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Development of Mobility and Congestion Measures for Metropolitan Areas

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EXECUTIVE SUMMARY

One of the biggest transportation challenges facing this country today is congestion. It is pervasive, affecting mobility and productivity, the environment, and our quality of life. In an effort to identify bottlenecks and address congestion, the Arkansas State Highway and Transportation Department (AHTD) is funding this research project to develop an appropriate, consistent and continuing means of assessing congestion in small to medium-sized metropolitan areas in a rural state such as Arkansas.

Through an extensive literature search, the following performance measures were identified for Phase II testing for their ability to assess and reflect the congestion that is experienced by motorists.

- Delay
- Total Delay
- Average Speed
- Speed Ratio
- Travel Time
- Travel Time Index
- Delay Rate Index

Under Phase II, travel time and speed studies utilizing the global positioning system (GPS) technology will be conducted on major arterials and commuting corridors in three metropolitan areas. Based on travel time and delay analyses, the selected performance measures will be calculated. With this initial data collection effort, statistical analysis will be conducted to determine the proper sample size and reliability of the results. Ultimately, a field implementation plan will be developed to spread this practice around the State.

CHAPTER 1 INTRODUCTION

1.1 Definition

What is congestion? Congestion is defined in §500.109 of the *Code of Federal Regulations* 23 – *Highways* (Revised as of April 1, 2007) (CFR) to be:

“...congestion means the level at which transportation system performance is unacceptable due to excessive travel times and delays.”

Highway congestion is caused when traffic demand approaches or exceeds the available capacity of the highway system and consists of recurring congestion and non-recurring congestion. Recurring congestion is caused by physical bottlenecks and poor traffic signal timing. Non-recurring congestion is caused by random occurrences, such as crashes and other incidents, work zones, bad weather, and special events.

While the concept of congestion is easy to understand, congestion can vary significantly based on the time of day and from one day to the next. Traffic demands also vary by season of the year in conjunction with fluctuations in recreational travel and special events. Although highway capacity is usually considered to be fixed, it can vary due to incidents, work zones, weather conditions, and other reasons. Moreover, the levels of highway congestion can vary based on user expectations. A section of highway that may seem to be very congested in a rural community may not even be considered an aggravation in a large metropolitan area.

1.2 Background

Congestion is one of the biggest transportation challenges in the United States. It is pervasive and affects mobility, productivity, the environment, and our quality of life. Congestion has clearly grown in large metropolitan regions as well as small cities and it now

affects more trips, more hours of the day, and more of the transportation systems than ever before.

In May 2006, then U.S. Department of Transportation (DOT) Secretary Norm Mineta announced the **National Strategy to Reduce Congestion on America's Transportation Network**, which provides the framework for government officials, the private sector, and most importantly, the travelers, to take the necessary steps to reduce congestion. The objective of this congestion relief initiative is not simply to slow the increase in congestion but to actually reduce congestion. Solutions of congestion reduction require new approaches to capacity expansion and improved productivity of existing transportation assets.

The Texas Transportation Institute (TTI) has studied congestion in a number of cities in the U.S. annually since 1982. According to the Federal Highway Administration (FHWA), this effort has been the most significant continuing study on congestion in the U.S. The most recent *Urban Mobility Report* released in September 2007 has expanded the number of urban areas studied and further refined and improved its methodology to accurately assess congestion in the US. Individual metropolitan areas were divided into four categories based on their population: Very Large (over 3 million), Large (1 – 3 million), Medium (500,000 – 1 million), and Small (less than 500,000).

Federal requirements state that urbanized areas with populations greater than 200,000 must maintain a congestion management process (CMP) and use it to inform transportation planning and decision making. Some metropolitan planning organizations (MPOs) around the country have also used the CMPs as an important tool for addressing persistent congestion problems and prioritizing investments. While a congestion management process is only required for large urbanized areas, the CFR also indicated the need for strategies that manage demand, reduce single occupant vehicle travel, and improve transportation system management and operations in both metropolitan and non-metropolitan areas.

1.3 Purpose

Much of the State of Arkansas is considered rural with a total population of less than three million. According to the 2000 Census, the most populous city in the State is Little Rock with a population of less than 200,000.

