Link To Table Of Contents

Chapter 2
Transportation System Characteristics

Jurisdictions and Affected Agencies

The focus of the ITS Early Deployment study is the Kansas City metropolitan area, which encompasses portions of Cass, Clay, Jackson and Platte counties in Missouri, and Johnson and Wyandotte counties in Kansas. Each county includes a number of incorporated cities, resulting in countless agencies that are responsible for activities related to some aspect of the transportation system. The large number of participants makes agency coordination and cooperation all the more important.

While the need for agency coordination and cooperation is significant at all times, it becomes especially critical during incident management and in other situations where a large number of agencies are involved and time is imperative. To provide some appreciation for the breadth of agencies that are involved in incident management activities, Table 2-1 provides information about emergency management services in the larger cities in the six county region.

Major Facilities in the Kansas City Area

The primary emphasis of this study was on the freeway system in the Kansas City area, with a secondary emphasis on arterials and transit, to the extent that they affect freeway operations and contribute to mobility in the metropolitan area. Thus, the major facilities that were considered in this study include the freeways, both interstate and non-interstate facilities, as well as major arterials and transit facilities and services that influence freeway operations. Intermodal facilities and facilities planned for deployment are also briefly addressed in this section.

FREEWAYS

The freeway system in Kansas City is extensive, including both radial and circumferential facilities. Not unexpectedly, it serves a significant portion of the vehicle miles traveled in the city, as shown in Table 2-2. Note that while the freeway system has 30 percent more lane miles than the principal arterial system, it serves more than two and a half times the vehicle miles traveled[1], accounting for over 70 percent of the vehicle miles traveled in the metropolitan area.

[1] David L. Schrank, Shawn M. Turner, and Timothy J. Lomax, *Trends in Urban Roadway Congestion - 1982 to 1991, Volume 2: Methodology and Urbanized Area Data*, Research Report 1131-6, Texas Transportation Institute, September 1994.

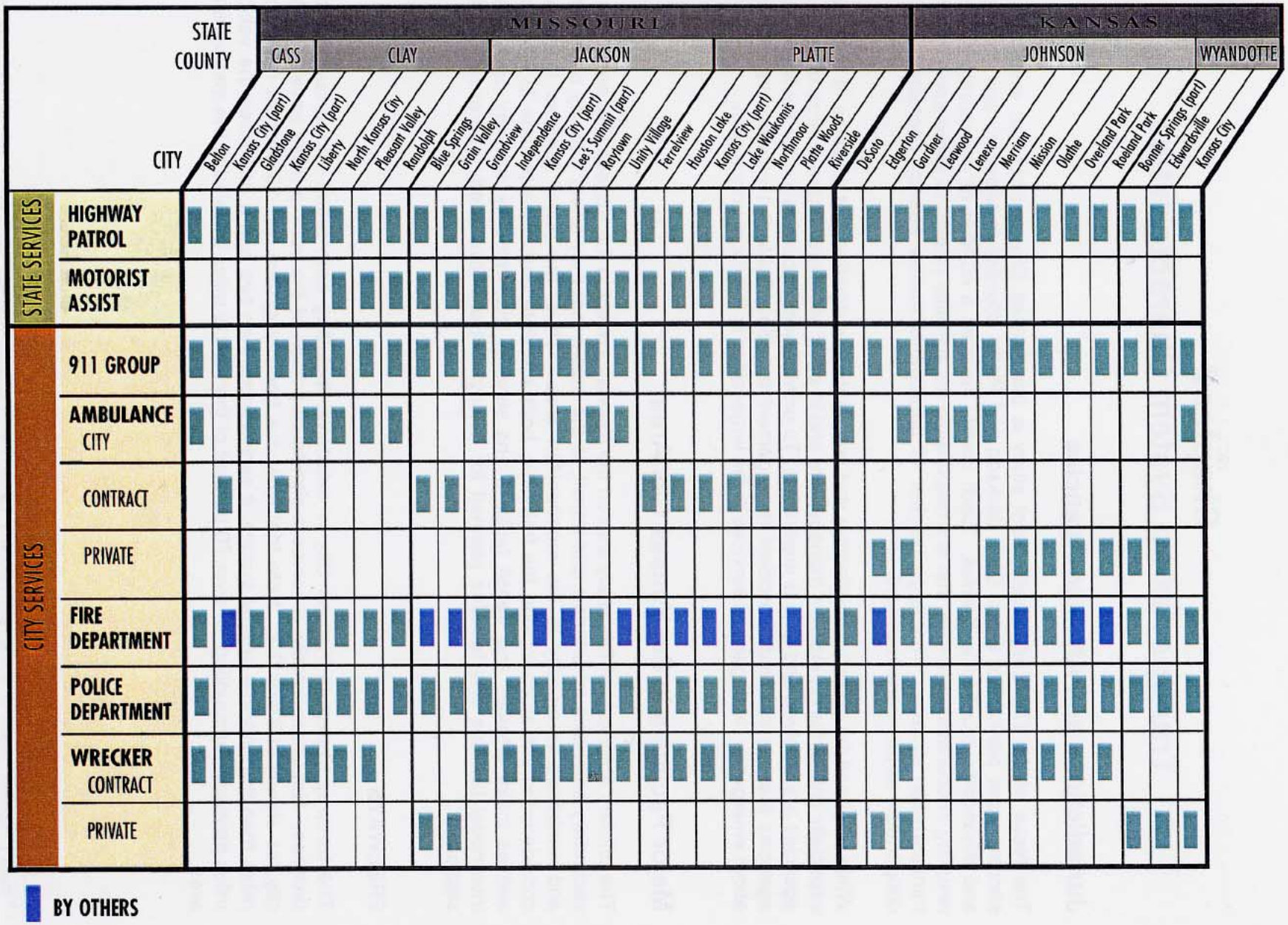


Table 2-1. Emergency Management Services in Kansas City Area

Table 2-2. Travel Characteristics in the Kansas City Area

Type of Facility	Daily Vehicle Miles Traveled (DVMT)	Lane-miles	Average Number of Lanes	DVMT per Lane-mile
Freeway	12,520,000	1,360	4.4	9,200
Principal Arterial	4,840,000	1,050	3.5	4,610

Source: David L. Schrank, Shawn M. Turner, and Timothy J. Lomax, *Trends in Urban Roadway Congestion - 1982 to 1991, Volume 2: Methodology and Urbanized Area Data*, Research Report 1131-6, Texas Transportation Institute, September 1994.

Major freeway facilities in the Kansas City area are shown in Figure 2-1 and include:

- Radial interstates I-35 to the northeast and southwest, I-29 to the northwest, and I-70 to the east and west.
- Circumferential loop I-435.
- Partial loops I-635, west of downtown connecting I-35 to I-29; and I-470, connecting I-70 to the southeast portion of I-435.
- I-670, the south leg of the downtown loop, extending west to I-70.

Major non-interstate freeway and expressway facilities in the metropolitan area include:

- US 169, north of downtown connecting I-29 and I-435 in Missouri.
- US 71, south of downtown near I-435 in Missouri.
- M-152, north of downtown between I-435 and I-35 in Missouri.
- US 69, just east of the junction of I-35 and I-435 in Overland Park, Kansas.
- Segments of K-7 and K-10, west of I-435 in Kansas.
- 18th Street Expressway (US 69), between I-35 and I-70 in Kansas.

ARTERIALS

Kansas City has an extensive system of principle arterials, comprising 1,050 lane-miles and serving almost 5 million vehicle miles of travel daily. Principal arterials serve major activity centers, linking these activity centers to freeway facilities (for example, Bannister Road to I-435 in Kansas City, Missouri and Metcalf Avenue to I-435 in Overland Park, Kansas). Principal arterials also serve as a primary means for mobility for trips that are not served by freeway facilities (for example, a trip directly south from downtown Kansas City may be served by the Southwest Trafficway and Ward Parkway).

Ideally, arterials also serve as alternative routes to the freeway. Diversion of traffic from freeways to arterials when freeway facilities are under construction or when there is an incident on the freeway can result in reduced overall delay. However, not all arterials are suitable as alternative routes for freeway traffic. An arterial used as an alternative route would preferably run approximately parallel to the freeway, would have adequate access onto and off of the freeway, and would have adequate capacity and operating speeds. Arterial capacity is influenced not only by the number of lanes in each direction (a minimum of two lanes in each

direction is appropriate in many circumstances), but also by the signal timing along the facility. Thus, the capability to vary signal timing plans in response to a large volume of traffic diverting from the freeway significantly enhances the effectiveness of an arterial as an alternative route. This is discussed in greater detail in a later section, *System Characteristics*.

Facilities that may be suitable as alternate routes to the freeway are shown in Figure 2-1 and include:

- Missouri 9 to Missouri 283 as an alternate route for I-35/I-29 north of downtown.
- Southwest Boulevard as an alternate route for I-35 southwest of downtown.
- US 69 as an alternate route for I-35 northeast of downtown.
- Truman Road as an alternate route for I-70 immediately east of downtown.
- US 40 as an alternate route for I-70 east of downtown.
- Central Avenue as an alternate route for I-70 west of downtown and east of I-635.
- State Avenue as an alternate route for I-70 west of downtown.
- US 24/US 40 as an alternate route for I-70 west of downtown and west of I-635.
- 103rd and 111th (College Boulevard) as alternate routes for the southern portion of I-435.
- North Broadway as an alternate route for US 169, north of downtown and south of Missouri 152.

TRANSIT FACILITIES AND SERVICES

There are three major transit providers in the Kansas City metropolitan area, the Kansas City Area Transportation Authority (KCATA) in Kansas City, Missouri; the Public Transportation Division, Public Works Department in Kansas City, Kansas; and Johnson County Transit in Johnson County, Kansas. These agencies provide fixed route transit service as well as paratransit services. Characteristics of the fixed route transit service provided in the metropolitan area are shown in Table 2-3.

Table 2-3. Fixed Route Transit System Characteristics in Kansas City Area

System	Fleet Size	Annual Service Miles	Weekday Ridership	1994 Annual Ridership
KCATA	265	7,933,322	49,950	14,573,656
KCK "The Bus"	12	420,750	1,070	272,078
Johnson County Transit	24	459,740	740	187,365
Total	301	8,813,812	51,760	15,033,099

Source: 1994 transit agency operating data.

Ridesharing - All of the transit agencies currently refer requests for ridesharing to MARC's RideShare program. This program serves the entire metropolitan area, and was established in 1980 to help reduce air pollution, traffic congestion, and energy consumption.

Paratransit - Paratransit service is provided by over 40 agencies in the metropolitan area. Agencies providing paratransit service include county agencies (for example, Reserve-A-Ride in Cass County, Missouri), city agencies (for example, LIFT in Lenexa, Kansas), transit agencies (for example, KCATA's Share-a-Fare), medical organizations (for example, Research Mental Health Services), organizations for children (for example, Children's TLC), and organizations for the elderly (for example, Wyandotte Department of Aging). Paratransit services are generally managed and operated independently. A coordinated approach to operations and dispatch may result in increased efficiency.

