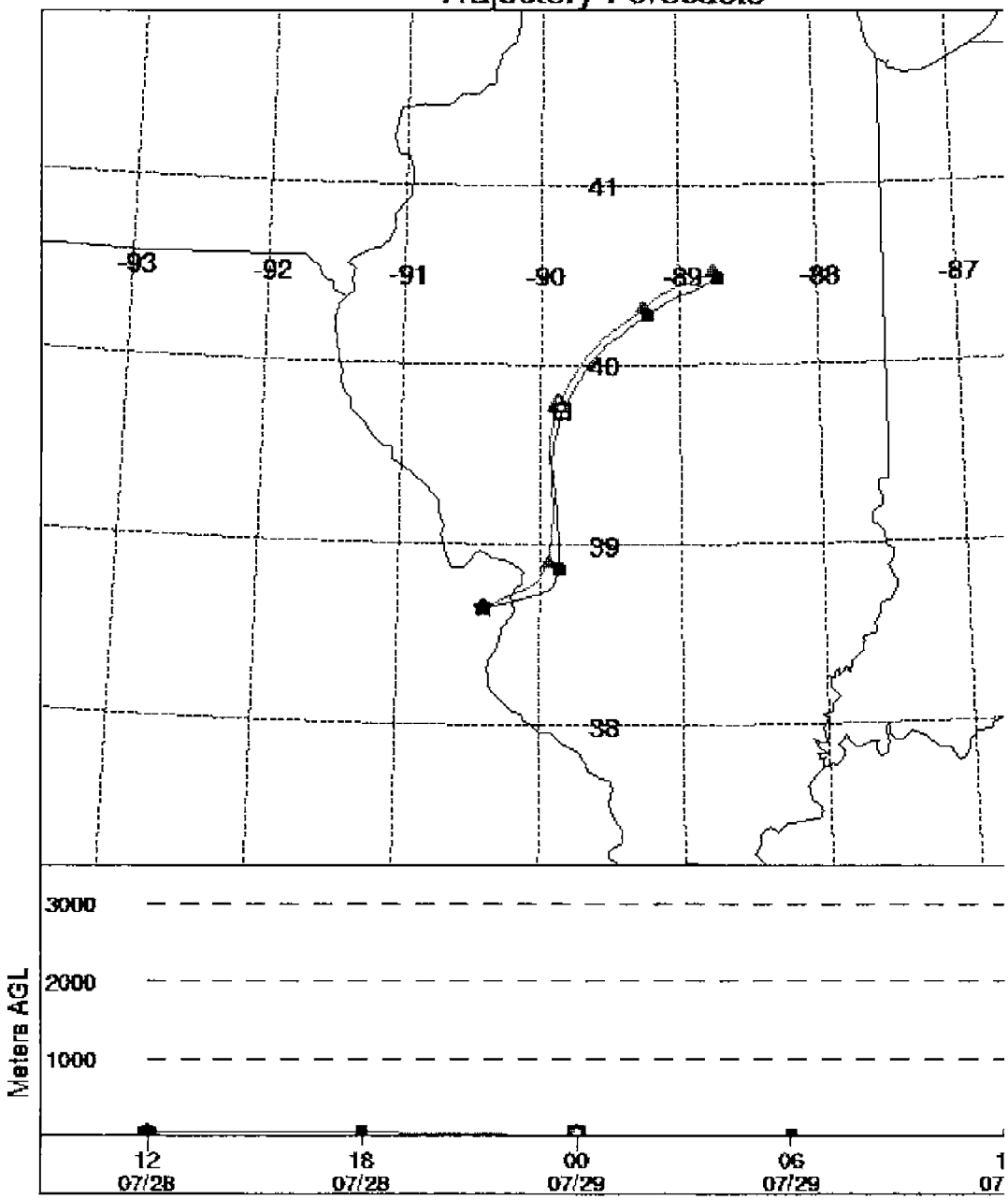
Forward Trajectories Starting- 12 UTC 28 JUL 99

Trajectory Forecasts

West Alton .086

Source Location ★ at 38.65 N 90.39 W



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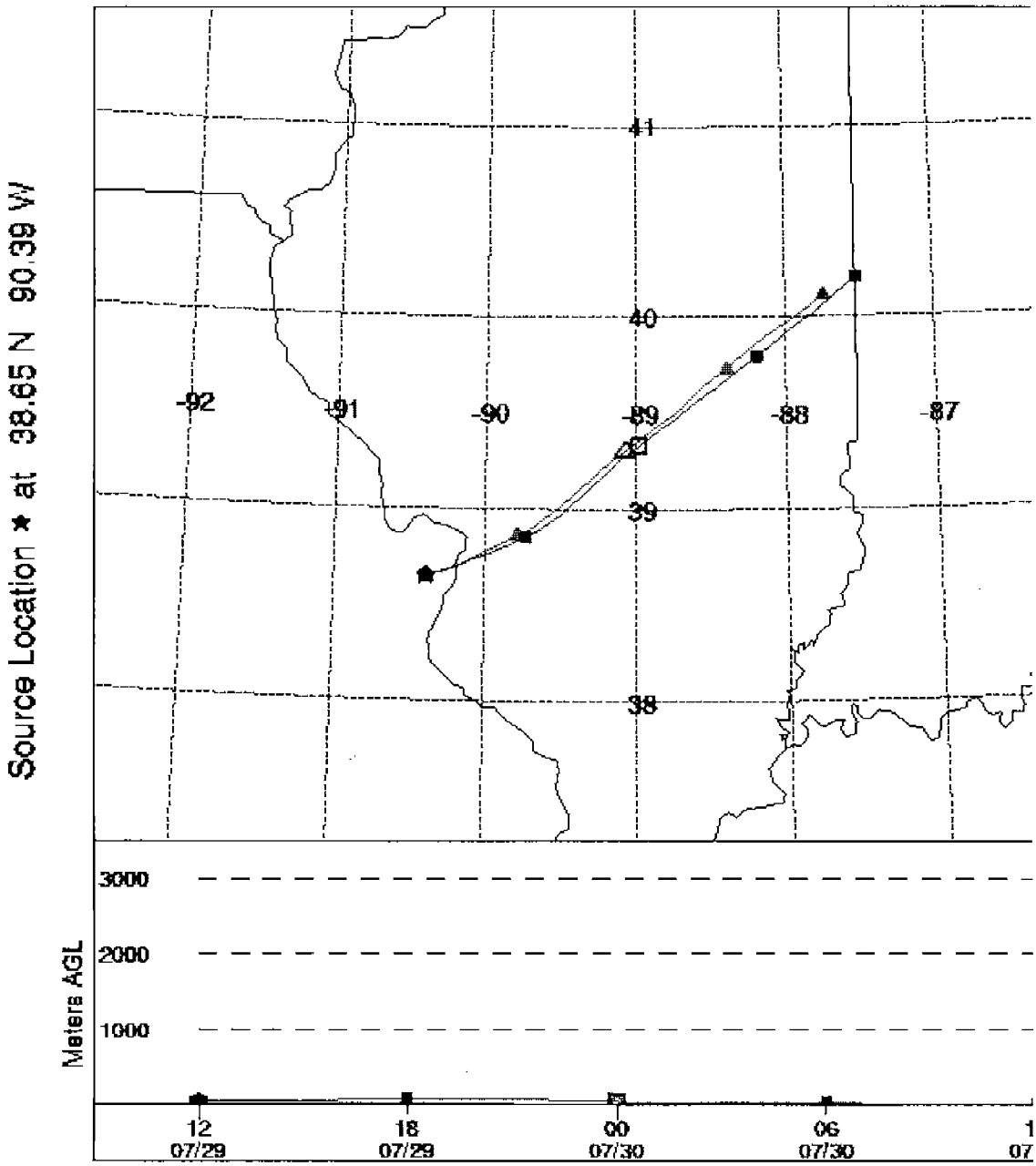
Forward Trajectories Starting- 12 UTC 29 JUL 99