Federal requirements state that a metropolitan planning organization (MPO) shall be designated for each urbanized area with a population of more than 50,000 as determined by the Bureau of the Census. An urbanized area with a population of more than 200,000 is designated as a transportation management area (TMA). Based on these criteria, there are eight metropolitan planning areas in the State (Figure 1) of which two are designated as TMAs. The eight metropolitan planning areas are listed below:

- Bi-State MPO
- Central Arkansas Regional Transportation Study (CARTS) - *TMA*
- Hot Springs Area Transportation Study (HSATS)
- Jonesboro Area Transportation Study (JATS)
- Northwest Arkansas Regional Transportation Study (NARTS)
- Pine Bluff Area Transportation Study (PBATS)
- Texarkana Urban Transportation Study (TUTS)
- West Memphis - Marion Area Transportation Study (WMATS) – *TMA*

Although the West Memphis – Marion area alone does not reach the population threshold for a TMA designation, WMATS was designated as a TMA due to the fact that the West Memphis – Marion area has been included in the Memphis Urbanized Area since the year 1980. Further, TUTS includes portions of Miller County, Arkansas and Bowie County, Texas and the Bi-State MPO includes portions of Crawford and Sebastian Counties in Arkansas and Leflore and Sequoyah Counties in Oklahoma.

While the *2007 Urban Mobility Report* included the Little Rock and Memphis Urbanized Areas, most of the state's metropolitan planning areas were not included. Moreover, The

Memphis area was considered to be one of the 25 Large areas while Little Rock is categorized as a Small area.