INTERMODAL FACILITIES

There are a number of intermodal facilities in the Kansas City area, including aviation facilities, river facilities on the Missouri River, and facilities for truck/rail interface. These facilities are shown in Figure 2-2. Most of these facilities are in industrial areas along the Missouri and Kansas Rivers. ITS user services oriented toward commercial vehicles would need to consider the location and activities at these facilities.

PLANNED FACILITIES

A variety of transportation projects have been proposed or are planned for deployment in the Kansas City area. The impact of these proposed and planned projects on the transportation system would be expected to vary, depending on the magnitude of the project. The following information on planned facilities is based on MARC's *Draft Long Range Transportation Plan*[1], and on MARC's *Transportation Improvement Plan*[2].

Freeway Facilities - The 1994 *Transportation Improvement Plan* includes recommendations for a number of facilities in both Kansas and Missouri. Although no new freeway facilities are currently proposed, there are recommendations to provide additional capacity on a number of existing freeways, and to provide 26.2 miles of new expressway in Missouri. New structures proposed include a new Chouteau Bridge in Missouri and a new Turner Diagonal Bridge in Kansas. Major capacity improvement projects recommended in the *2010 Interim Long Range Street and Highway Plan* (approved in 1990) include 58.8 miles of freeway widening, 16.7 miles in Kansas and 42.1 miles in Missouri. Additional capacity is recommended on the following facilities.

In Kansas:

- I-435, widen to 8 lanes between K-10 and the Missouri state line.
- I-635, widen to 6 lanes between Metropolitan Avenue and I-35 (a continuation of this project is also proposed: US 69 Metcalf Avenue, widen to 6 lanes from I-35 to Shawnee Mission Parkway).
- US 69, widen to 6 lanes from 95th Street to K-150.

[1] *Draft Long Range Transportation Plan*, March 1995, Mid-America Regional Council, Kansas City, Missouri
[2] *Transportation Improvement Plan*, 1994, Mid-America Regional Council, Kansas City, Missouri.

In Missouri:

- I-29/I-35, widen to 8 lanes from the northeast corner of the downtown loop to the I-29/I-35 split.
- I-29, widen to 6 lanes between I-35 and US 169.
- I-35, widen to 6 lanes between I-29 and US 69.
- I-70, widen to 8 lanes between I-470 and Truman Road (another option being considered for I-70 east of downtown in Missouri is the addition of a high occupancy vehicle (HOV) lane).
- US 71, widen to 6 lanes from 155th Street to Route 58.
- US 50, widen to 6 lanes between I-470 and M-291 North.

The *Draft Long Range Transportation Plan* also provides information regarding proposed improvements on a number of facilities. The following projects are in the 2020 Long Range Transportation Plan for interstates, freeways and expressways.

In Kansas:

- I-35 in Wyandotte County, widen to 8 lanes from US 69 to Southwest Boulevard, and from K-150 to I-435 in Johnson County.
- I-435 in Johnson County, widen to 8 lanes from State Line Road to I-35.
- I-635 in Wyandotte County, widen to 6 lanes from Metropolitan Avenue to I-35 (as stated above).
- US 69 in Johnson County, widen to 6 lanes from I-35 to Shawnee Mission Parkway (as stated above), from I-35 to 119th, from US 169 to 151st Street, and from 151st Street to 155th Street.
- US 169 in Johnson County, widen to 6 lanes from College Boulevard to US 69.
- Southgate Road, add 2 lanes from Kansas Avenue to Harrison Street.

In Missouri:

- I-35 in Jackson County, widen to 8 lanes from I-70 to I-29.
- I-70 in Jackson County, add 2 lanes from M-7 to Lafayette County.
- I-435, add 2 lanes from M-210 in Clay County to US 71 (NB) in Jackson County.
- US 71/Bruce Watkins Drive in Jackson County, new 6 lanes from 12th Street to Truman Road, and widen to 6 lanes from Brush Creek Boulevard to Swope Parkway.
- US 71 in Cass County, widen to 6 lanes from 155th Street to M-58.
- US 169 in Clay County, widen to 4 lanes from I-435 to the metropolitan planning organization boundary.
- Jackson County Roadway, new 4 lanes from I-435 to I-470.
- M-210 in Clay County, upgrade to freeway from I-435 to M-291.
- M-152 in Clay County, new 4 lanes from Green Hills Road to Brighton Avenue.
- M-291 in Jackson County, widen to 4 lanes from M-210 to US 24.
- US 50 in Jackson County, widen to 6 lanes from I-470 to Rte RA.
- M-350 (Blue Parkway) widen to 6 lanes from Benton Boulevard to Elmwood.

High Occupancy Vehicle (HOV) Facilities - MARC has identified high occupancy vehicle (HOV) lanes as one approach to increasing vehicle occupancies in the *Draft Long Range*

Transportation Plan, and has identified a possible HOV Network, shown in Figure 2-3. The facilities shown in Figure 2-3 are line-haul HOV facilities. Other types of HOV facilities, such as queue bypass facilities that allow HOVs to avoid bottleneck locations, may also be appropriate for deployment. Although not addressed in the *Draft Long Range Transportation Plan*, HOV support facilities, such as park-and-ride lots, would also be necessary upon implementation of HOV lanes.

Transit Facilities - The 1994 Annual Element of the *Transportation Improvement Plan* for transit is comprised primarily of routine projects required for the maintenance of current services. Projects include bus replacement, acquisition of maintenance tools and equipment and upgrades to existing transit facilities.

A notable exception is a project for preliminary engineering services for a proposed light rail transit (LRT) line in south Kansas City. This study, sponsored by the KCATA, recommended the preferred alternative shown in Figure 2-4. The recommended alignment extends from its northern terminus at 3rd and Grand to Crown Center, then through Midtown along Broadway to the Country Club Plaza. South of the Plaza, the east branch parallels Volker Boulevard and 47th Street east toward Bruce Watkins Drive. The LRT would follow the Watkins roadway south to its terminus at 75th Street. The south branch proceeds from the Plaza along Brookside Boulevard and Wornall Road to a terminus at 85th and Holmes. Progress of the LRT project, including preliminary engineering, depends on the availability and receipt of federal funding.

Another fixed rail project involves a study of the feasibility of establishing commuter rail service between Olathe, Kansas, and downtown Kansas City, Missouri, generally following I-35. This study, sponsored by Johnson County Transit, is evaluating the use of existing Burlington Northern tracks for passenger transportation.

Several other transit related studies are currently underway in the metropolitan area:

- MARC is updating the transit element of the region's *Long Range Transportation Plan* with the 1994 Public Transit Planning Study. This study is expected to guide the development of a comprehensive and integrated public transportation system to serve the current and future mobility needs of the people and businesses in the region.

- KCATA is conducting a comprehensive analysis of its services intended to develop a short range transit plan for the KCATA services area.

- Kansas City, Kansas, is conducting a study of transit needs in that community to develop a short range plan for transit service improvements.

- The three Kansas counties in the metropolitan area (Johnson, Leavenworth, and Wyandotte Counties) are involved with an assessment of public transportation needs in part to develop a strategy for funding public transportation in the future.

While these studies are not specifically concerned with ITS applications, they are concerned with improving transit services and increasing efficiency. Coordination between service providers and the integration of service are common themes in all the study efforts. It is likely

that the application of ITS technologies can assist the agencies in meeting the recommendations of these studies.

Current and Planned ITS Applications in the Kansas City Area

There are a number of activities being conducted in the Kansas City area that could be classified as ITS projects, these projects are discussed below.

AUTOMATIC VEHICLE LOCATION SYSTEMS

Automatic vehicle location (AVL) systems provide agencies with real-time information about vehicle location. In some cases, AVL systems also provide other information about vehicle status, such as speed, vehicle diagnostic information, audio and/or video monitoring. The specific benefits of an AVL system vary, depending on the capabilities of the system and the needs of the agency implementing the system. AVL systems may be used to facilitate dispatch in the case of enforcement and emergency vehicles; they may be used to better track performance and operating conditions in the case of transit vehicles; they may be used to track equipment and/or freight in the case of commercial vehicles. Thus, AVL systems may be considered an application of the Emergency Vehicle Management, the Public Transportation Management, and Freight Mobility ITS user services (discussed more fully in Chapter 3), depending on the type of agency that implements the system.

A number of agencies in the Kansas City area have, or are planning to implement, AVL systems. KCATA and MAST (the emergency medical responder in Kansas City, Missouri) both have AVL systems. Efforts are underway to procure an AVL system for the Johnson County Kansas Sheriff and Med-Act (the emergency medical responder in Johnson County, Kansas). A pilot study on an AVL system is currently being conducted by the Kansas Highway Patrol.

KCATA's AVL System - In 1988, KCATA initiated a project to replace their two way radio system and enhance operations through the addition of an AVL system. The signpost/odometer AVL system that was ultimately procured enhanced operations by utilizing vehicle location information to assist with dispatching functions (referred to as computer aided dispatch, or CAD), and increase overall efficiency.

Despite hardware failures, the AVL system has recouped the entire cost of installation directly from operating and capital cost savings. Beginning in 1991, the signpost equipment (referred to as AVLTs) used to provide positive location reference began to fail as a result of inadequate circuit design and substandard components. Because the AVLTs fail to consistently produce the required strength signal, the vehicle location system is no longer being used. The system is expected to be fully operational again, however, because the Federal Transit Administration (FTA) has approved a grant to acquire hardware to restore the system's capability.

KCATA's AVL system, when operational, may be considered an application of the Public Travel Security ITS user service, as well as the Public Transportation Management user service, because it enhances security by providing improved response time to incidents and an increased perception of security.

HIGHWAY ADVISORY RADIO

Highway advisory radio (HAR) provides information regarding current traffic, roadway, and/or weather conditions to commuters. The provision of this information may be considered an application of the En-Route Driver Information ITS user service.

A HAR system has been implemented by MHTD at the southeast corner of the downtown loop in Kansas City, Missouri. The system provides very good reception to the east and south on AM 1610. Prior to implementation, the system was tested at least three times: when the artwork on Bartle Hall was being erected, when there was a hazardous material incident on the south end of the loop, and at the 1995 St. Patrick's Day Parade. A number of advisory signs have been installed, in Kansas as well as Missouri (locations are shown in Figure 7-2). Signs in Kansas are needed on I-35 to intercept drivers coming into the downtown loop area.

The HAR signs have lights that flash only when messages are being conveyed. Messages are transmitted during maintenance and construction activities, as well as during incidents. The radio message can be deployed over the phone; there is a separate phone line to each sign with an automatic dialer. The dynamic capability of the signs (the lights will flash when there is a message) is expected to greatly enhance the effectiveness of the system.