Flo Valley .085
East St. Louis 55
Maryville 104.58



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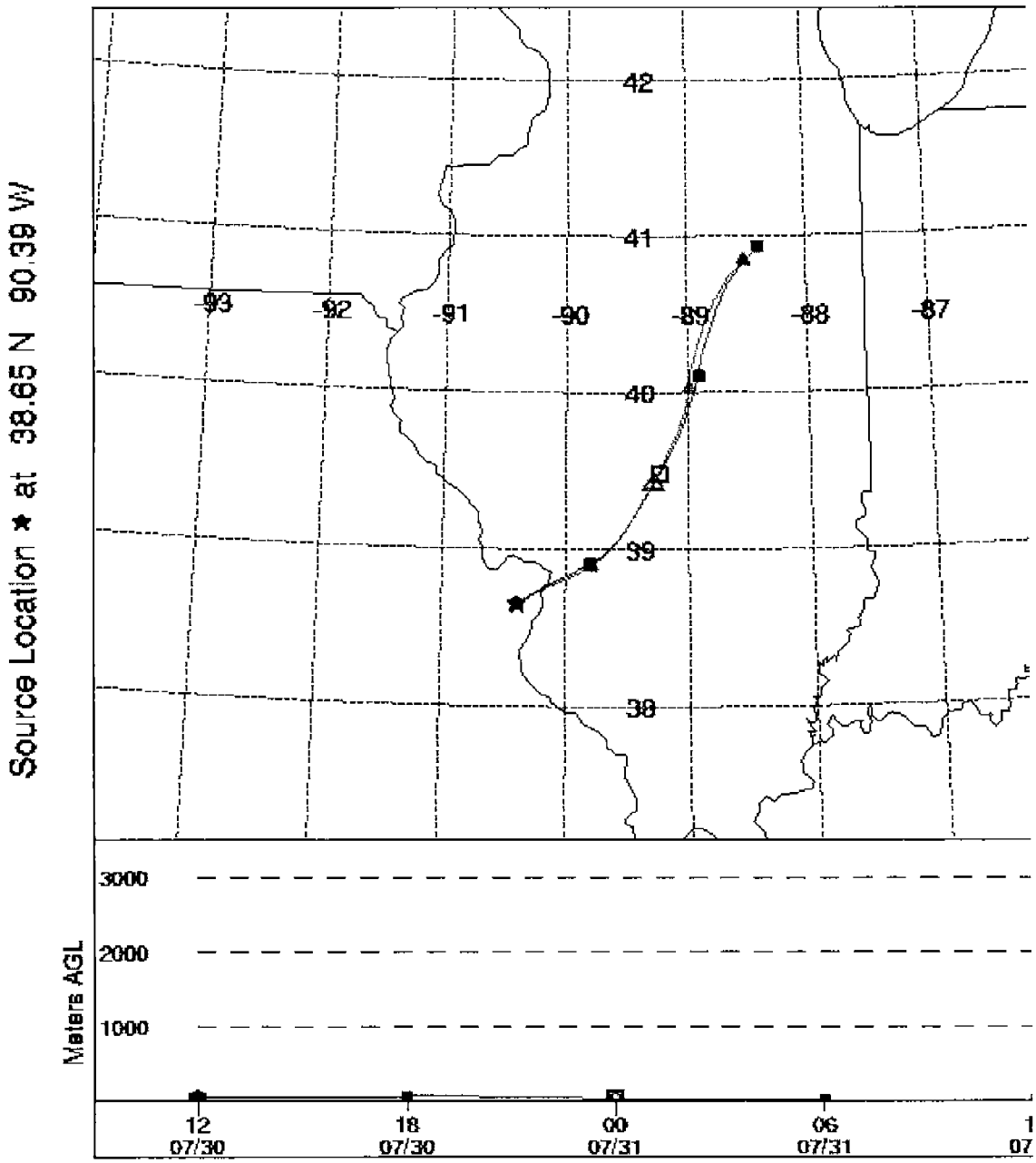
Forward Trajectories Starting- 12 UTC 30 JUL 99

W. Alton .088
Alton 89.13



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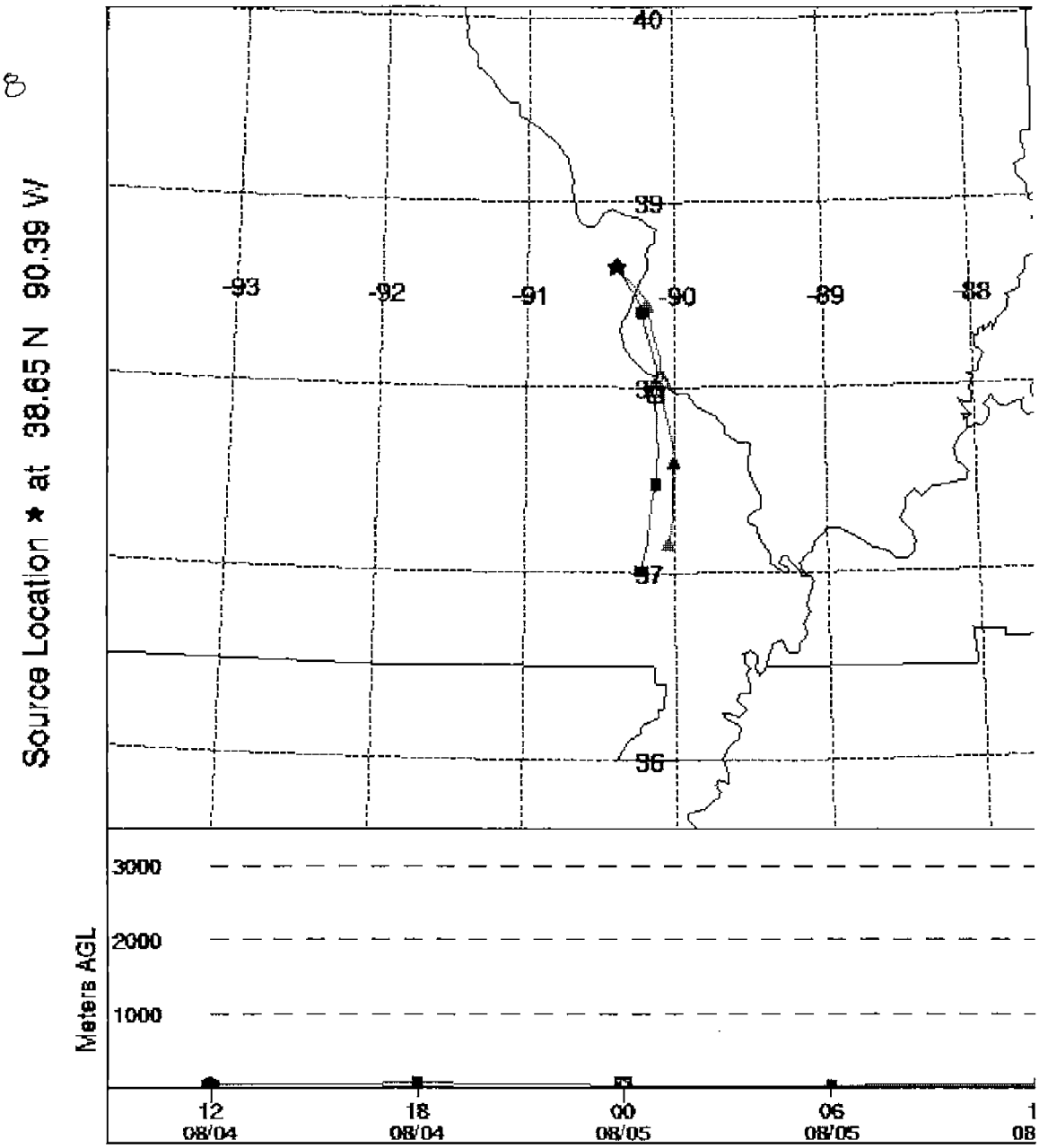
Forward Trajectories Starting- 12 UTC 04 AUG 99

Effingham 95.38



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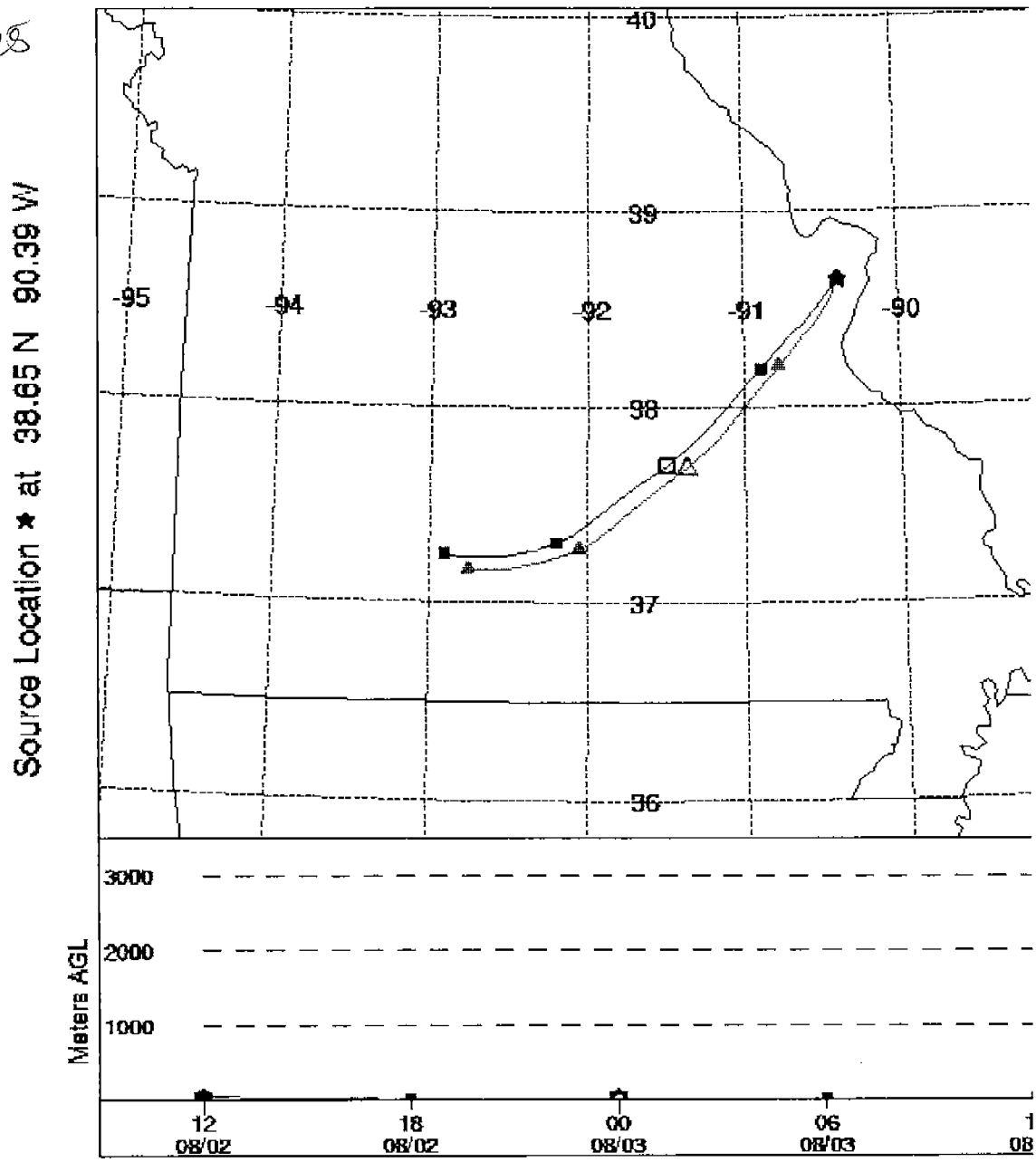
Forward Trajectories Starting- 12 UTC 02 AUG 99