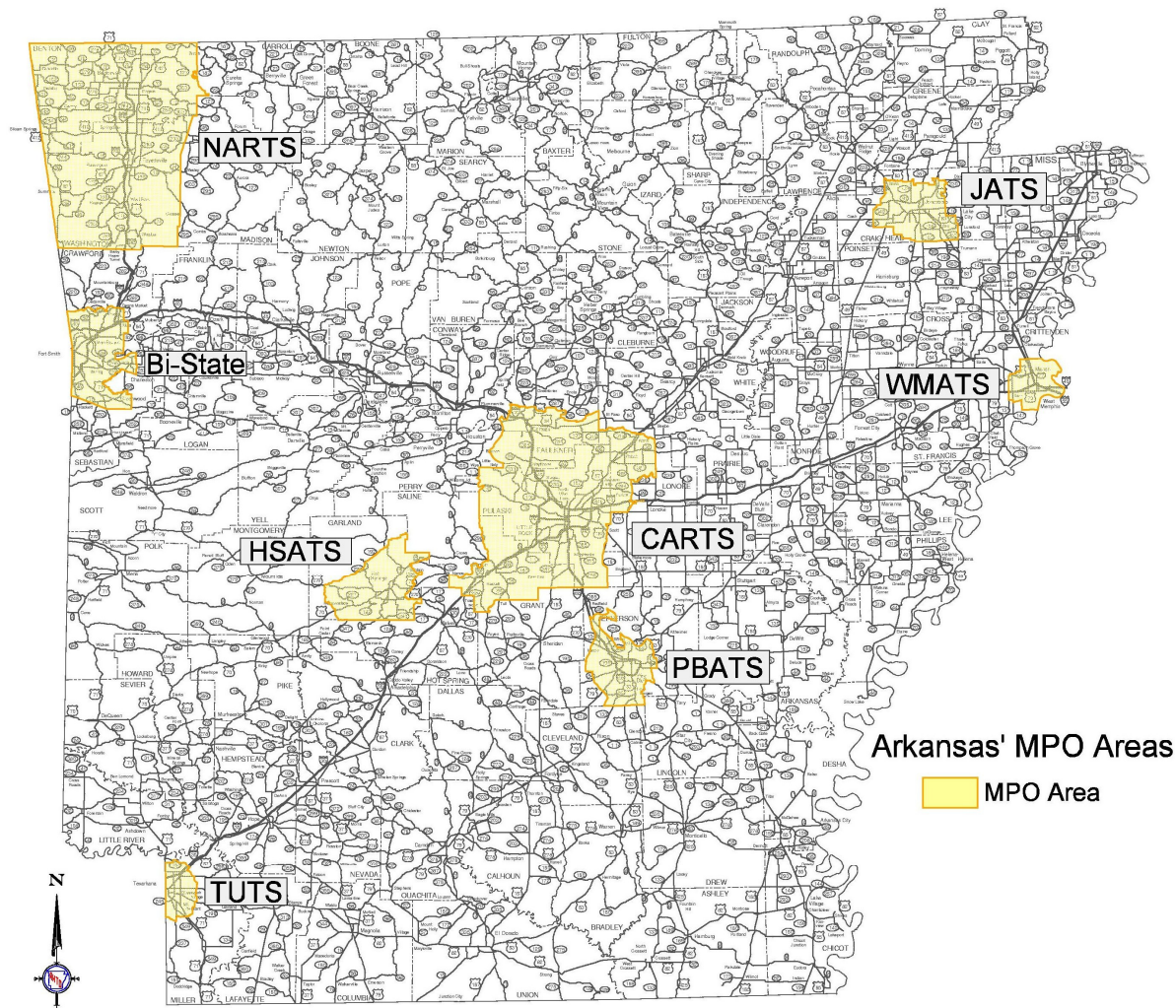


Figure 1.1. Arkansas' MPO Areas

In an effort to fill in the gap that the TTI studies did not address, the Arkansas State Highway and Transportation Department (AHTD) is funding this research project to identify an appropriate, consistent and repeatable method to assess congestion in small to medium-sized metropolitan areas in a rural state such as Arkansas. The final report can be used as a basis for developing a congestion management plan (CMP) for Arkansas' MPOs. Most importantly, it will be able to provide a multi-dimensional view of the congestion problem that small and medium-sized communities are facing and a tool to develop strategies for highway improvements in a rural state.

CHAPTER 2 LITERATURE REVIEW

Several performance measures were identified during the literature search and are described below. Some of these performance measures are used more frequently than others. Refer to Appendix A for the full State of the Art Survey that provides a list of different agencies and their methods for quantifying congestion.

2.1 Frequently Appearing Performance Measures

2.1.1 Highway Capacity Manual Methods. The Highway Capacity Manual (HCM) uses level of service (LOS) and intersection delay to describe traffic congestion.

- *Level of Service.* LOS ranges from uncongested to severely congested related to the letters A through F, respectively. The HCM, while it may use more than one quantitative measure to depict LOS, stresses the use of density on the roadway to describe the levels of service for freeways and multilane highways. As one proceeds from LOS A to LOS F, traffic on roadways become denser and the ability to maneuver is more restricted.

LOS is used quite often, but has also been criticized by many in its inability to differentiate between levels of severe congestion. Once congestion arrives at LOS F, all traffic congestion is labeled the same. In a report by Shawn M. Turner, *Examination of Indicators of Congestion Level*, he criticizes this limitation of LOS and proceeds to explain how the California Department of Transportation (Caltrans) has developed a methodology that considers the number of hours with LOS F operation. The v/c ratio is still used to identify the service level, but once congestion is classified as LOS F the duration is included to represent the extension of peak hours into peak periods (Turner, 1992).

- *Intersection Delay.* Intersection delay is the measure of delay at roadway intersections. The amount of time spent at a intersections is called stopped delay. This measure can also include measuring the time that is spent at very slow speeds such as less than five mph between intersections. For these measures most agencies relate the seconds of delay at the intersection to level of service or at least give a threshold for unacceptable delay.

The Knoxville Regional Transportation Planning Organization believes that this measure is a good way to identify problem areas so that further analysis can be done (KRTPO, 2003). Control delay used by the Northern Middlesex Region of Massachusetts calculates the same delay as the stopped delay, but includes the deceleration, time stopped, and reacceleration of the vehicle. This measure can be used on signal controlled intersections or on stop controlled intersections (NMCOG, 2006).

The Chattanooga-Hamilton County-North Georgia Transportation Planning Organization chose to use a measure slightly different than the stopped delay. They examined delay as the amount of time spent at less than 20 mph between intersections (Chattanooga, 2004). The Corpus Christi MPO does not think that stopped delay is an efficient measure because it does not include delay from turning movements or cross street traffic. It is also not applicable to a corridor or area-wide network (CCMPO, 1997).