FIBER OPTIC CABLE

Efforts to install fiber optic cable are underway by multiple entities in the Kansas City area. MHTD, KDOT and the Kansas Turnpike Authority (KTA) are all working towards the installation of fiber optic cable, and are in various stages of completion. In general, the fiber optic cable is being installed as part of a private/public venture. In exchange for use of right-of-way, the private entities installing the cable will allow the public entity use of a number of the fibers on the cables being installed. Fiber optics partnerships allow public agencies to save not only on capital investments, but also on maintenance expenditures. Fiber optics provide a communications infrastructure that can be utilized for monitoring equipment that supports Incident Management, Traffic Control and other ITS user services.

Kansas Turnpike Authority - Fiber optic cable has been installed on the Kansas Turnpike. Twelve fibers are dedicated for the turnpike's use.

Missouri Highway and Transportation Department - Installation of fiber optic cable in Missouri began in St. Louis, and is expected to be completed in Kansas City by the end of 1996. Installation has resulted in minimal disruption on freeways.

Kansas Department of Transportation - In Kansas, activities necessary for the installation of fiber optic cable have been initiated, and KDOT management has indicated that fiber optics is a priority.

ELECTRONIC TOLL COLLECTION

The Kansas Turnpike Authority (KTA) recently implemented an electronic toll collection (ETC) system. This system allows vehicles to pass through the toll collection area without stopping

(the KTA system requires vehicles to slow down to approximately 20 mph). This system reduces vehicle delay and increases agency operating efficiency by reducing the personnel needed for toll collection. Vehicles using ETC are equipped with transponders, which allow payment on a monthly credit or debit system. Electronic toll collection is an application of the Electronic Payment Services ITS user service.

PUBLIC TRANSIT

KCATA has undertaken or is planning to undertake a number of activities that could be considered applications of ITS user services. In addition to KCATA's AVL system, discussed previously, KCATA has implemented two MetroFlex routes, plans to upgrade paratransit scheduling, and is exploring the feasibility of vanpooling and the electronic display of transit information.

MetroFlex - KCATA currently offers MetroFlex transit service on two routes. MetroFlex includes two services: rush hour service, during which the bus will deviate a few blocks (within a certain zone) from its designated route if a "standing order" has been requested (by phone); and midday service, during which door-to-door service can be arranged anywhere within the service area. This service, which became available on one route in April 1993, and on a second route in July 1994, has proven to be very successful and more cost effective than regular route transit. Cost effectiveness of the MetroFlex services is enhanced by a special wage agreement with the labor union. Arrangements for this service are currently provided by a single human operator/dispatcher. KCATA's MetroFlex service is an application of the Personalized Public Transit ITS user service.

Vanpooling - KCATA is planning to conduct a vanpooling feasibility study sometime within the next year. While specific details on the proposed study were not available, this kind of project does represent an application of the Demand Management and Operations ITS user service.

Paratransit - KCATA has programmed funding to upgrade the paratransit scheduling and reservation system. Although specific details on this study were not available, this kind of project may be considered an application of the Public Transportation Management ITS user service.

Electronic Information Display - KCATA is considering use of the electronic display of transit information at the transit facility at 10th and Main. Although specific details are not available, this kind of project may be considered an application of the En-Route Transit Information ITS user service.

TRAFFIC INFORMATION

Traffic information is currently provided on television and on the radio, as well as in the newspaper. Newspaper reports include information about lane closures, construction, and other planned events. Radio and television reports often provide current information not only about construction, but also about incidents, congestion, and alternate routes. Information may be based on a variety of sources. For example, radio reports rely on police and city wire, police radio, telephone dispatchers who are contacted on a regular basis, motorist assistance

patrol, a network of reliable "stringers" or "spotters" who call in information, and even air monitoring. Reports are also based on information provided by local agencies, for example, KDOT provides daily information about construction activities and lane closures to traffic reporters as well as newspapers.

The information currently provided via radio and television traffic reports may be considered an application of the En-Route Driver Information, Route Guidance, and Pre-trip Travel Information ITS user services. Information regarding construction activities and lane closures provided in the newspaper may be considered an application of the Pre-Trip Travel Information user service.

EMERGENCY VEHICLE SIGNAL PRE-EMPTION

Emergency vehicle signal pre-emption allows emergency vehicles to get preferential treatment at traffic signals. Emergency responders in Johnson County, Kansas (including Med-Act and the Overland Park Fire Department), and Independence, Missouri, both utilize traffic signal pre-emption to reduce response time. Signal pre-emption for emergency vehicles is considered an application of the Emergency Vehicle Management user service. It should be noted that not all emergency responders are interested in signal pre-emption. For example, MAST, the emergency medical responder in Kansas City, Missouri, prefers not to have signal priority based on the presumption that it is safer if drivers do not expect to have signal priority. MAST notes that this is particularly critical due to the fact that MAST serves multiple jurisdictions, and it would be dangerous with respect to driver expectation if some jurisdictions implemented signal priority, and some did not.

TRAVELER INFORMATION

Traveler information includes information about hotels, restaurants and other activities, facilities, and services. Electronic traveler information is currently available via a computer touch screen at each Visitor Center in Missouri and at a kiosk in Bartle Hall in Kansas City, Missouri.

The touch screens at the Missouri Visitor Centers, which were implemented over five years ago, allow travelers to select a region, and then receive information about restaurants, attractions, lodging, and events. Directions and maps are also available, and may be printed out. Each Visitor Center also has a hotel reservation board. Travelers can contact hotels and make reservations by using the phones provided and dialing a two digit code for the hotel. The deployment of touch screens in the Missouri Visitor Centers and the kiosk at Bartle Hall may be considered an application of the Traveler Services Information user service.

MOTORIST ASSISTANCE PATROL

Motorist assistance patrols have been implemented in both Kansas and Missouri. These programs provide motorists with assistance for minor problems (such as a stalled vehicle, a vehicle with a flat tire, a vehicle out of gas), and call a tow truck when the problem is beyond the scope of repair. These programs help reduce congestion by clearing the lane of traffic and

the shoulder as quickly as possible, and thus may be considered components of the Incident Management user service.

Missouri - Missouri's motorist assistance patrol (MAP), run by MHTD, has two shifts that cover many of the busiest segments of freeway. The area is divided into zones, and is served by five vehicles and a staff of nine people (four per shift plus a supervisor). The existing zones serve:

- I-70 from west of the I-470 interchange to just east of the I-435 interchange.
- I-70 from east of the I-435 interchange to and including the south and east legs of the downtown loop.
- I-35 from the state line to M-210 north of downtown, I-70 and I-670 west of the downtown loop, and the north and west legs of the downtown loop.

The MAP service may be expanded to cover I-435 between I-70 and Grandview.

Kansas - Kansas started a motorist assistance patrol (MAP) in November 1994 with one vehicle. The program, which is run by the Kansas Highway Patrol (KHP) and funded by KDOT using safety set-aside funds, has since added a second vehicle. The program operates 20 hours per day, from 5 a.m. to 1 a.m., with a staff of five people. Although there are no specified routes or areas of assignment, much of the service is provided on the interstates. Service is provided on I-435, and on interstates north of I-435, particularly I-35. Service is also focused on areas under construction, which currently includes I-435, I-35, and K-7.

COMMERCIAL VEHICLE OPERATIONS

A number of ITS activities and studies related to commercial vehicle operations (CVO) have been underway in both Kansas and Missouri. These include the following:

- In 1994, a Kansas-Missouri ITS CVO Institutional Issues Study was completed. The purpose of this study was to determine legislative barriers that must be addressed in order to implement ITS CVO user services.
- Missouri is currently participating in a study to identify and prioritize issues related to the implementation of ITS CVO services. This study focused on services between the states of Missouri, Iowa, Nebraska, South Dakota, Minnesota, Wisconsin and Illinois.
- Both Kansas and Missouri are involved in an ongoing project to develop and perform an operational test of an electronic system that will enable motor carriers to request, pay for and receive registration, fuel tax, operating authority, and oversize/overweight permits from one state to legally operate in eight neighboring states (NE, SD, IA, IL, MN, WI).
- Missouri is currently determining the feasibility of combining electronic CVO screening and clearance with the electronic toll collection process used on the Kansas and Oklahoma turnpikes.

- Missouri is currently in the process of executing an agreement with the Center for Transportation Research and Education at Iowa State University to assist MHTD in researching and developing technical specifications necessary to implement electronic screening of commercial vehicles at the 36 Official Weigh Stations in Missouri at highway speeds. Implementation will include automatic vehicle identification, weigh-in-motion, and credential, safety, and permit verification.

System Characteristics

System characteristics include current and future freeway traffic volumes, freeway accident characteristics, freeway speeds in the morning and evening, signal control systems on selected arterials that may be appropriate for diversion from the freeway, and transit routes for the three major transit agencies in the metropolitan area.

FREEWAY TRAFFIC VOLUMES

Traffic volumes on major freeway facilities are shown in Figure 2-5. Traffic volumes shown are based on average annual daily traffic (AADT) for 1994 for Kansas and Missouri.

Note that a number of facilities have traffic volumes of 100,000 or more vehicles per day, including I-35 in Kansas from US 69 to south of downtown; I-435 from US 69 in Kansas to west of US 71 in Missouri, and immediately south of the interchange with I-70 in Missouri; and I-70 in Missouri from downtown to the interchange with I-470. The highest volume in the urban area occurs on I-35 in Kansas immediately north of the interchange with US 69. The 1994 AADT at this location was nearly 143,000 vehicles. Not only do higher volumes result in recurring congestion when demand exceeds capacity, but furthermore, incidents on these high volume facilities may be expected to result in greater delay due to the large number of vehicles affected.

Traffic volumes on major facilities are shown on a per lane basis in Figure 2-6. These values were calculated based on the 1994 AADT values for Kansas and Missouri. The highest volume per lane values occur in Kansas on I-35 between US 69 and I-635, and in Missouri on US 71 south of I-435. Note that an AADT/lane value in excess of 20,000 represents a peak hour volume in excess of 1,600 vehicles per lane, for a K-factor of 0.08. For a facility with a 70 mph design speed, volumes in excess of 1,600 vehicles per hour correspond to a level of service (LOS) D, at best.[1]

Facilities that exhibit recurring congestion, which may be evidenced by high AADT per lane values, are especially of interest if demand for the facility is expected to increase. In some cases, historical trends may be examined in an effort to ascertain future conditions. If trend analysis is considered in conjunction with high existing AADT per lane values, then I-35 in Kansas is of particular interest. I-35 has experienced steady increases in traffic volume. The increase in traffic on I-35 is evidenced by a 1989 AADT of 101,845 and a 1994 AADT of 142,630 (for the segment on I-35 just north of US 69). On the other hand, US 71, which also

[1] Transportation Research Board, *1985 Highway Capacity Manual, Special Report 209.*

demonstrates a high AADT per lane value, has experienced relatively steady volumes, as evidenced by a 1989 AADT of 97,690, and a 1994 AADT of 99,320.