Effingham 9428



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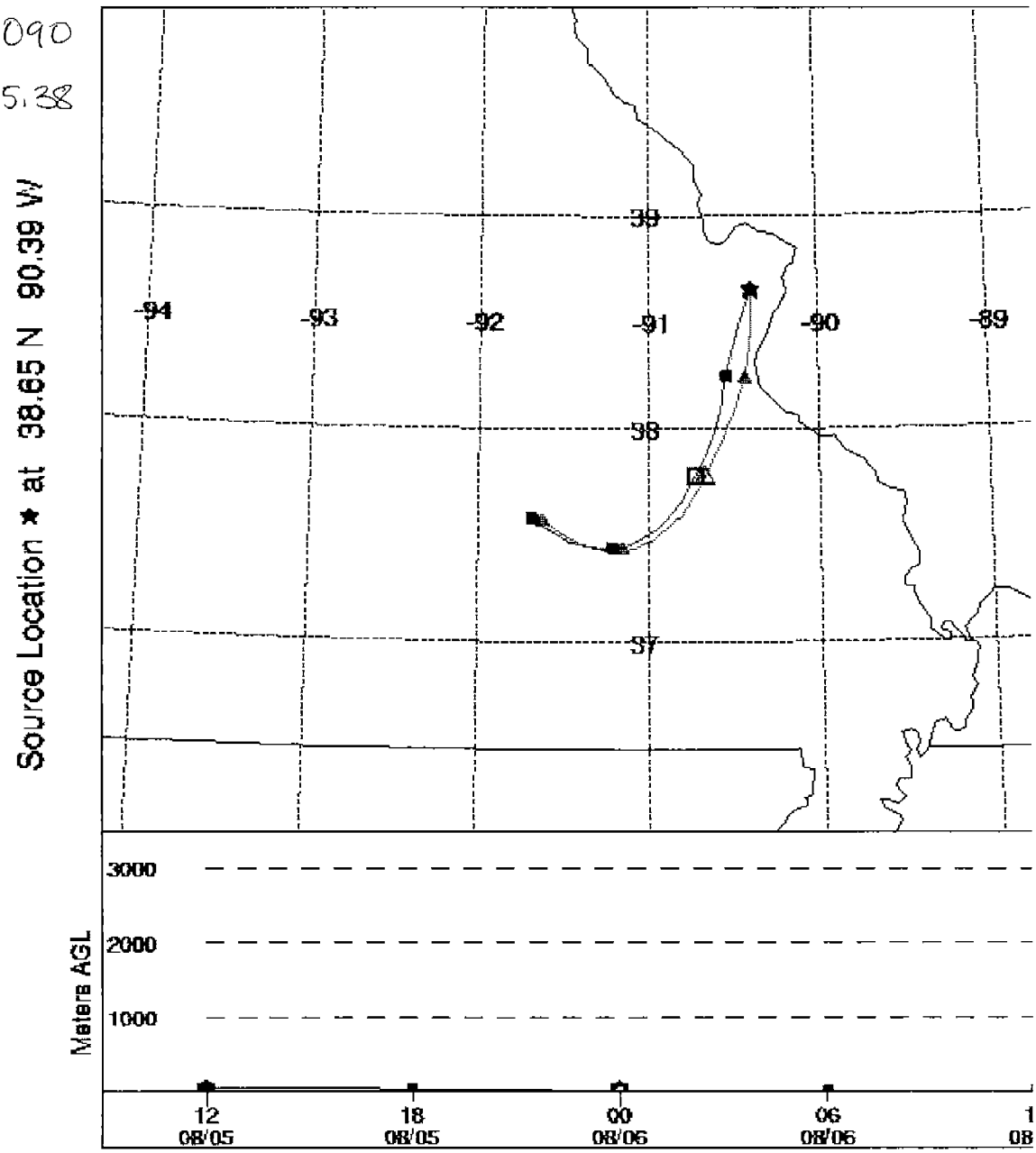
Forward Trajectories Starting- 12 UTC 05 AUG 99

Bonne Terre .090
Effingham 95.38



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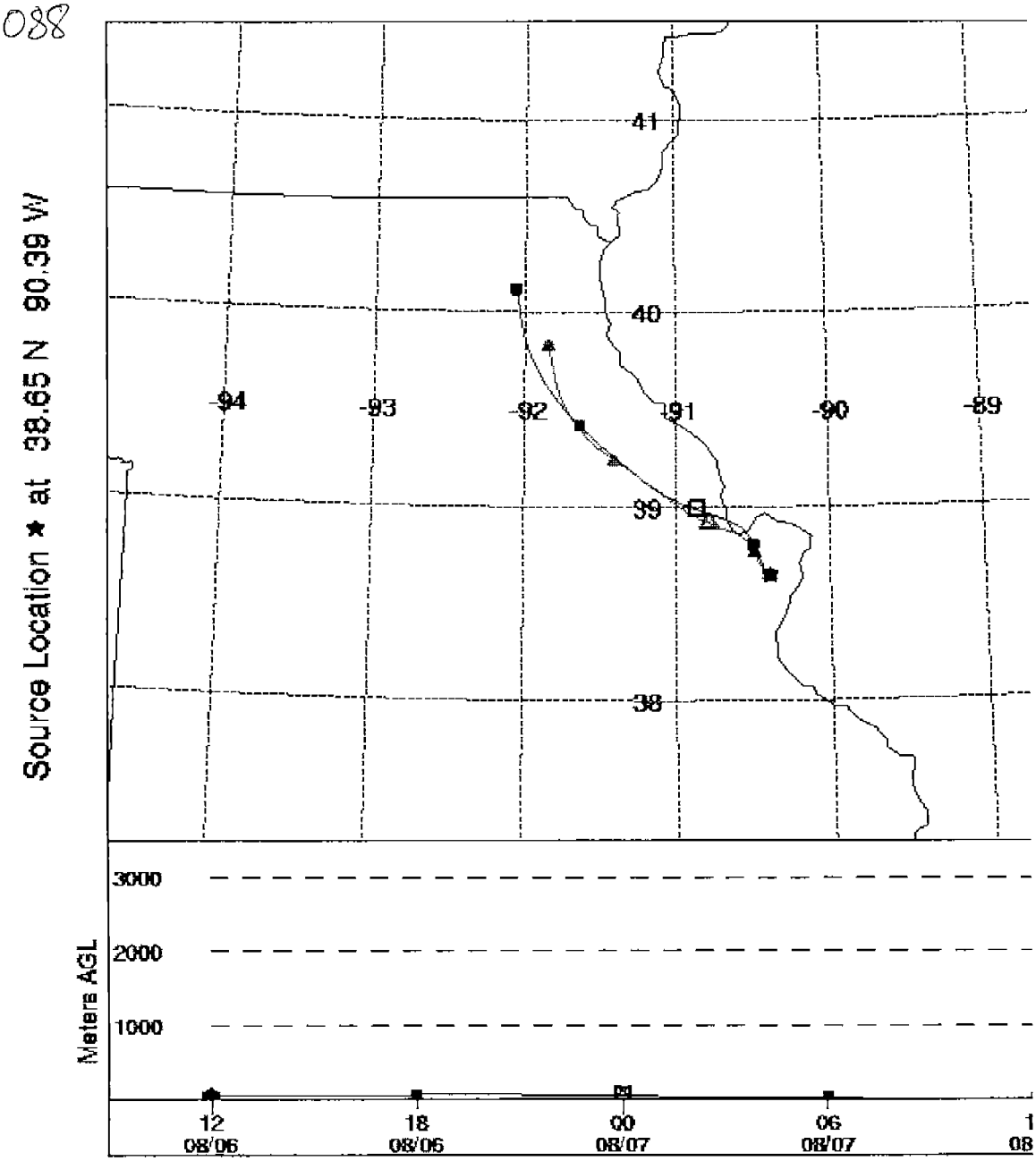
Forward Trajectories Starting- 12 UTC 06 AUG 99