2.1.2 Volume to Capacity Ratio. The volume to capacity ratio (v/c ratio) is the comparison of traffic demand to roadway capacity. This is one of the most widely used performance measures. Its popularity originates from its simple, low cost data collection process and its ability to easily identify congested areas.

As the v/c ratio approaches one, traffic congestion increases and is considered severe when it exceeds one. The Michigan Tri-County Region relates this to “near deficient” and “deficient” values (TCRPC, 2004). The v/c ratio is associated with LOS in the HCM and this technique is commonly used by transportation agencies. Some agencies create their own categories to describe congestion based on v/c ratios. The South Jersey Transportation Planning Organization uses a three-tiered rating system, describing congestion as below capacity, approaching capacity, and above capacity based on the v/c ratio.

2.1.3 Delay. Delay is the difference between the actual travel time and the free flow travel time. In California, they consider this to be the best possible measure for congestion for their Freeway Performance Management System (Varaiya, 2006). Four variations of delay are listed below.

- *Delay.* This is the most basic form of delay. The Washington State Department of Transportation determines the daily hours of delay for each roadway segment under study. They believe this variation of delay to be easily understood and addresses the extent, severity, and duration of the congestion (MacDonald, 2006).
- *Delay rate.* This is found by dividing the delay by the length of the roadway segment. The Southwestern Pennsylvania Commission feels it is important to make note of the distance traveled because segments can differ significantly in their length (SPC, 2005). The delay rate is also used by the Pioneer Valley Region in Massachusetts.
- *Peak Period Delay.* This is used to measure delay specifically for peak periods. As delay is most significant during peak periods, the Wasatch Front Regional Council in Utah created an equation to measure peak period delay. It multiplies the inverse of congested speed minus the inverse of free flow speed by distance traveled, volume, and percent of volume in the pm peak period (WFRC, 2004). The South Jersey

Transportation Planning Organization also uses a peak period approach measuring peak period vehicle unacceptable delay (Lai, 2002).

- *Excess delay.* This is “the amount of time spent at a given location that exceeds the maximum amount of time that is generally considered acceptable.” The Syracuse Metropolitan Transportation Council of New York uses excess delay to provide further details on congestion on roadways that have already been classified as congested by the peak hour v/c ratio. They have developed their own equation to calculate this measure using free flow time, directional volume, and directional capacity (SMTTC, 2005).

2.1.4 Total Delay. Unlike delay, total delay measures the delay for all vehicles on the roadway. It can be measured by finding the difference between the total travel time and the free flow travel time and multiplying it by the peak hour volume of the roadway segment. In a study from the University of Virginia, it was found that total delay is easily understood by the public and produces useful and accurate measures for transportation professionals (Medley, 2003).

The New York Metropolitan Transportation Council and the Greater Buffalo-Niagara Regional Transportation Council both find it useful to also include person-hours of delay. This can be done by multiplying the average vehicle occupancy rates by the vehicle-hours of delay (GBNRTC, 2004).

2.1.5 Average Speed. Average speed is simply the distance traveled divided by the travel time. Because speed is a time-based measure, it is a popular choice for agencies to measure congestion. Time-based measures are viewed by most transportation professionals to be the most accurate performance measures and most easily related to the public.

Most of those who use average speed as their measure have a congestion category table or relate the average travel speeds to a level of service ranking system to identify how

congested a roadway system is. The Lexington Area MPO has four levels of congestion rating from un-congested to severely congested with speeds relating to each congestion level (LAMPO, 2007). San Diego Association of Governments and Northern Middlesex Region both relate average speeds to LOS on arterials as suggested in the HCM (SANDAG, 2004 & NMCOG, 2006).

Speed data is collected most commonly by the floating car method using GPS technology to collect data. The Lexington Area MPO is able to collect the time, speed and location data over the segment traveled from its GPS system (LAMPO, 2007). San Diego also uses the floating car method, but they continue to use the computational method also. This method uses turning movement traffic volumes and traffic signal information to find intersection delay, which is then added to the street's estimated running times (calculated from segment length and posted speed limits). The actual speed is then calculated from the travel time and distance of roadway segment (SANDAG, 2004).