Future traffic volumes on major freeway facilities are shown in Figure 2-7. These volumes, which were provided by MARC, are for the year 2020. Future traffic volumes on a per lane basis are shown in Figure 2-8.

FREEWAY ACCIDENTS

Freeway accident analysis was based on accident data provided by KDOT and MHTD. The results presented vary slightly on either side of the state line, due to variations in the information available.

In Kansas, KDOT accident data was provided for the five year period from 1989 through 1993. Accident data is compiled for each facility, by county. For example, all of I-35 within Wyandotte County is considered a single segment. High frequency accident spots and high frequency accident sections are also identified. High frequency accident spots are segments (0.1 miles long in urban areas and 0.3 miles long in rural areas) for which the accident rate exceeds the critical accident rate. The critical accident rate is the 95 percentile accident rate for similar roadways in the state. High frequency accident sections are roadway segments that include a number of high accident spots. The length of the high accident sections varies, depending on a variety of things, such as geometric characteristics and jurisdictional boundaries.

In Missouri, data from MHTD's Accident Master database was provided for each facility of interest. This data included information about each accident on every facility, by milepost, for a one year period (1994 for Jackson and Cass counties, 1993 for Clay and Platte Counties). Information regarding high accident locations was also provided by MHTD. Information about high accident locations included the number of accidents at each location for all legs of the interchange, and was based on a three year summary for the years 1991 through 1993.

Accident Rates - Accident rates for major freeway facilities are shown in Figure 2-9. Accident rates are expressed in terms of the number of accidents per million vehicle miles traveled. In Kansas, the accident rates were provided by KDOT and are shown for each facility by county. High frequency accident sections are also indicated. In Missouri, accident rates were calculated using the Accident Master database and average annual daily traffic volumes for the facility segment.

High Accident Locations - High accident locations on major freeway facilities are shown in Figure 2-10. The high accident locations in Missouri were provided by MHTD and are based on accident data for the years 1991, 1992 and 1993. These values include accidents on all legs of the entire interchange. For example, there were approximately 65 accidents a year on both I-70 and Van Brunt Boulevard at the I-70/Van Brunt interchange.

The values associated with the high accident locations in Kansas are based on the number of accidents in high frequency accident sections. These values are based on accident data for the five year period from 1989 to 1993. These values include only the accidents on the interstate facility itself, unless the interchange is a high frequency accident section for both the

interstate and the intersecting roadway. For example, on I-35 at the Roe Avenue/18th Street Expressway interchange, the value includes only the accidents in the high frequency accident section on I-35, and does not include any accidents on Roe Avenue/18th Street Expressway. However, at the interchange of I-35 and US 69, there is a high accident section on each facility and thus the value shown includes the accidents in the high frequency accident sections on both US 69 and I-35 at the interchange.

FREEWAY TRAVEL TIMES

Freeway congestion may be evaluated by considering travel times, which reflect travel speeds. Travel speeds on major freeway facilities are shown in Figures 2-11 and 2-12 for the morning and evening peak periods. The information presented in this exhibit is based on travel time runs conducted in 1993 by the Mid-America Regional Council. Travel speeds in Missouri were modified to reflect the results of MHTD's freeway monitoring, which was conducted in 1994 and 1995. Note that the most significant congestion occurs on the north leg of the downtown loop, on I-35 north and south of downtown, on I-70 east of downtown, on I-435 south of town, and on US 71 south of I-435. Also note that the speeds on I-70 between I-435 and K-7 are less than 50 miles per hour, this is probably due to the delay caused by toll collection. This delay may be reduced to some extent by the recent deployment of electronic toll collection (ETC), however, it has not been eliminated because vehicles using ETC must still slow down to approximately 20 miles per hour.

Figure 2-13 shows "Areas of Concern" as indicated in the 79 responses to MARC's Congestion Survey (a 13 percent response rate). Note that both facilities, such as I-35 and I-70, as well as specific interchanges, such as I-29 and Barry Road, are indicated. While the results of this Congestion Survey may not be statistically representative of the viewpoint of local citizens, they do highlight some of the local concerns. Note that in many cases, the areas of concern correspond to locations that experience high traffic volumes, low travel speeds, and/or a high incidence of accidents.

ARTERIAL SIGNAL SYSTEMS

Selected arterial signal systems are shown in Figure 2-14. Systems shown include systems under the jurisdiction of Kansas City, MHTD, and Independence in Missouri, and Kansas City, Overland Park, and Lenexa in Kansas. Arterial signal systems are of particular interest on facilities that could potentially serve as alternative routes for the diversion of traffic from the freeway.

Coordination of signals on arterials that span more than one municipality is of interest not just during incidents, but also during typical operating conditions. The need for increased coordination among the various cities was noted at the public meetings.

Missouri - Kansas City, Missouri has extensive signal systems, encompassing all of the downtown loop, as well as numerous arterials. Most of Kansas City, Missouri's signals are included in either a system or network. Figure 2-14 shows some of the signal systems that may be most appropriate for diversion from the freeway. Kansas City, Missouri's system signals include both electromechanical and solid state controllers, coordinated by time clock,

hardwire or communications cable interconnect. In terms of alternate routes, one example is Truman Road, which currently has solid state controllers and will have communications cable interconnect and telephone access to the system (planned for implementation). Truman Road can serve as an alternate route to I-70 between the downtown loop and I-435. As signal improvements are made, the capability of other facilities to serve as alternative routes will increase.

MHTD also maintains traffic signals in the Kansas City metropolitan area, both isolated intersections and signal systems. MHTD works closely with local jurisdictions, as evidenced by the fact that MHTD and Kansas City, Missouri, currently share signal systems on Bruce Watkins Drive. All of MHTD's closed loop signal systems utilize solid state controllers (NEMA and Type 170) and signal interconnect, and have the capability for remote access. The capabilities of this sophisticated equipment enhance the effectiveness of facilities under MHTD's jurisdiction to be used as alternate routes for incident management. The fact that all of MHTD's signal systems are based on solid state equipment not only enhances current capabilities, but also provides flexibility with respect to expandability and the potential for future enhancements. For example, MHTD's current NEMA systems can utilize technologies such as changeable message signs and other auxiliary equipment that can be remotely activated.

Independence, Missouri has a signal system on Noland Road, between US 24 and 44th Street. Furthermore, there are currently plans to upgrade the controllers on Noland, at which time the controllers currently on Noland Road will be installed on Sterling, and Sterling will be timed as a system between Truman and US 40.

Kansas - Kansas City, Kansas, has 13 signal systems currently implemented, both network and arterial. Ten of these 13 systems are interconnected with a distributed master system and a telephone drop to the master; the remaining three use time clocks for coordination and operate as a master/slave. All signals utilize solid state controllers. In terms of alternate routes, State Avenue, Central Avenue east of I-635, and Kansas Avenue west of US 69 may be appropriate for diversion from I-70, especially given the fact that additional signal interconnect is planned for implementation on each of these facilities.

In Johnson County, Kansas, some of the arterials that could potentially be used as diversion routes are in the jurisdiction of either Overland Park or Lenexa. Overland Park has a distributed master system with 20 arterial sections, encompassing 88 coordinated intersections. All of Overland Park's signals are Type 170 microprocessor controllers, and thus signals currently operating independently could be integrated into a coordinated signal system without updating signal controller hardware. In some cases, this might be expected to result in significant benefits. For example, coordination of the signals on 103rd Street (immediately north of I-435) and/or 111th Street (immediately south of I-435), would allow these arterial facilities to be better utilized as alternative routes when there is an incident on I-435. Overland Park has communications capabilities with 120 intersections, which consists of telephone lines from the PCs to the master 170s in City Hall, and cable TV lines from the masters to the local intersections.

Lenexa, Kansas, has 43 traffic signals, over half of which are connected by fiber. All of the signals in Lenexa have solid state controllers, and there are currently eight signal systems (which encompass 34 signals), as shown in Figure 2-14. Six of Lenexa's eight signal systems have fiber interconnect, and the remaining two systems are identified as potential candidates

for fiber installation. Signal systems on 87th Street, 95th Street, and Quivera have telephone access. This capability, coupled with location considerations, may make these facilities appropriate for diversion from I-35 and I-435 under some circumstances.

TRANSIT RIDERSHIP

Transit routes provided by KCATA, by the Public Transportation Division, Public Works Department in Kansas City, Kansas, and by Johnson County Transit (Kansas) are shown in Figure 2-15. Additional information about transit ridership characteristics was provided in a previous section, *Major Facilities in the Kansas City Area.*

Kansas City Area Transportation Authority - The KCATA provides service to portions of Clay, Jackson, and Platte counties in Missouri, and Wyandotte County in Kansas. However, over 95 percent of the service is concentrated in Kansas City, Missouri and Jackson County, Missouri[1].

Public Transportation Division, Public Works Department, Kansas City, Kansas - The City of Kansas City, Kansas operates public transit, in addition to contracting with KCATA for the provision of transit service. Fares and operations are coordinated to some extent with KCATA services, although there are presently no connections between transit in Kansas City, Kansas with Johnson County Transit services.

Johnson County Transit - Johnson County Transit provides service primarily oriented to serve the commute from Johnson County to downtown and the Crown Center in Kansas City, Missouri. This service is currently provided through a contract agreement with Mayflower.

Other Transit Services - Transit service is also provided in a number of other municipalities within the Kansas City area. In some cases, transit service is provided within the city, and in other cases, transit service consists of commuter routes to downtown Kansas City, Missouri. Cities such as Independence and Excelsior Springs, Missouri, contract with KCATA for their transit service, while in other cities, such as Blue Springs, Missouri, transit service is provided by an independent operator.

Transit Service Utilizing Freeways - Because a primary focus of the Early Deployment Study is on freeways, it is useful to explore the extent to which existing transit service utilizes the freeway. Table 2-4 indicates ridership characteristics of transit routes that currently utilize the freeway.

Institutional Characteristics

The Kansas City metropolitan area encompasses a large number of jurisdictions and affected agencies, as discussed in a previous section, *Jurisdictions and Affected Agencies*. The large number of agencies operating in the metropolitan area complicates institutional issues by increasing the number of players that must be involved in any endeavor that affects the entire

[1] *Draft Long Range Transportation Plan*, March 1995, Mid-America Regional Council, Kansas City, Missouri.