Queeny Park .088



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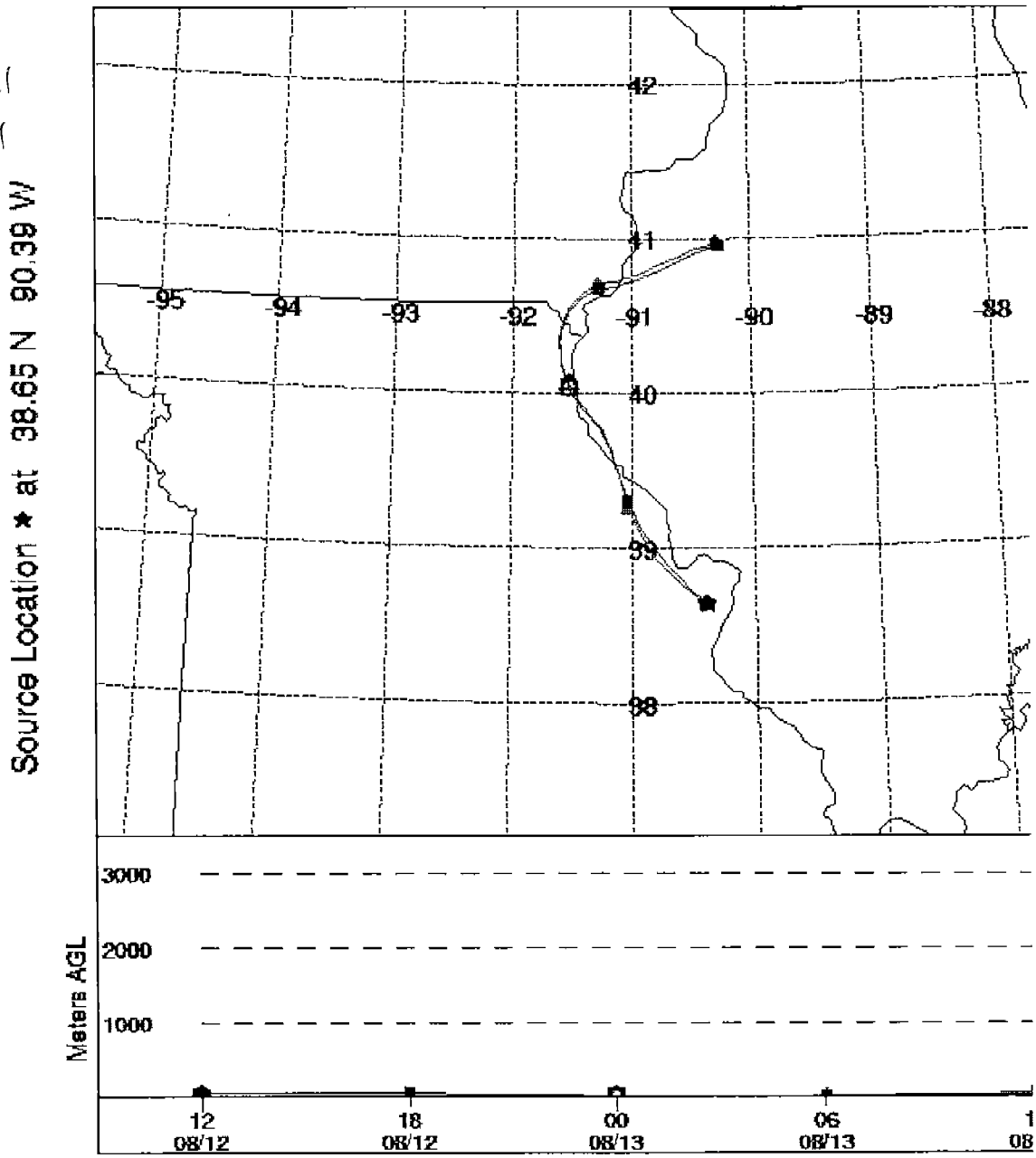
Forward Trajectories Starting- 12 UTC 12 AUG 99

W. Alton. 089
Orchard Farm .091
Bonne Terre .091



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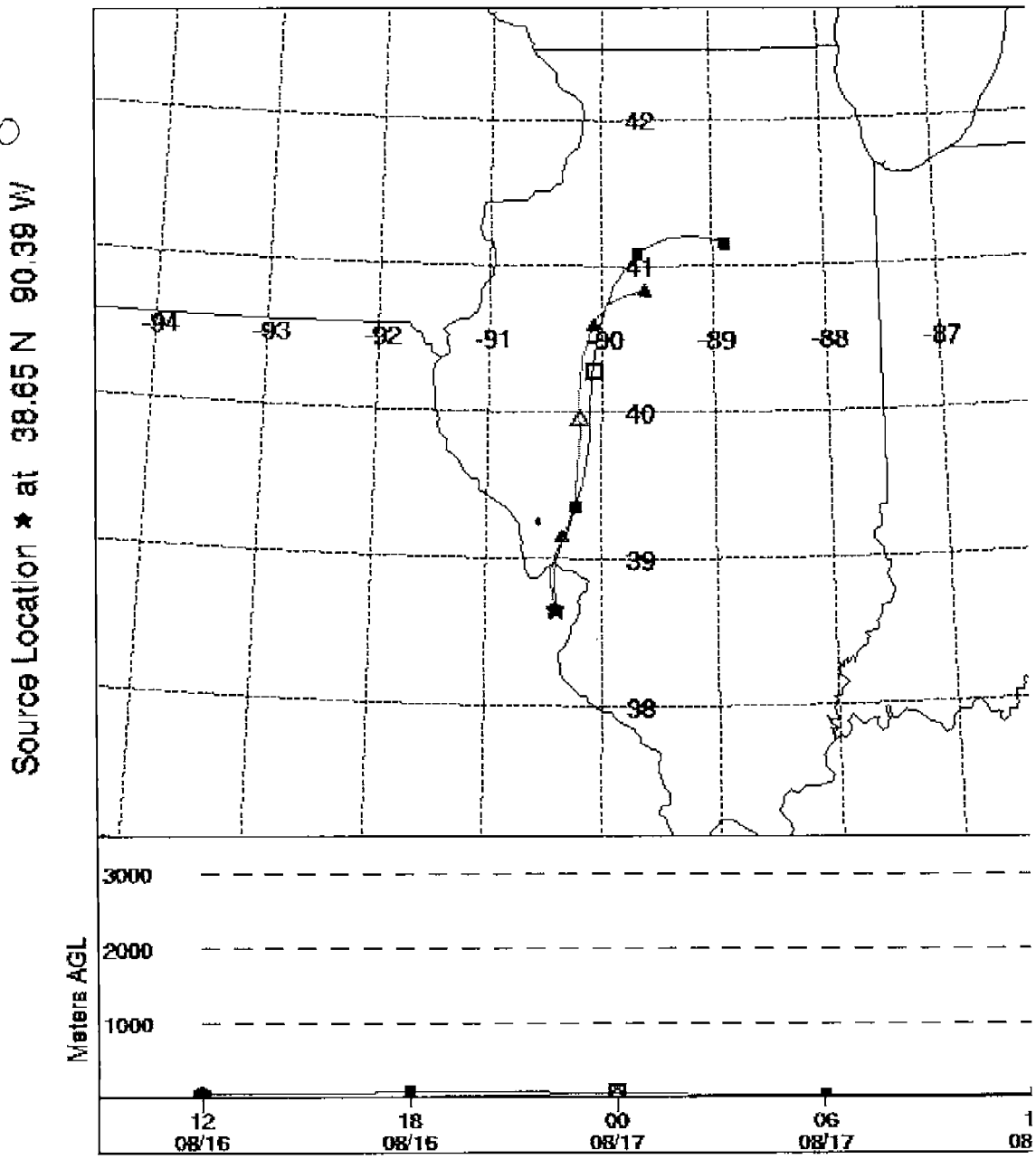
Forward Trajectories Starting- 12 UTC 16 AUG 99

West Alton .099
Arnold .087
Orchard Farm .090
St. Ann .085
Flo Valley .097
Alton 90.03



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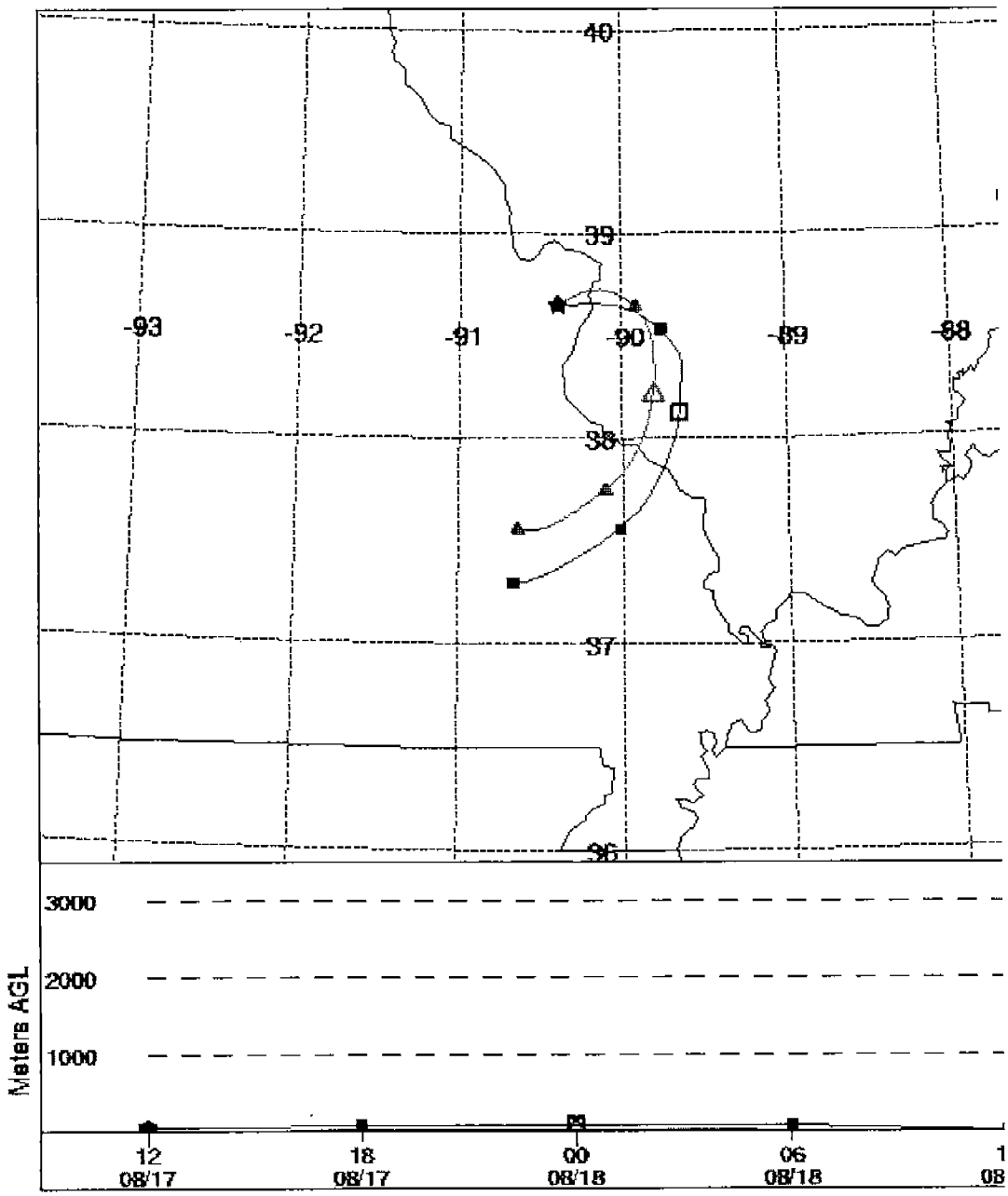
Forward Trajectories Starting- 12 UTC 17 AUG 99