2.1.6 Speed Ratio. The speed ratio or speed as percent of the speed limit is the ratio between the actual speeds at which one is traveling and either the posted speed or the free flow speed (whichever one chooses to use). Most agencies that use this measure use the posted limit as their base speed. Because speed is a time-based measure agencies feel that the speed ratio is easily understood by the public.

Wilmington Area Planning Council in Delaware and the Rhode Island Department of Transportation (RIDOT) have created LOS thresholds for arterials and freeways based on thresholds found in the Transportation Research Board's Highway Capacity Manual. Instead of using the speed as percent of the speed limit, they used percent under the posted speed limit, which is a variation of the speed ratio (WILMAPCO, 2005 & RISPP, 2004). The Nashville Area MPO uses average route speed as a performance measure, but they use a threshold of 30 percent of free flow speed for all urban roadway segments (RPM, 2006).

2.1.7 Travel Time. Travel time is the measure of time that it takes to travel a specific distance such as a roadway segment. This can be referred to as the point to point

travel time. When travel times are found, peak hour travel times can be compared to off peak travel times.

Travel time and travel time-based measures are considered the best performance measures by many transportation agencies. Both the Oregon Department of Transportation and the Indianapolis MPO believe that travel time is the most accurate measure of congestion. Indianapolis found that obtaining travel time data is too expensive to collect for every roadway, so they have developed a screening process where roadways are identified as congested by the volume to capacity ratio and further analysis is done to classify how severe the congestion is based on travel time (HNTB, 1996).

2.1.8 Travel Time Index. The Travel Time Index (TTI) is the ratio of peak hour travel times to free flow travel times. This index can be used for multiple facilities, including streets, freeways, sidewalks, and bus facilities.

Values for the TTI must be found on individual segments, but they can be combined by weighting each facility's value by its vehicle or person miles of travel. This technique is used by the Arizona Department of Transportation (ADOT). As the TTI has not been extensively tested in rural areas, ADOT felt it was necessary to find a method to accurately use the TTI in rural areas. They have suggested either separating roadways into 20 to 50 mile segments or to keep the acceptable values for rural areas closer to one and set it higher for urban areas (Willis, 2002).

2.2 Less Common Performance Measures

2.2.1 Number or Percentage of Lane-Miles Congested. This measure identifies the length or percentage of a roadway system that is classified as congested. This is a simple measure used to describe the level of mobility on a roadway and can be conducted in a variety of ways. Agencies must first define what a congested roadway is. Both the New York Metropolitan Transportation Council and the Durham-Chapel Hill-Carrboro MPO consider all roadways that are operating at 85 percent of their capacity to be congested. Once

congested roadways are identified, those segments are added to find the total lane-miles congested (NYMTC, 2006). The percent can be calculated by simply dividing the congested lane-miles by the total lane-miles on the roadway system (DCHCMPO, 1999).

2.2.2 Vehicle Miles of Travel (VMT) and Vehicle Hours of Travel (VHT).

VMT and VHT measure the total number of vehicles on a roadway segment multiplied by the length of the segment or the time spent on the segment depending on the measure being used. This is not a common measure of congestion and the majority of its use is found when describing future roadway conditions or evaluating improvement strategies that have already been put in place on a congested roadway segment.

Both the Nashville Area MPO and the Wasatch Front Regional Council use the calculated reduction of VMT to estimate the success of their roadway improvements (RPM, 2006 & WFRC, 2004).

The Northeastern Indiana Regional Coordinating Council uses percent of and total weekday vehicle miles traveled with v/c ratios greater than a specific threshold. They are able to monitor congestion by looking at the relationship of the total VMT and the percent VMT at a given v/c ratio “X.” “If the total VMT increases significantly, but the percent VMT at a given v/c ratio > ‘X’ remains constant, the system is accommodating increases in travel demand without increased congestion (NIRCC, 2006).” In the South Alabama Regional Planning Commission’s Area-Wide Congestion Index, they use the VMT weighted travel speed (SARPC, 2003).