Table 2-4. Transit Use of Freeways

Freeway	Location[1]	Morning Inbound		Afternoon Outbound	
		Bus Trips	Ridership	Bus Trips	Ridership
I-29 North	s/o 56th Street	2	40	2	50
Broadway Extension	n/o Broadway Bridge	6	110	6	130
I-35 North	n/o Chouteau	2	110	2	110
I-29/I-35 North	n/o Paseo Drive	5	170	5	190
I-70 East	e/o I-435	1	30	1	30
I-70 East	e/o Manchester	13	380	15	450
I-70 East	w/o Manchester	23	600	23	650
I-435 South	s/o I-70	5	140	5	160
Southwest Trafficway	s/o I-35	6	120	6	120
I-35 South	s/o Southwest Trafficway	13	215	13	215
I-35 South	n/o Southwest Trafficway	19	335	19	335
I-70 West	w/o CBD	19	220	19	290

[1] s/o = south of, n/o = north of, w/o = west of, e/o = east of.

metropolitan area. Alternately, the jurisdictions and agencies operate independently, which results in a variety of policies.

This section provides an example of one area in which cities operate independently, namely towing, as well as a general discussion of the opportunities for coordination in the metropolitan area.

TOWING OPERATIONS

One area in which the various cities operate independently is with respect to towing. Towing regulations can have a significant impact on transportation, because they impact incident management and incident removal. This impact is especially evident in the Kansas City area, where much of the congestion is related to incidents.

Currently, towing regulations vary throughout the metropolitan area. Because each city operates independently with its own regulations, tow truck operators generally must obtain a separate license for every city in which they operate. There are estimated to be approximately 50 tow companies in the metropolitan area; 15, 20 or 25 of these are in-depth operations. The

remaining companies are small, with one to two trucks, and often are not in business very long.

There are a variety of tow policies demonstrated by the various cities and agencies in the Kansas City area. Some cities, such as Independence, Blue Springs, and Lee's Summit, Missouri, contract for tow services on a low bid basis. Other agencies, such as the Kansas Highway Patrol (KHP) and the City of Overland Park, Kansas, operate using a rotation system. Other cities, such as Kansas City, Kansas, have divided the city into districts, and have tow contracts within each district. Finally, some cities in the metropolitan area, such as Kansas City, Missouri, have no regulations regarding towing.

There are advantages and disadvantages to each system. Considering advantages, when a company contracts with a city, there are specifications for performance, such as response times, and there are penalties if these criteria are not met. Considering disadvantages, in some cities that have exclusive contracts with a single tow service, the contract may be for less than five dollars per tow for police tows, in which case the disabled vehicle is impounded in the police garage. A tow company would not be expected to cover its expenses by charging less than five dollars per tow, as is the case for some towing contracts. However, if the owner of the disabled vehicle has no preference as to whether or not the tow is a "police tow", or prefers to have the vehicle towed to a service station or garage, then the vehicle will not be towed as a police tow and the tow charge can be significantly higher ($65 or more). Furthermore, the tow company often receives money from a body shop if a damaged vehicle is brought in, which can make up for a loss on the tow.

In Kansas City, Missouri, vehicles are cleared on a first come, first serve basis. Tow truck operators listen to scanners and come to the scene. As a result, multiple operators may arrive at the scene, which may further delay traffic, and may contribute to congestion and traffic delays, and in some cases, additional accidents. However, Kansas City, Missouri, police note that response times are minimal under the current system, and thus incidents are cleared quickly, but not without a price, opponents contend. While charges vary significantly (sometimes depending on whether or not the motorist has insurance), towing charges as high as hundreds of dollars have been mentioned. Towing in Kansas City, Missouri, may be expected to change, however. The procurement of a new police radio system may limit access to police radio by tow truck operators, and furthermore, the city plans to introduce a bill that would divide the city into zones, and set up a primary and secondary contractor for each zone. Under this system, tow trucks would be dispatched from public works, when notified by the police.

Rotation systems, such as the ones used by the KHP and the City of Overland Park, Kansas, have generally worked satisfactorily. KHP tags abandoned vehicles, and calls tow trucks on a rotational basis. Although Overland Park utilizes a rotation system, and the Overland Park Service Commission previously set prices for towing, the practice of setting prices for towing has been called into question since a rider to a Federal Aviation Administration bill was passed in 1994. This federal deregulation legislation limits the ability of local and state jurisdictions to regulate towing operations. This legislation states that state and local jurisdictions cannot impose regulations regarding price, routes, or service on carriers of property. Although this regulation does not apply to emergency vehicles or when public safety is an issue, it does raise some questions regarding the ability of a local jurisdiction to regulate towing. This legislation has been challenged, and a ruling favorable to cities' rights to regulate towing has come down from a district court in Louisiana.

The controversy and issues surrounding tow trucks address not only police tows and removal of disabled vehicles, but also issues such as the motorist assistance patrol (MAP). Some tow agencies think that MAP should be provided by contracts with private tow truck operators, who would be paid to patrol during rush hours. Under this system, proponents say, the public would not incur equipment costs, and personnel resources could be focused only on peak hours. Some cities, such as San Diego and Los Angeles, California, have contracted with private patrols to provide this service. Other cities, such as Chicago, Illinois; Minneapolis, Minnesota; Houston, Texas; and both Kansas and Missouri in the Kansas City area, provide this service through the public sector.

OPPORTUNITIES

There are a number of activities and organizations in the metropolitan area that foster interagency communication and cooperation. These activities and organizations can contribute to the successful deployment of an intelligent transportation system both as a source of information and feedback, and as a foundation for further institutional communication and cooperation.

Incident Management Activities - Activities are currently underway to organize a bi-state incident management system. This system will provide basic guidelines for all agencies involved in incident management activities. Although incident management programs vary from region to region, in general, all address the following elements: incident detection, verification, response, removal, traffic management, and motorist information. Information about these elements will be included in an Incident Management Manual, which will address everything from contacts for agencies to pre-planned alternate routes.

Incident management activities were initiated in the fall of 1994 by MARC, and have been continued by KDOT. The incident management activities have been met with a lot of interest by the agencies that have been contacted. The core group consists of approximately 25 people, and represents all the major public agencies, as well as some private groups, such as a motor club and towing companies.

While the activities for the development of an incident management program are currently underway and may be expected to facilitate and enhance incident management activities, it is important to note current practices for incident management. The agencies interviewed generally felt that the various agencies worked fairly well together at incident locations, and there is not usually any problem with respect to authority at the incident site. However, there is the potential to realize benefits from enhanced coordination and communication, which would be realized to some extent if there was an interagency plan for all activities at the incident site. Furthermore, development of an incident management program would provide agencies with a better understanding of the ramifications of one agency's activities on other agencies' activities.

Existing Organizations - The Kansas City area has Metropolitan Fire and Police Chiefs and Sheriffs Associations. These associations include members from both the State of Kansas and the State of Missouri. Organizations such as these that encompass various jurisdictions on both sides of the state line enhance communication and cooperation, which may be expected to be of benefit when interagency cooperation is required in a more structured

environment, such as during large incidents that require response from multiple jurisdictions. There are also organizations that include members from smaller geographic areas, such as the Johnson County Police Chiefs Association.

INSTITUTIONALIZATION OF EARLY DEPLOYMENT PLAN

It is recommended that the ITS Strategic Deployment Plan be institutionalized. This is recommended not only with the hope that it then would have an advocate and a mechanism for deployment, but also because the document is intended to be a living document, one which will require modification and re-interpretation as local circumstances change, and as technology advances, making new technologies appropriate for deployment. Because the plan encompasses facilities in two states and multiple jurisdictions, it may be institutionalized in a regional entity, such as the Mid-America Regional Council. The institutionalization of the ITS Strategic Deployment Plan will require a team effort which includes KDOT, MHTD, and Kansas City local transportation organizations as well as MARC.

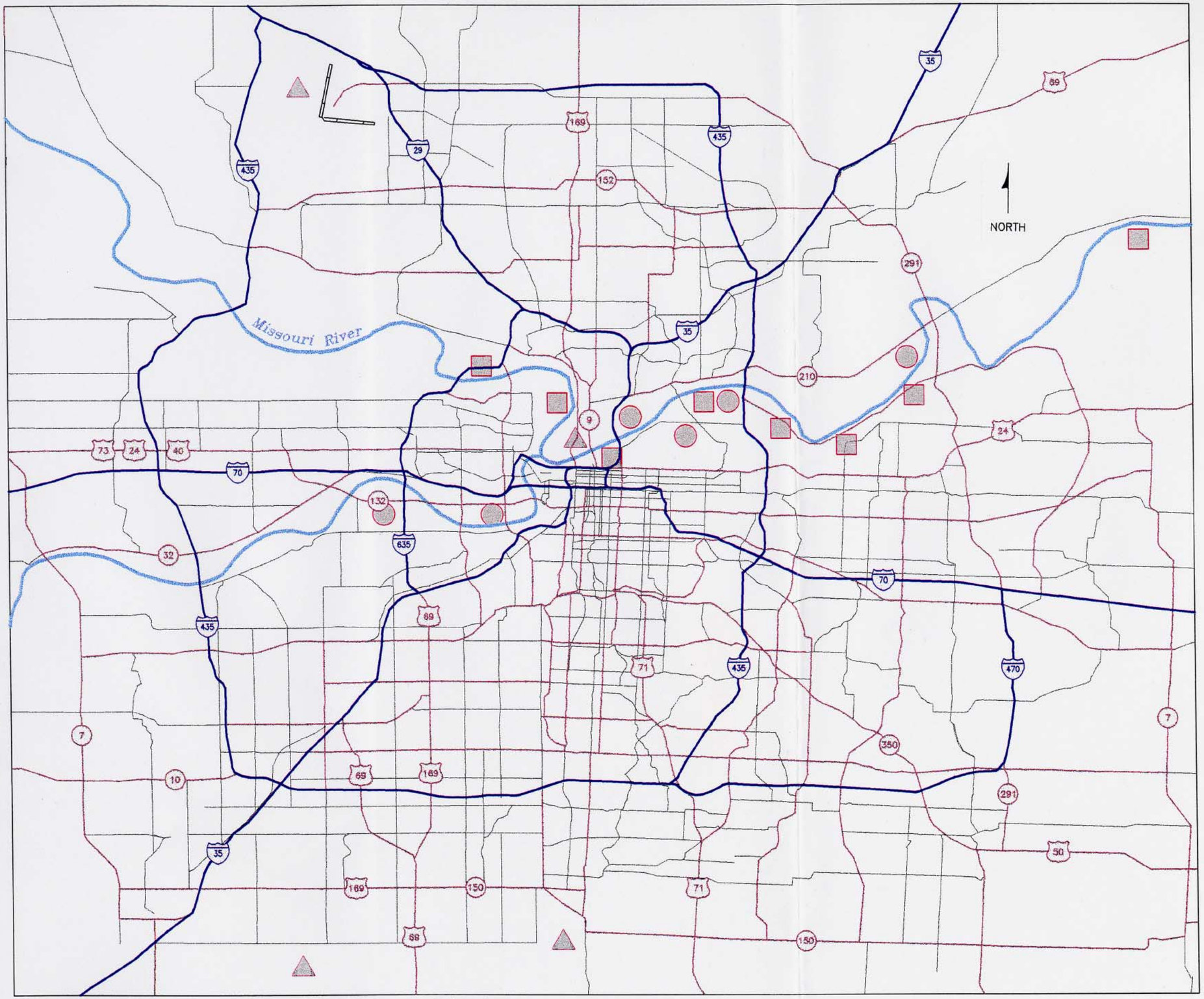
ITS Early Deployment Study
Strategic Deployment Plan