Arnold .102
Sainte Terre .095

Source Location ★ at 38.65 N 90.39 W



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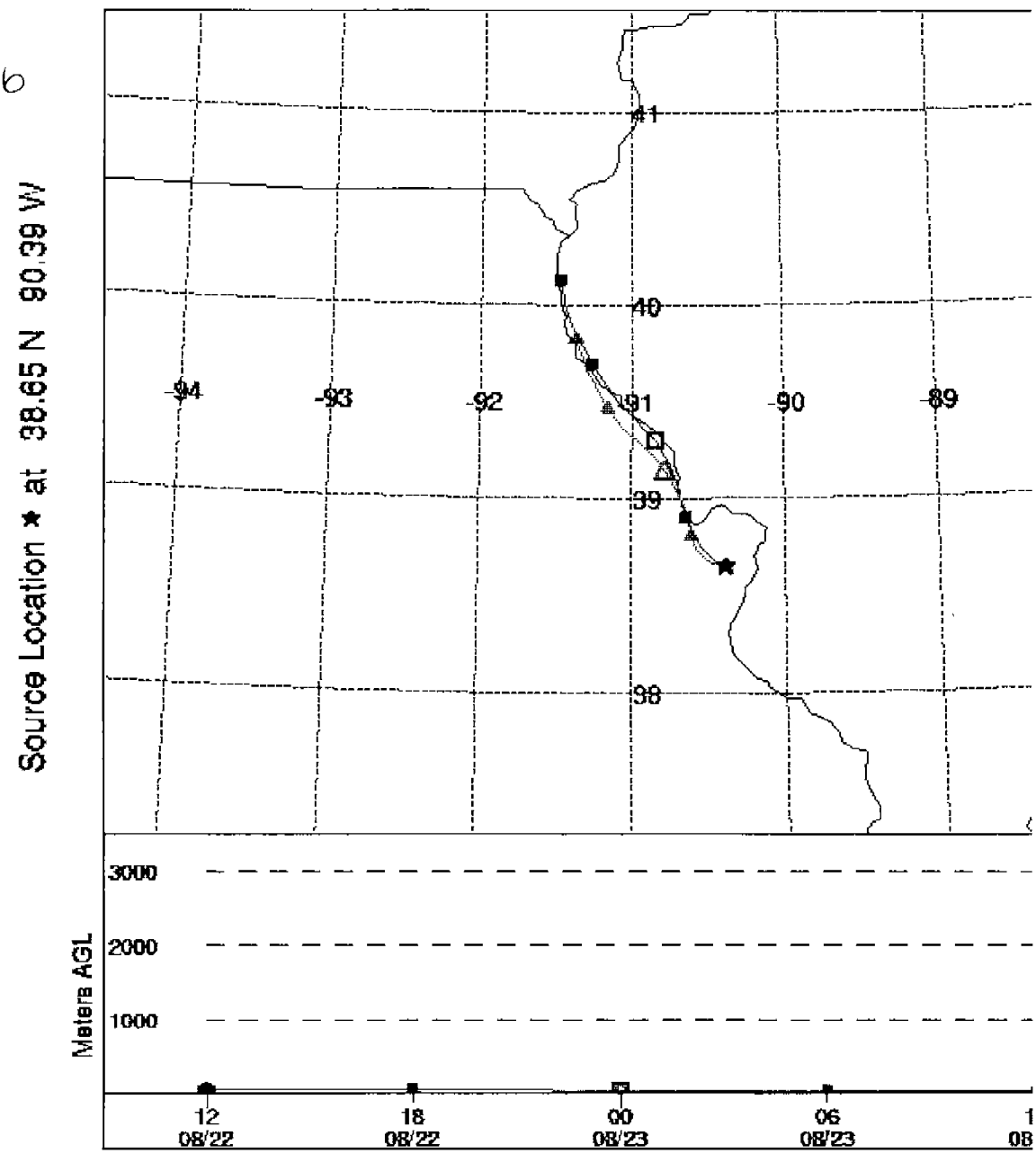
Forward Trajectories Starting- 12 UTC 22 AUG 99

W. Alton .088
Orchard Farm .096



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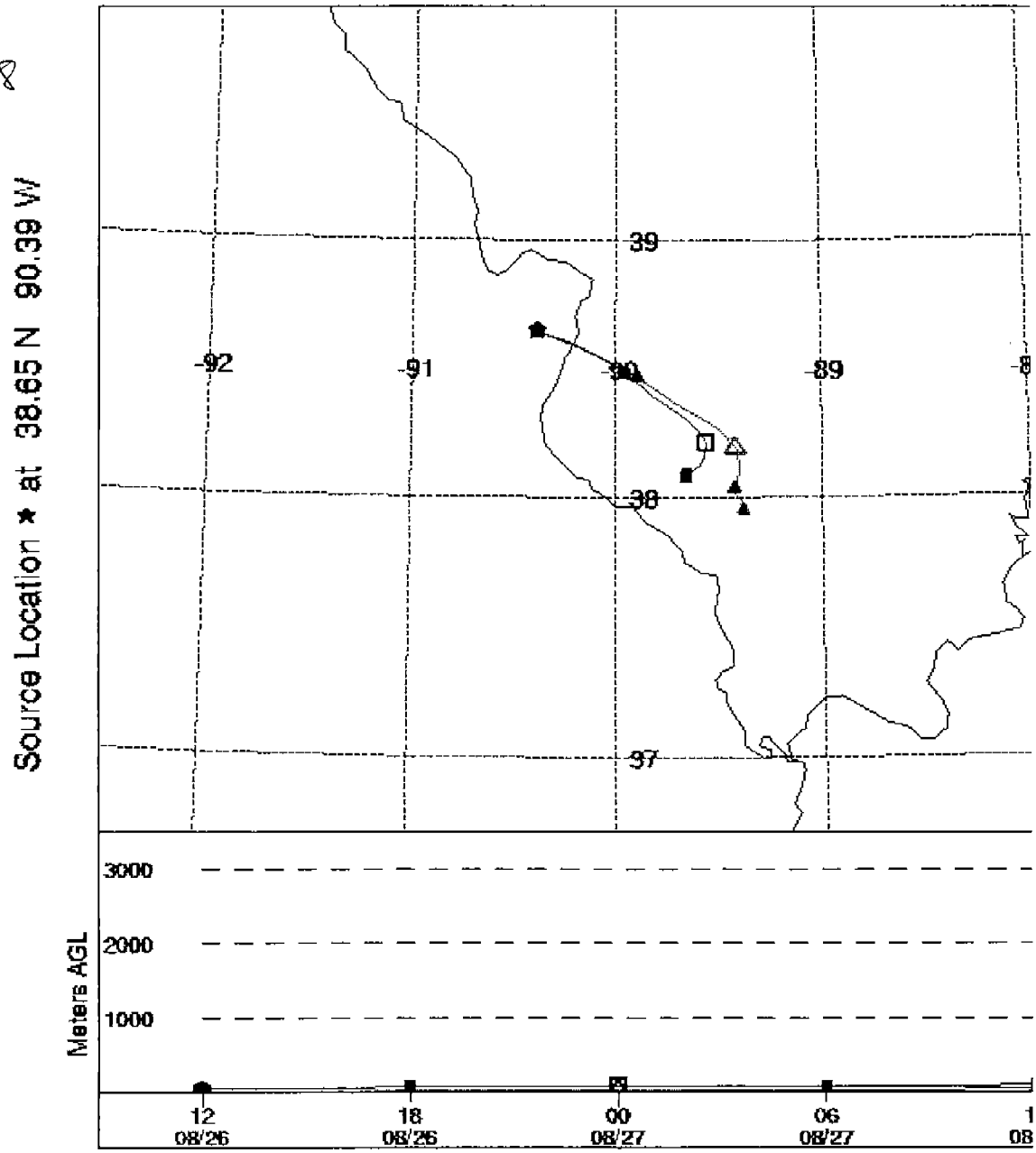
Forward Trajectories Starting- 12 UTC 26 AUG 99