2.2.3 Buffer Index. The buffer index indicates the level of reliability of a roadway system. Instead of focusing on the whole network, this measure provides insight to the impact of congestion on individual vehicles traveling on the roadway system. This proves to be beneficial to the user because they are able to see how traffic congestion will affect them personally. Transportation professionals can use this measure to alert the public when travel times may be affected so they can alter their traveling plans.

In a study from the University of Virginia, the buffer index was identified as the extra percentage of time an individual should allow to be on time 95 percent of the time. It is calculated by subtracting the average travel rate (the inverse of speed) from the 95th percentile travel rate, dividing that by the average travel rate, and then multiplying by 100. The travel rate can be determined from average speed or travel time and length of roadway segment data (Medley, 2003).

2.2.4 Loss of Productivity. Loss of productivity may also be referred to as lost throughput or lost capacity. The Washington State Department of Transportation defines these measures as “the difference between the potential capacity of the roadway and the actual number of cars that the roadway is serving.” They describe it as lost throughput productivity, which describes the numbers of cars that can pass a given point on a roadway. They measure this in vehicles per lane per hour (MacDonald, 2006). In the Freeway Performance Measurement System of the Caltrans, they describe loss productivity by terms of lane-miles-hours that are lost due to congestion. It multiplies the drop from free flow to congested conditions by the lane-miles of congested freeway and the hours of congested flow to give a quantitative loss of productivity (Varaiya, 2006).

2.2.5 Lane-Mile Duration Index. The lane-mile duration index (LMDI) was created by Cottrell as a measure of the extent and duration of congestion. It is the sum of the product of the congested lane miles and hours of congestion for congested freeway segments. For this index agencies must have a measure such as v/c ratio or others to identify congested roadways before calculating the extent or duration (Turner, 1992).

2.2.6 Planning Time Index. The planning time index was developed by the Texas Transportation Institute and is currently being used by the Capital District Transportation Committee of New York. This index indicates the predictability and reliability of a roadway, and in this way helps to identify and respond better to non-recurring congestion. The index uses a ratio that compares actual travel time on one of the slowest travel days to travel time at a speed of 55 mph. A scale is then produced that indicates how much longer or shorter a trip will be. At a value of one the trip is equal to the average day. If the value exceeds one the

trip will be longer and below one the trip is shorter. With the planning time index value, transportation agencies can calculate the extended time of a congested trip. With the knowledge of the amount of time that the longest trip may take, travelers will be able to plan to leave that much earlier to ensure that they have a 95 percent chance of arriving on time to their destination (CDTC, 2007).

2.2.7 Congestion Severity Index. The congestion severity index was developed by Jeffrey Lindley. This index calculates the total delay in vehicle-hours per million vehicle miles of travel.

2.2.8 Delay Rate Index. The delay rate index (DRI) is based on LOS, speed, delay rate, and travel time. This index, developed by Herbert S. Levinson and Timothy J. Lomax, describes different degrees of severe congestion, while keeping a continuous scale from zero to ten so that it can be easily understood by everyone (Levinson, 1996).

Creating a graph of the DRI against the delay rate, they were able to identify thresholds for the DRI that relate to the LOS delay rates for freeways in the 1985 HCM. If a freeway was given a free flow speed of 60 mph, when graphed it was able to have a slope of one. Then LOS thresholds of delay rate from the HCM were plotted on the freeway line. These were then read to find the thresholds for the DRI. These values were also used for the arterial streets. The index was created so that LOS F would be the equivalent to DRI values greater than or equal to 5. This helps to distinguish differences between the severities of congestion levels at LOS F.

The DRI can be used on several different facilities or multiple facilities at the same time. If more than one facility is being evaluated they should be combined as weighted averages. The DRI addresses the intensity, duration, extent, and reliability of congestion.