NORTH

Legend

- Interstate
- Non-Interstate Freeways
- Major Arterials
- Minor Arterials

FIGURE 2-1
Freeways and Major Arterials
in Kansas City Area



Source: Intermodal Freight Strategies Study,1995 Prepared for Mid-America Regional Council

ITS Early Deployment Study
Strategic Deployment Plan

FIGURE 2-2
Intermodal Facilities in Kansas City Area

ITS Early Deployment Study
Strategic Deployment Plan

Missouri
Kansas
Missouri River
Platte Co.
Clay Co.
Wyandotte Co.
Johnson Co.
Jackson Co.
Cass Co.
NORTH

Legend

Potential HOV Facility

Source: MARC Draft Long Range Transportation Plan, March 1994

FIGURE 2-3
Potential HOV Network in Kansas City Area

ITS Early Deployment Study
Strategic Deployment Plan

NORTH

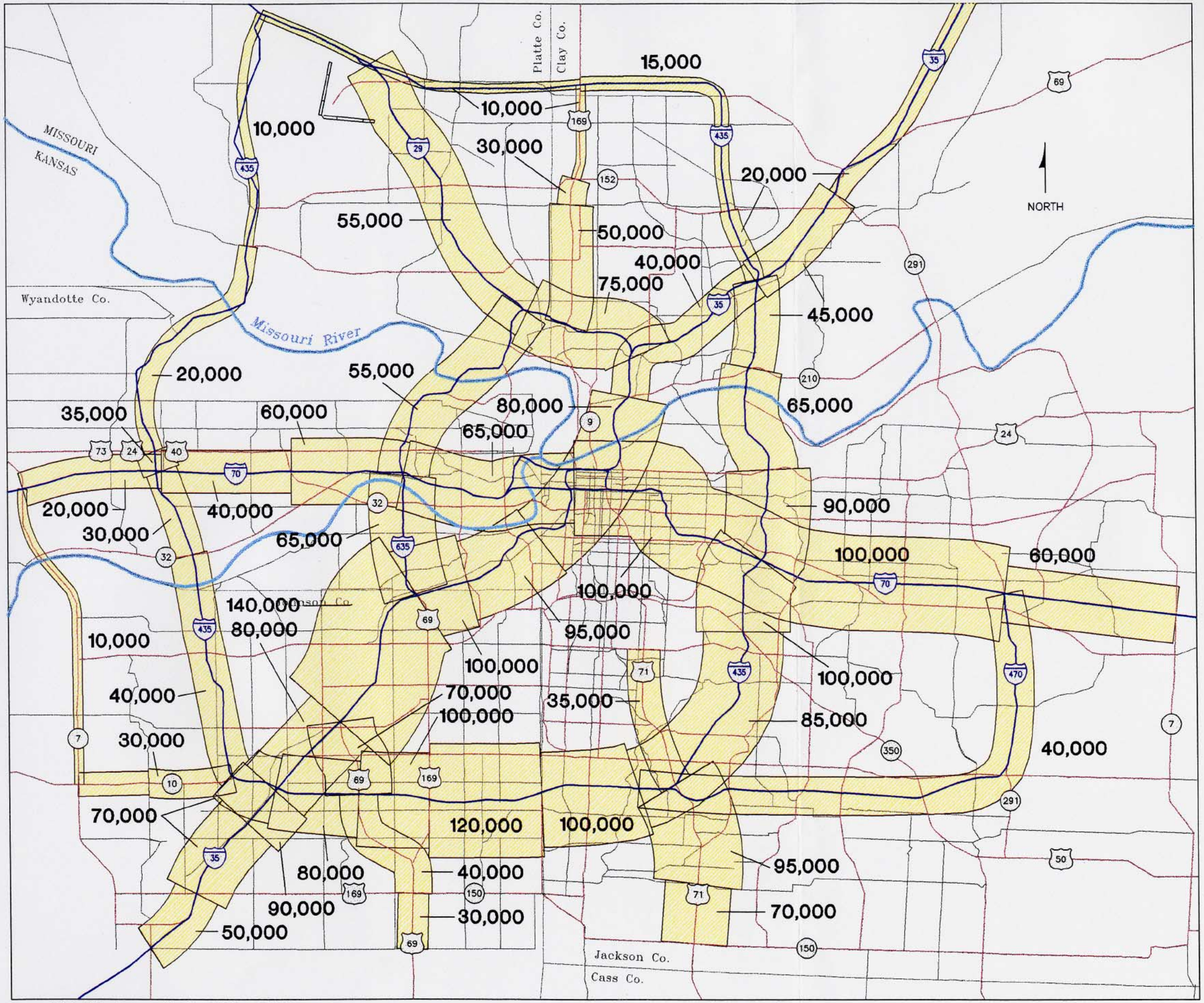
Legend

Preferred Alternative - Light Rail

Source: MARC Draft Southtown Corridor Investment Study and Environmental Analysis, prepared for KCATA by HNTB/Parsons Brinckerhoff, 1995

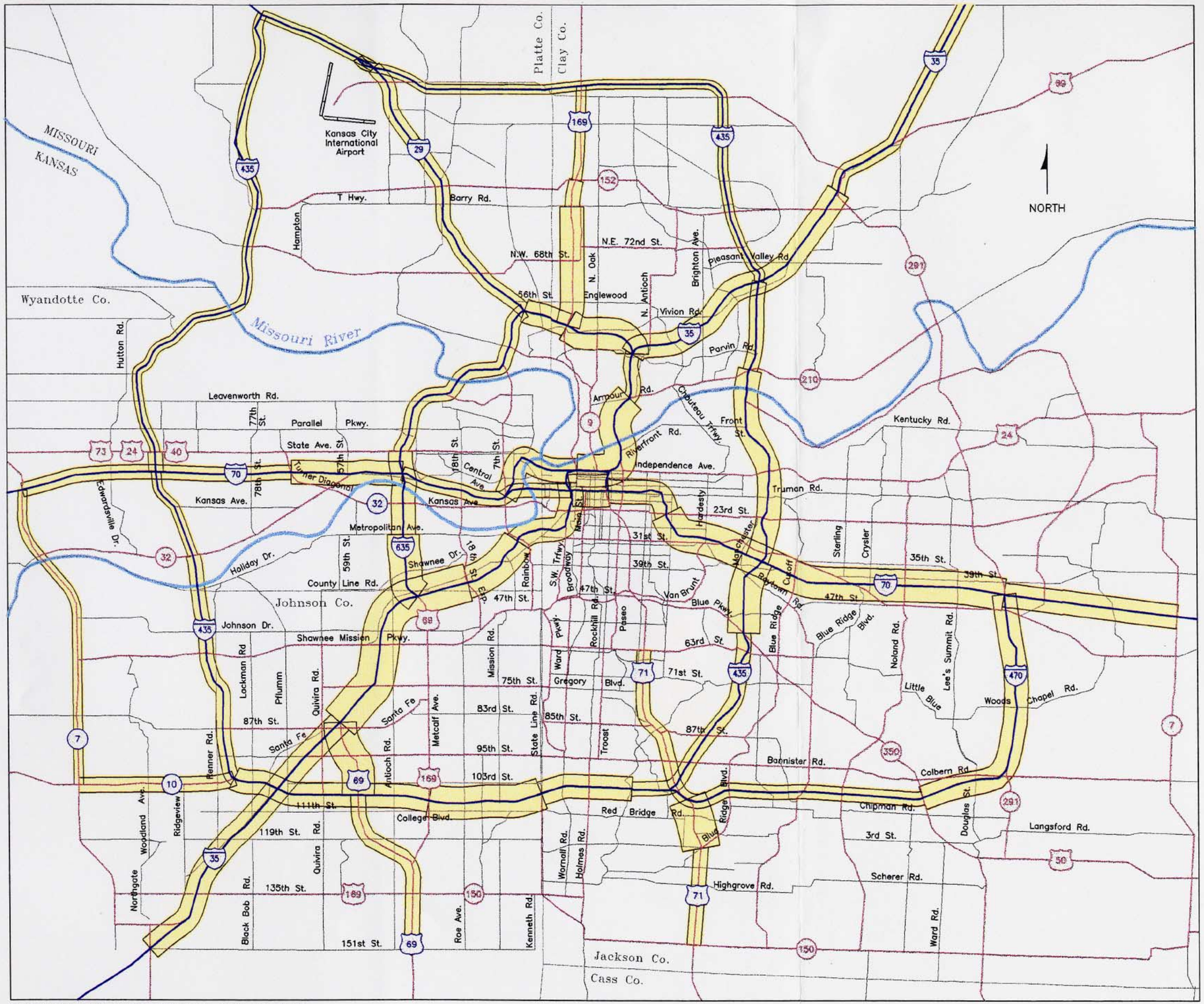
FIGURE 2-4
Light Rail Preferred Alternative in Kansas City Missouri