Arnold .098
Bonne Terre .088



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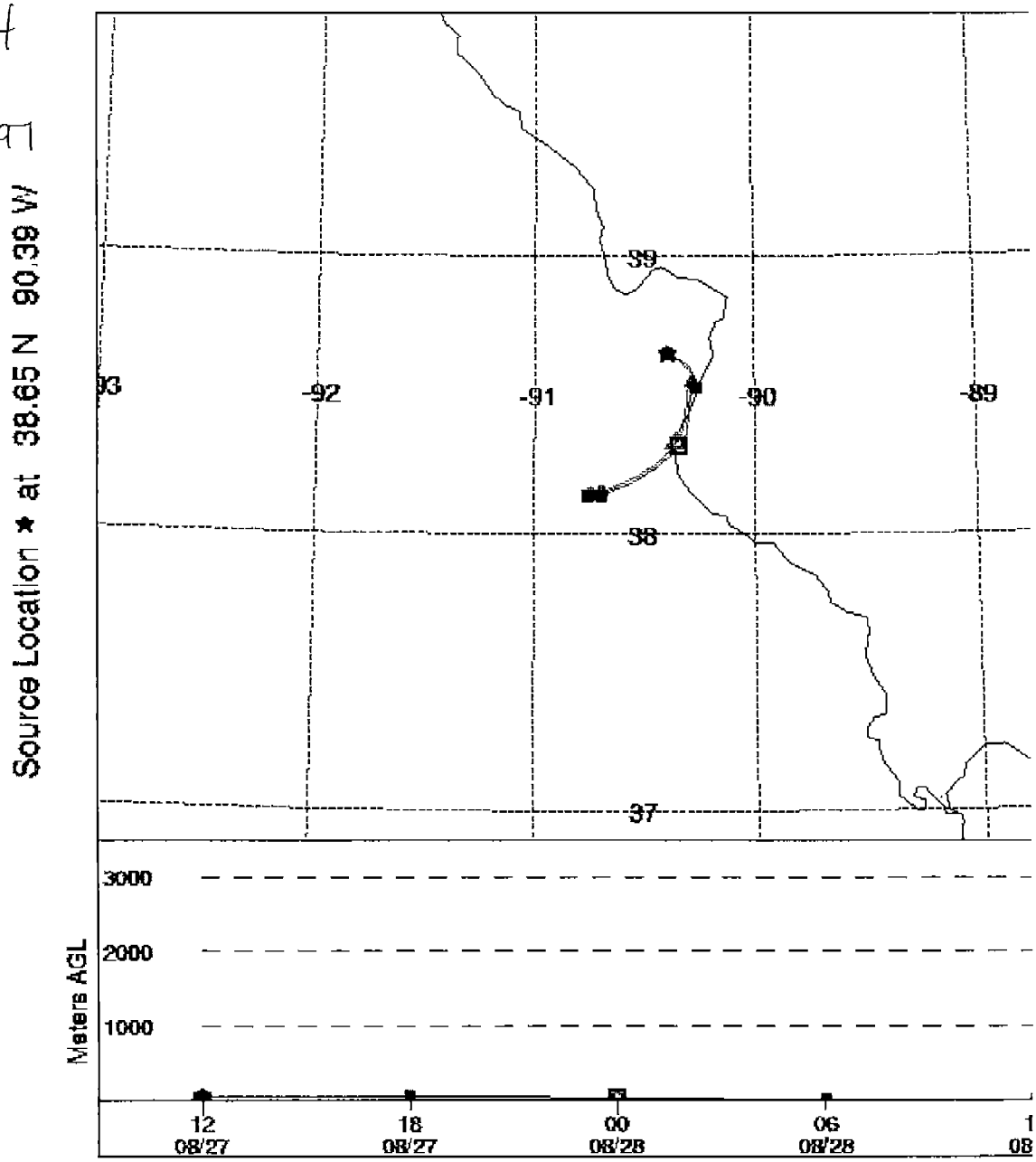
Forward Trajectories Starting- 12 UTC 27 AUG 99

Bonne Terre .104
Arnold .104
S. Lindbergh .097



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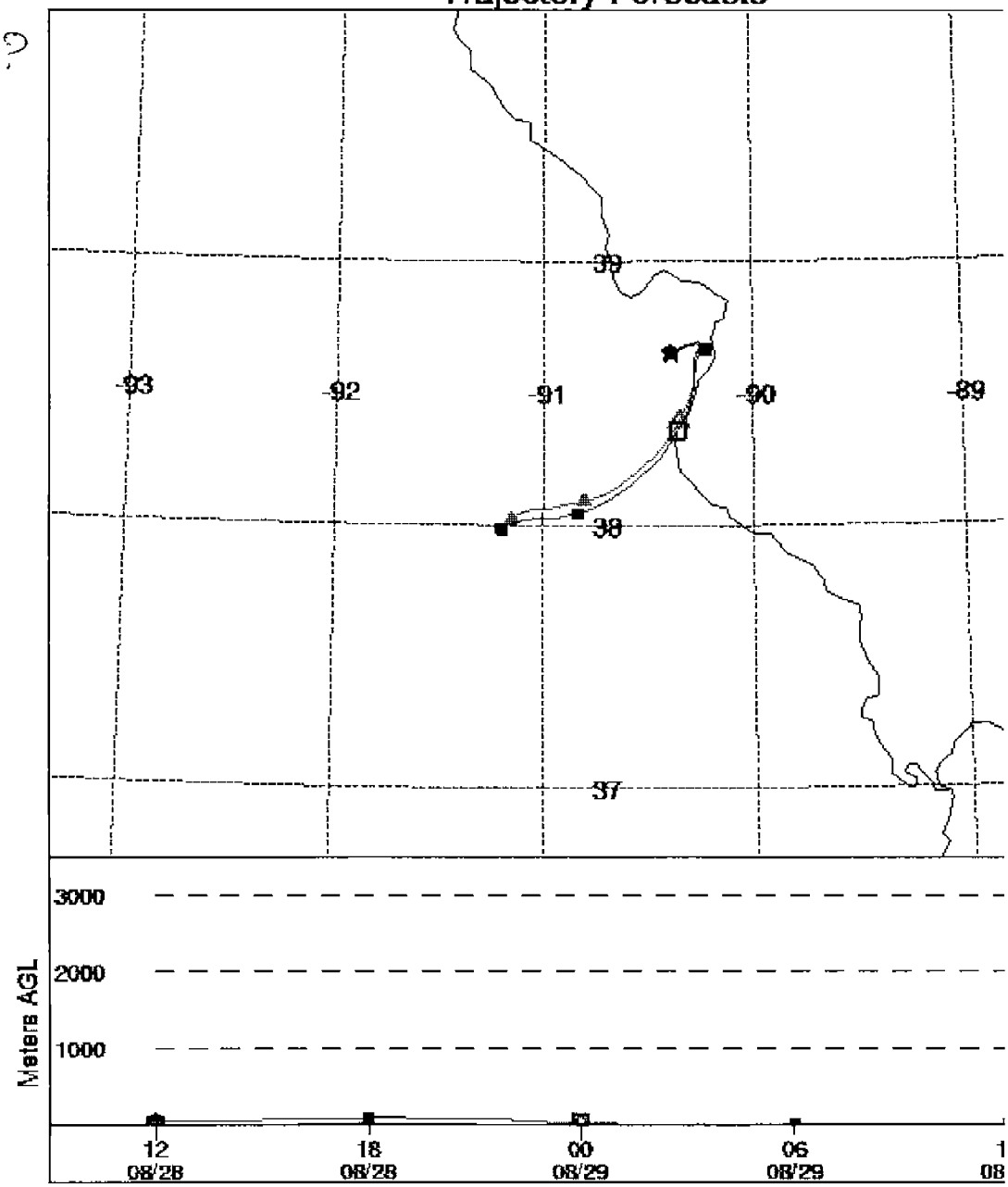
Forward Trajectories Starting- 12 UTC 28 AUG 99

Trajectory Forecasts

Arnold .108
Orchard Farm .086 ?
S. Lindbergh .095
Broadway .088

Source Location ★ at 38.65 N 90.39 W



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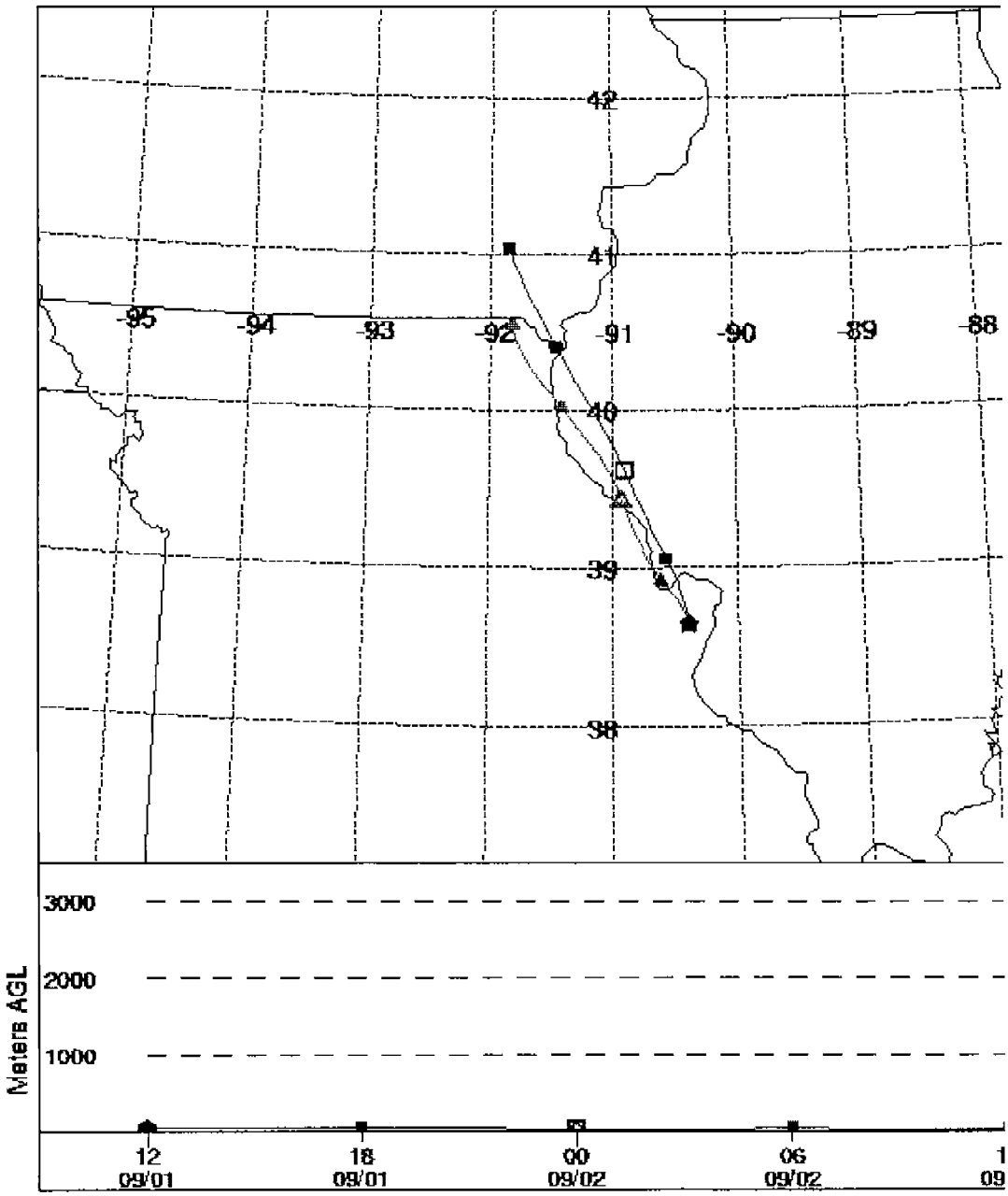
Forward Trajectories Starting- 12 UTC 01 SEP 99

W. Alton .104
Arnold .057
O. Farm .101
Bonne Terre .085
Queeny .093
Ft Ann .085
Lindbergh .086
River 96
Poag Rd 93.13
Alton 97.13

Source Location ★ at 38.65 N 90.39 W



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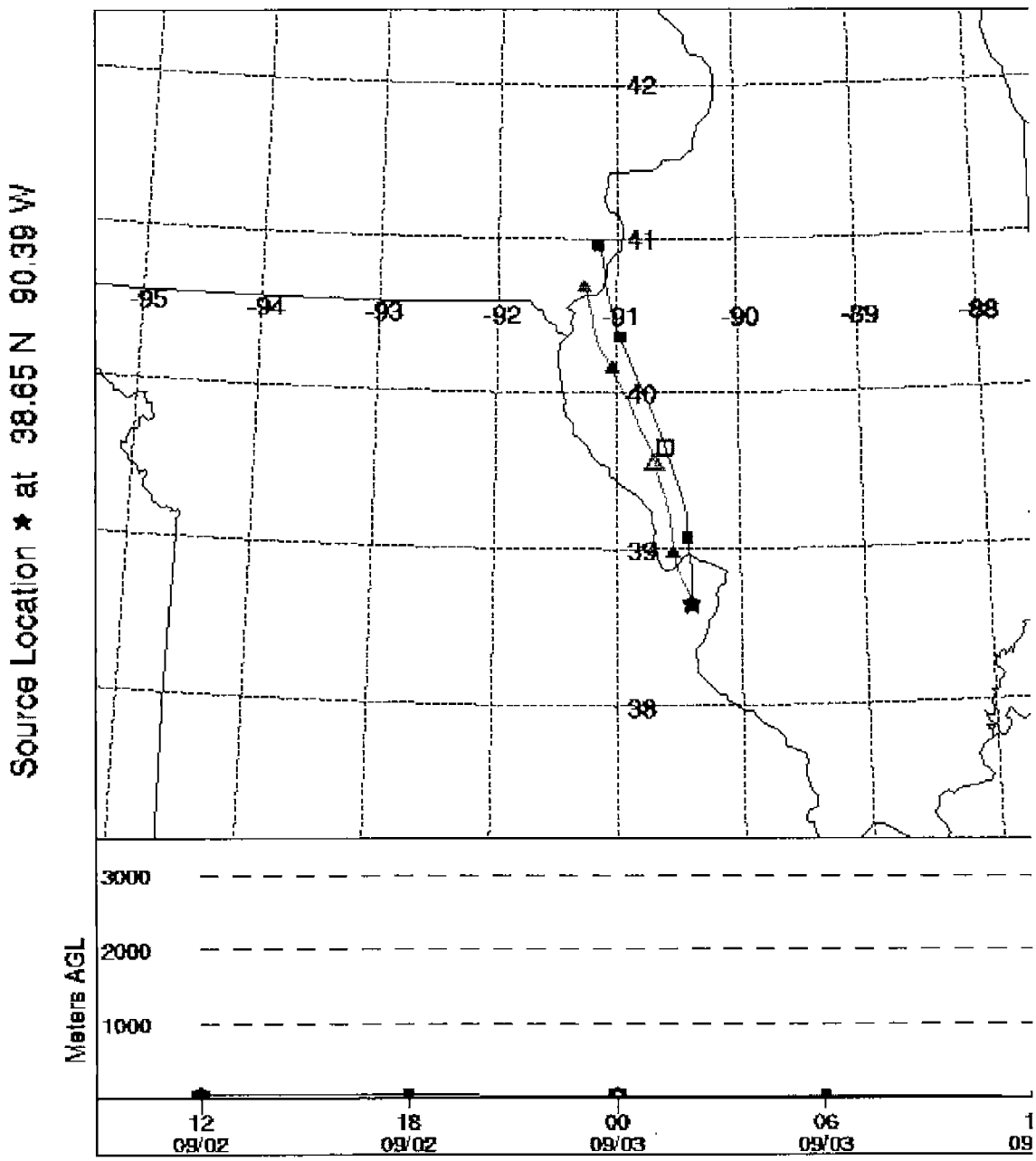
Forward Trajectories Starting- 12 UTC 02 SEP 99

W Alton .089
Alton 85.0



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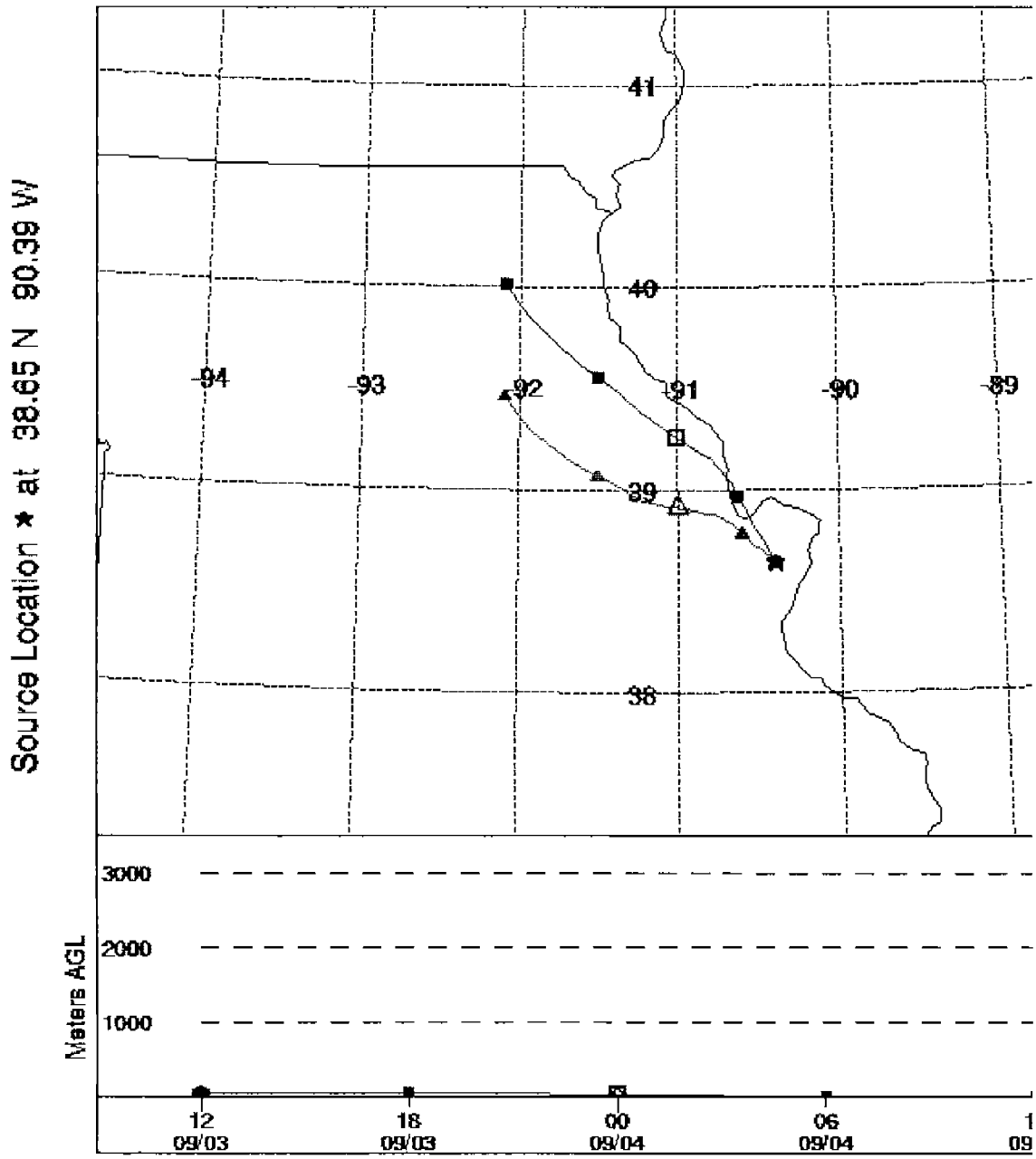
Forward Trajectories Starting- 12 UTC 03 SEP 99