ITS Early Deployment Study
Strategic Deployment Plan



Source:1994 ADT values provided by KDOT and MHTD

FIGURE 2-5
Average Daily Traffic Volumes on Major Freeway Facilities



Source: 1994 ADT values provided by KDOT and MHTD

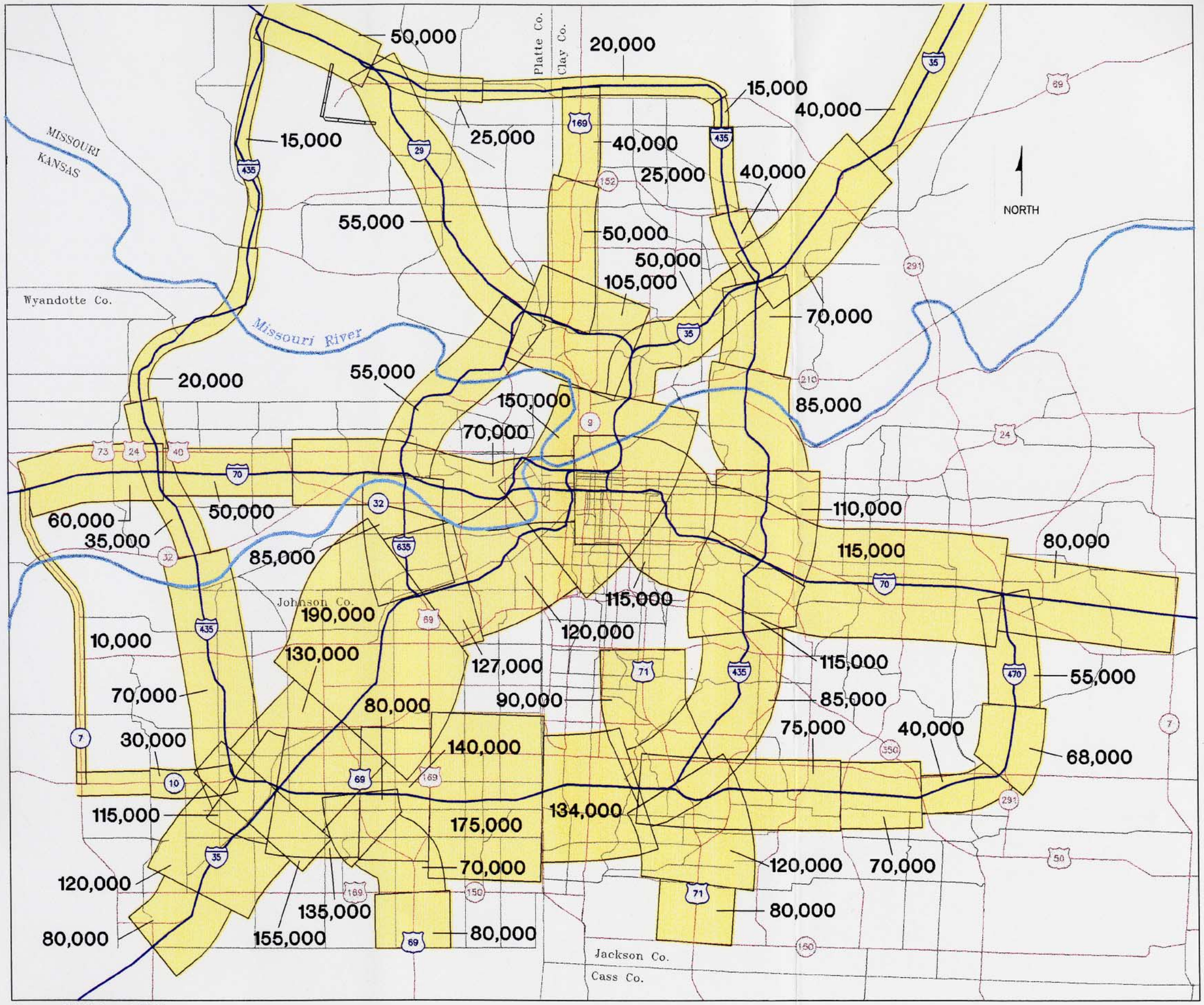
ITS Early Deployment Study
Strategic Deployment Plan

Legend - vehicles per lane

- Less than 5,000 veh/lane
- 5,000 to 10,000 veh/lane
- 10,000 to 15,000 veh/lane
- 15,000 to 20,000 veh/lane
- Greater than 20,000 veh/lane

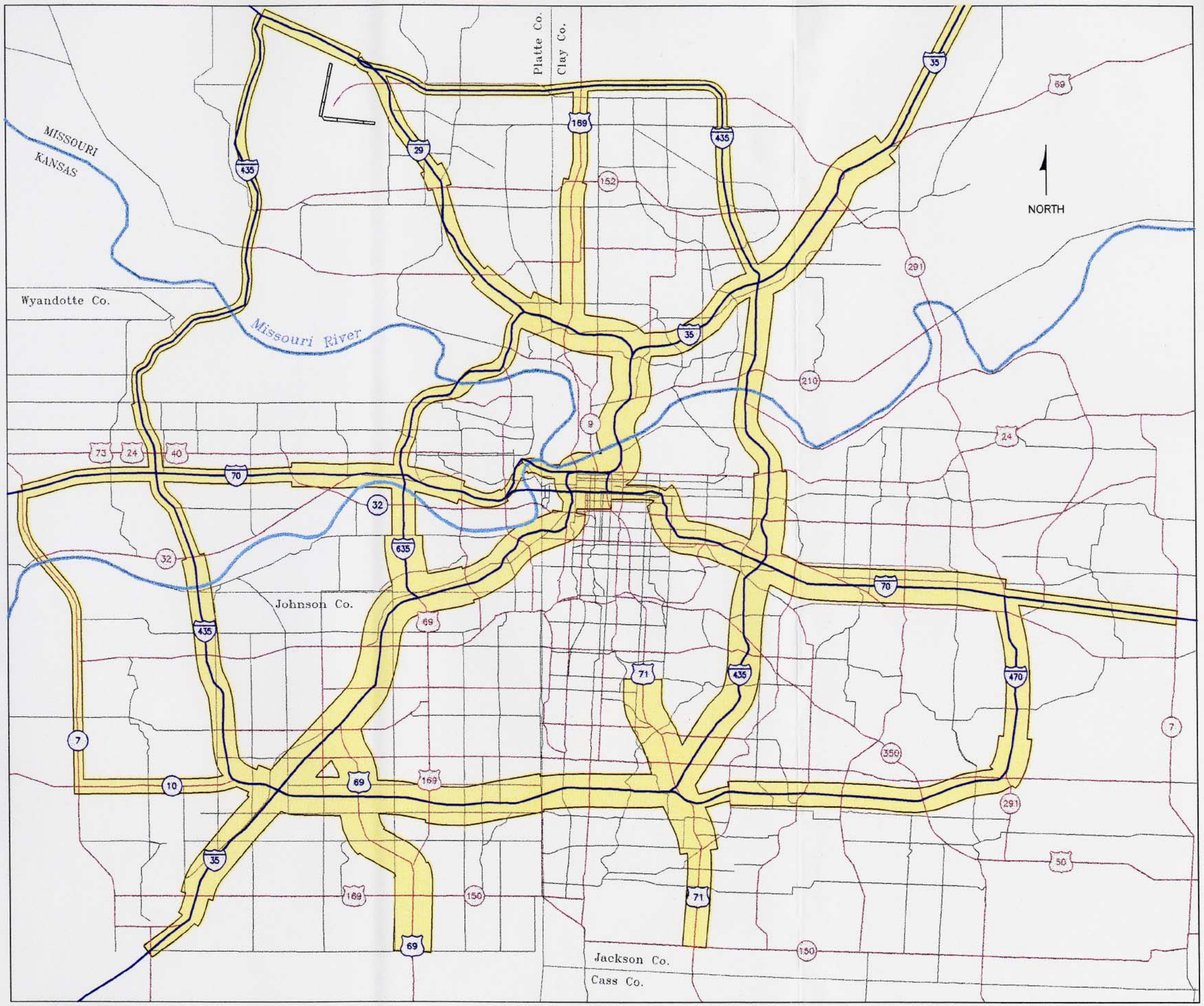
FIGURE 2-6
Daily Traffic Volumes/Lane on Major Freeway Facilities

ITS Early Deployment Study
Strategic Deployment Plan



Source: MARC, August 1995

FIGURE 2-7
Future Traffic Volumes
on Major Freeway Facilities
Year 2020



Source: MARC, August 1995

ITS Early Deployment Study
Strategic Deployment Plan

Legend

- Less than 5,000
- 5,000 to 10,000
- 10,000 to 15,000
- 15,000 to 20,000
- Greater than 20,000

FIGURE 2-8
Future Traffic Volumes Per Lane on Major Freeway Facilities Year 2020

ITS Early Deployment Study
Strategic Deployment Plan

NORTH

Missouri River

Legend - Accidents per million vehicle miles traveled (1989 - 1994)

- Less than 1
- 1 to 2
- 2 to 3
- 3 to 4
- Greater than 4

Source: Kansas – KDOT Accident Rate Data and High Frequency Accident Sections, January 1989 through December 1993.
Missouri – Rates calculated based on MHTD Accident Master Database and ADT, 1993 and 1994.

FIGURE 2-9
Accident Rates on Major Freeway Facilities

ITS Early Deployment Study
Strategic Deployment Plan

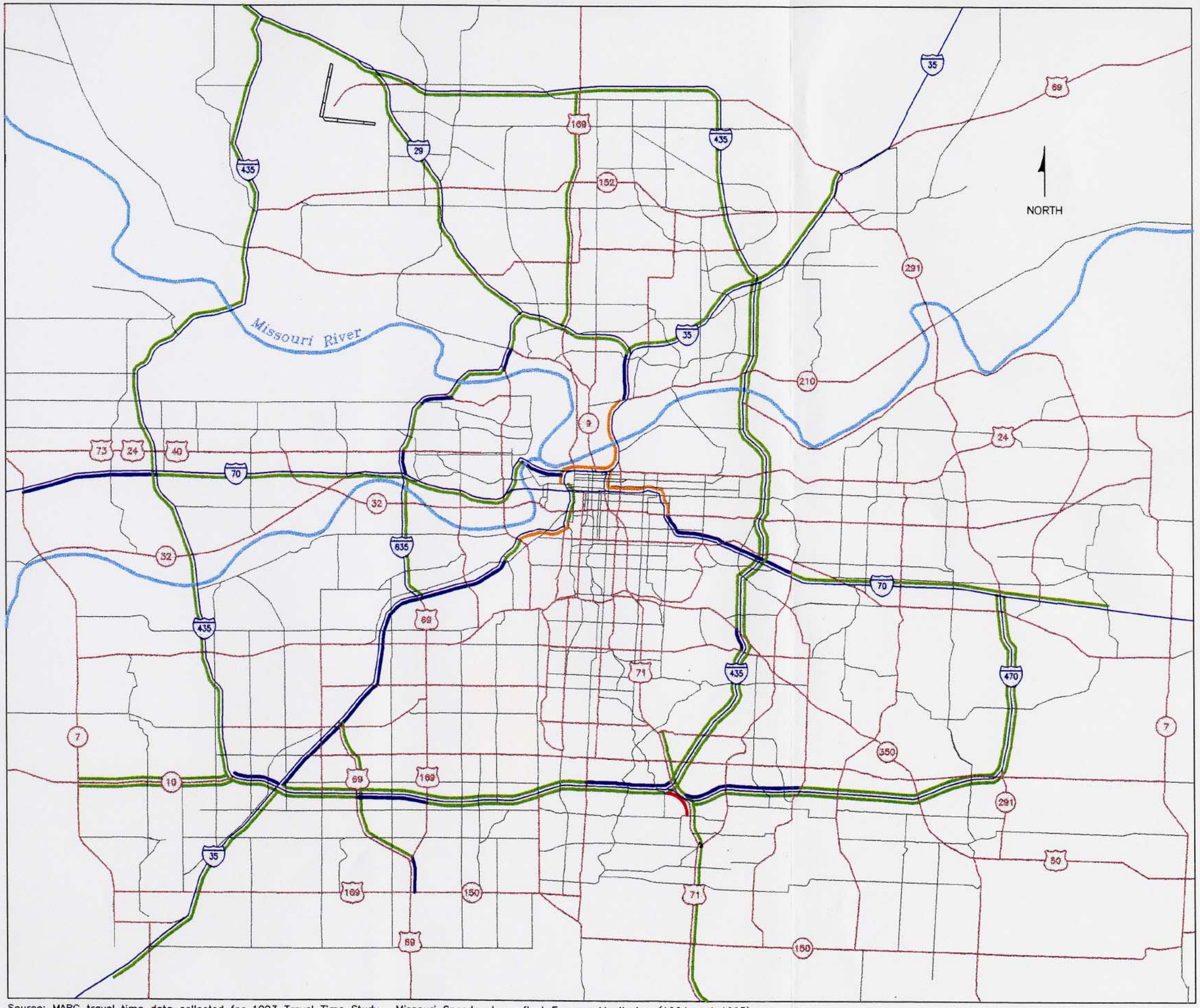
Legend

Average Number of Accidents per Year

High Accident Location

Source: Kansas – KDOT High Frequency Accident Sections, January 1989 through December 1993. Missouri – MHTD High Accident Locations, 1991 through 1993