W. Alton .087
Arnold .096
Bonne Terre .104
St. Ann .088
Hunter .112
S. Lindbergh .097
Broadway .088
[illegible]
Bag Rd 85.75



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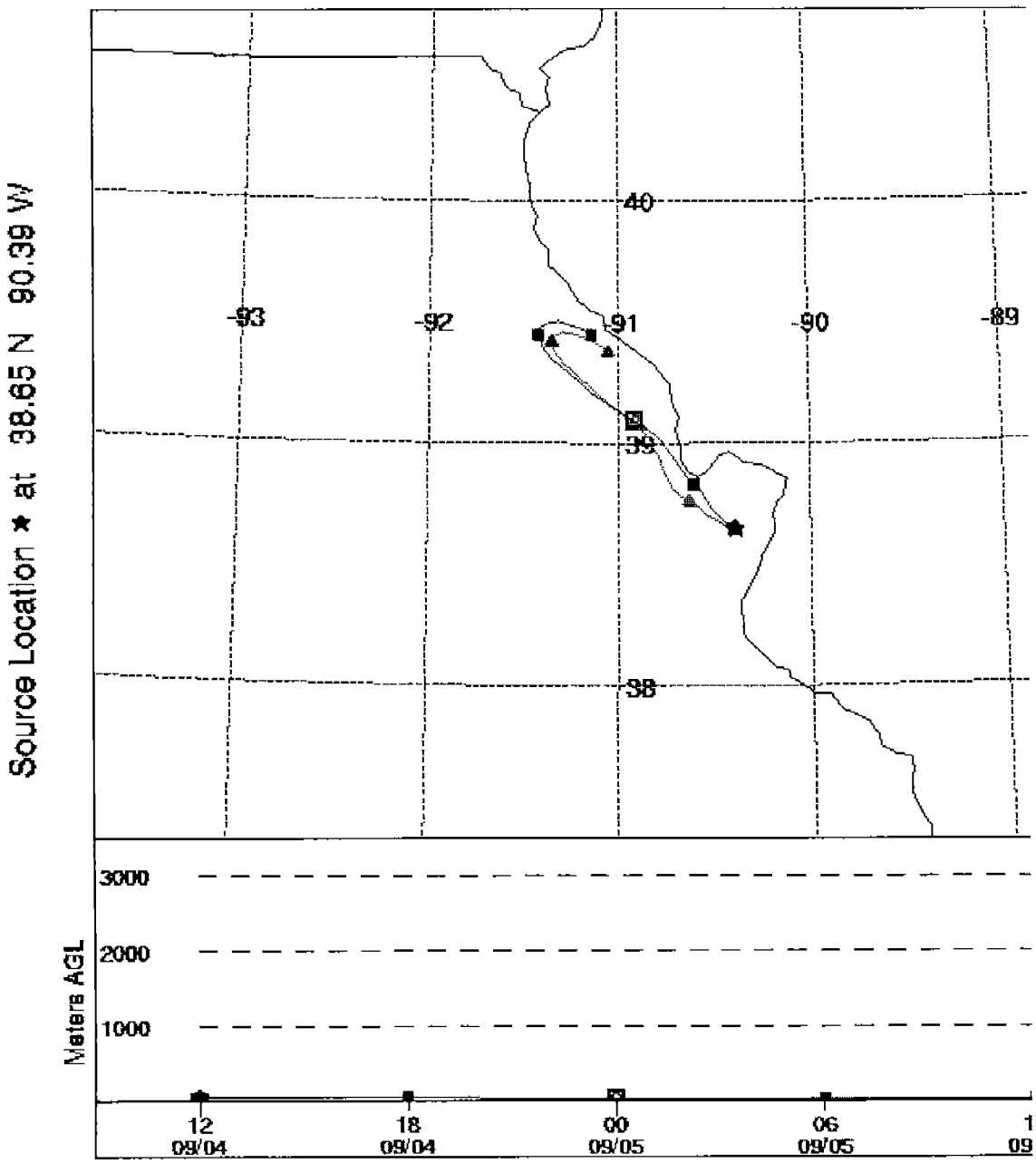
Forward Trajectories Starting- 12 UTC 04 SEP 99

Vest Alton .125
Arnold .111
Farm .129
Queeny .114
t Ann .117
Valley .118
Hunter .112
Lindbergh .114
Clark .109
Broadway .103
Newstead .100
Red River 111.63
Bag Rd 105.25
Tudor 96.75
Manyville 96.0
Alton 110.5
Bonne Terre .108



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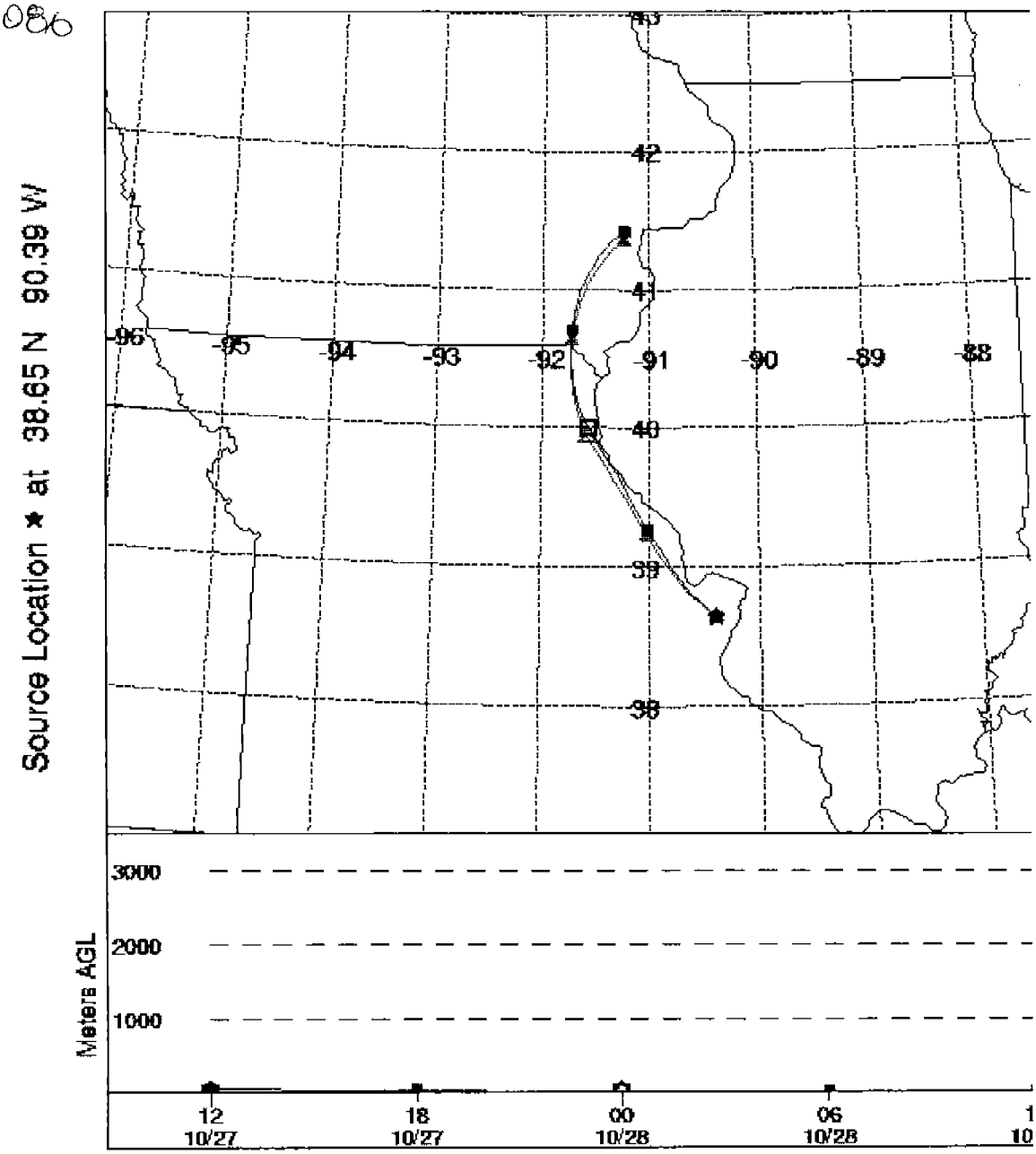
Forward Trajectories Starting- 12 UTC 27 OCT 99

Bonne Terre .086