FIGURE 2-10
High Accident Locations on Major Freeway Facilities



Source: MARC travel time data collected for 1993 Travel Time Study. Missouri Speeds also reflect Freeway Monitoring (1994 and 1995)

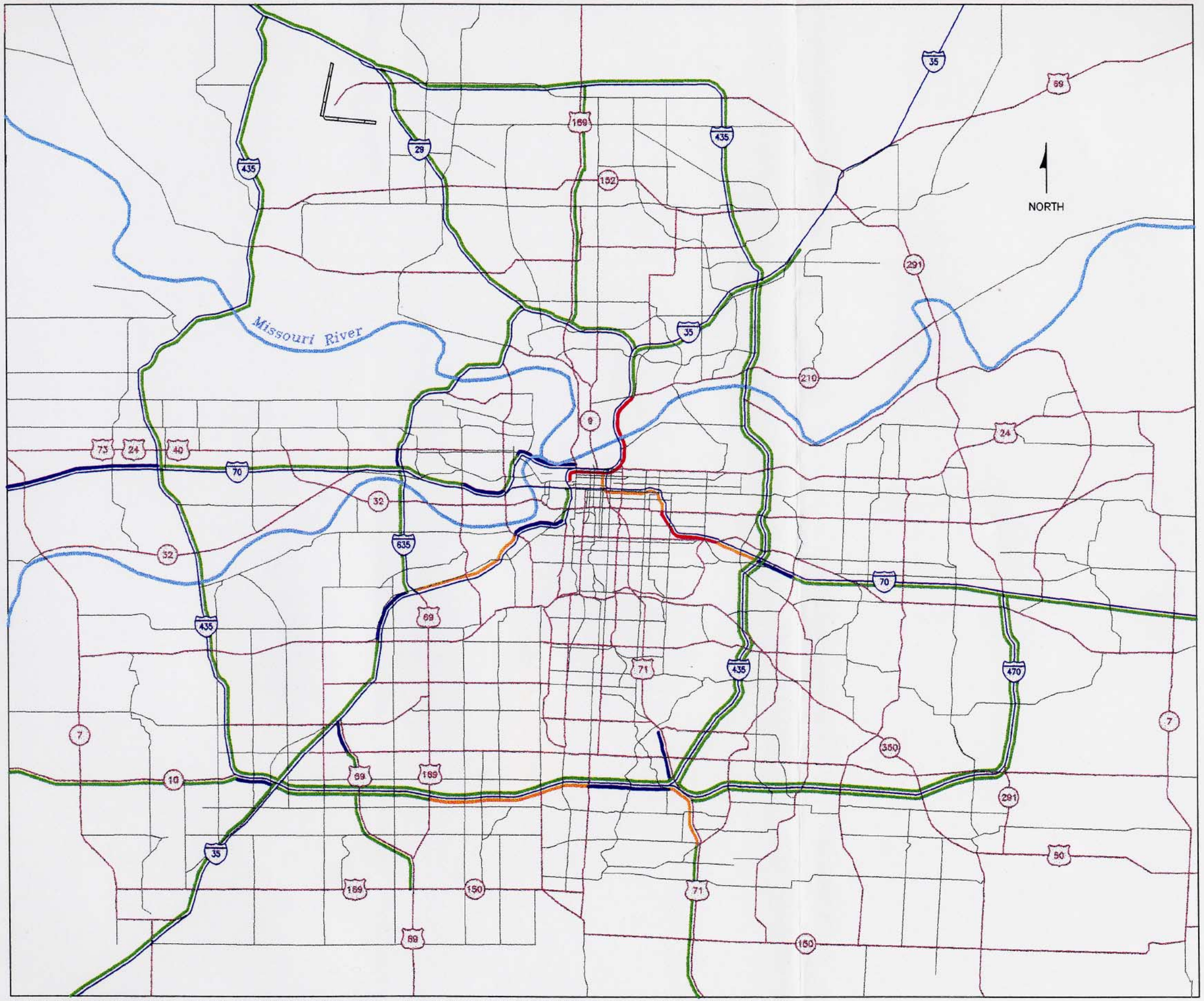
ITS Early Deployment Study
Strategic Deployment Plan

Legend

Travel Speeds

- Less than 20 mph
- 20 to 30 mph
- 30 to 40 mph
- 40 to 50 mph
- Greater than 50 mph

FIGURE 2-11
Travel Speeds on Major Freeway Facilities in Morning Peak Period



Source: MARC travel time data collected for 1993 Travel Time Study. Missouri Speeds also Reflect MHTD Freeway Monitoring (1994 and 1995)

ITS Early Deployment Study
Strategic Deployment Plan

FIGURE 2-12
Travel Speeds on Major Freeway Facilities in Evening Peak Period

ITS Early Deployment Study
Strategic Deployment Plan

NORTH

Legend

Freeway Facilities

Interchange

Source: Responses to MARC Congestion Survey, Spring 1993

FIGURE 2-13
Areas of Concern on Major Freeway Facilities as indicated in MARC's Congestion Survey

ITS Early Deployment Study
Strategic Deployment Plan

NORTH

Legend

- Soild State / Interconnected
- Soild State / Time Clocks
- Electromechanical / Interconnected
- Electromechanical / Time Clocks

FIGURE 2-14
Selected Arterial Signal Systems

Source: Kansas – Information provided by Kansas City, Ks. Overland Park, Ks. and Lenexa, Ks. (KDOT does not maintain signals in the metropolitan area).
Missouri – Information provided by Independence, Mo; Kansas City, Mo; and MHTD.

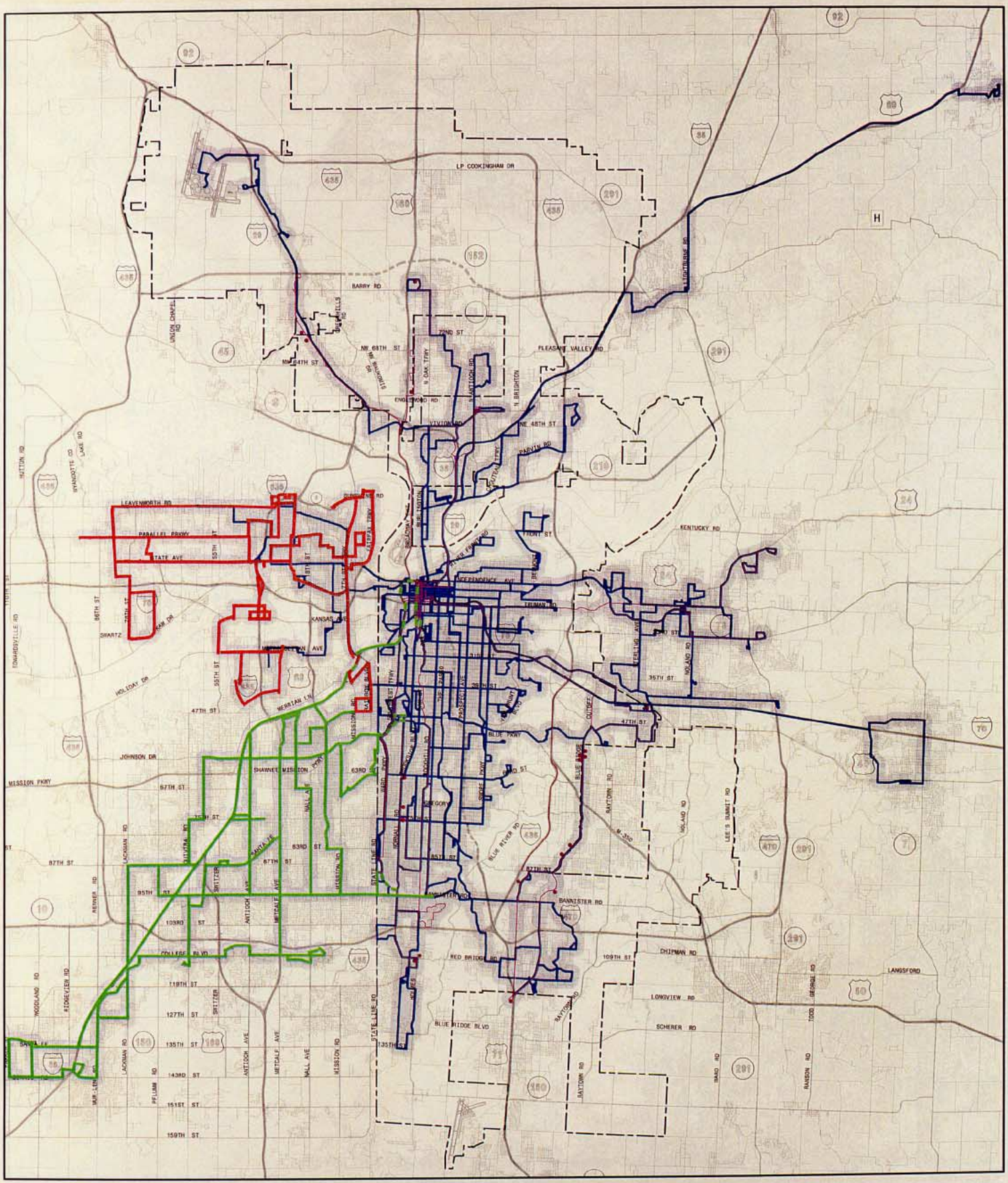


FIGURE 2-15
Transit Routes

Source: City Development Department, Kansas City, Missouri, prepared February 1994.