2.2.9 Capacity Adequacy Index. Capacity adequacy is the inverse of the v/c ratio multiplied by 100. The difference between the v/c ratio and capacity adequacy is that the capacity adequacy is not a shortened measure. Instead of labeling a threshold as congested

conditions and giving no other degrees of congestion, capacity adequacy is rated on a continuous scale where anything less than 100 indicates congestion and values greater than 100 are not considered congested. As its values decrease congestion becomes more severe. One advantage of this congestion index is that it can be used in counties, urbanized areas, highway segments, rural or principal arterial segments, or other portions of geographic areas, or highway networks. Creating indices for an entire network works best in areas with similar roadway and travel conditions (Boarnet, 1998).

2.3 Congestion Indices

2.3.1 Texas Congestion Index. The Texas Congestion Index compares peak period travel to free flow travel. VMT and VHT from the TransCAD model output is sorted by congestion level (un-congested, moderate, heavy, severe, or extreme) and area type (downtown, urban, urban fringe, suburban, or rural). In this index, total delay is found using free flow VHT and actual VHT with consideration to recurring delay, incident delay, and operational treatments that reduce the delay. The delay is then split into car and truck delays, which is then added to the free flow travel times to obtain actual travel times. Vehicle occupancies for passenger cars are then multiplied by the travel times (free flow and actual) to obtain person travel times. Truck values remain in vehicle travel times. Travel times for all peak hours of travel are added and multiplied by cost per person-hour and cost per vehicle-hour for cars and trucks respectively as a value of time comparison measure to join car and truck travel. The peak hour travel times are then added and put over the free flow travel times to calculate the Texas Congestion Index value. The congestion index can be expressed on a roadway segment or system and can also be expressed by region or for an entire state (Lomax, 2005).

2.3.2 Roadway Congestion Index. The roadway congestion index (RCI) was developed by Timothy Lomax at the Texas Transportation Institute. This index uses daily vehicle miles of travel (DVMT) for freeways and arterials to compare congestion between urban areas. For both freeways and arterials, the DVMT per lane mile are weighted by the total DVMT for each urban area. These are added together and normalized by the following

thresholds. A total of 13,000 and 5,000 vehicles per lane per day for freeways and arterials, respectively, are equivalent to a v/c ratio of 0.77 and LOS D. These are multiplied by the total DVMT for freeways and arterials and used for the normalization of the congestion levels. A RCI value that is greater than one represents unacceptable congestion (Turner, 1992).

This index differs from the Texas Congestion Index in that it measures daily demand volumes versus congested threshold volumes instead of peak versus off peak travel times. VHT is not necessary for calculating RCI, but is the basis for delay calculations for the Texas Congestion Index. The Texas Congestion Index also separates the passenger car and truck travel times and weights them by a dollar value to give a value of time comparison measure between car person-hours and truck vehicle-hours. The RCI does not differentiate between the two.

2.3.3 Freeway Congestion Index. This index was created in a study done by the Brigham Young University and funded by the Utah Department of Transportation. The freeway congestion index (FCI) includes both the extent and duration of congestion. This index is unique because indices such as the RCI or the Texas Congestion Index do not address both the extent and duration at the same time. The lane mile duration index (LMDI) provided insight of how their index may work. These differ in that the LMDI assumes that if any part of a two-way roadway segment is congested then the whole segment is congested. The FCI improves this by multiplying the total congested lane-miles of a one-way freeway segment by the duration of congestion in hours and dividing this by the total lane miles in the freeway segment. By dividing by the total lane miles, professionals are able to compare the extent and duration of congestion on segments with different lengths.

To determine the extent and duration of congestion, any measure that can determine when congestion begins, ends, and the length of congestion is also acceptable in addition to speeds which are used as an indicator of congestion. Travel below the average speed of 40 mph was considered congested. Because the extent of congestion is always changing, it was necessary to collect several sample speeds relative to the duration of the congestion period. A graph is

then created with congested lane miles versus time. The area under the curve is equivalent to the product of extent and duration of congestion. Again, these are divided by the total lane miles in the freeway segment to obtain the FCI.

The FCI can range from 0 (no congestion) to 24 (all lanes operating below the threshold all day long) lane-mile-hours per lane-mile for a 24-hr period. An analysis was also done to examine the differences of collecting data from each lane of the freeway versus one lane. The analysis concluded that the FCI values for each lane of the freeway and one lane of the freeway had a good correlation. They were then able to create an equation ($FCI_{all} = -0.006 + 0.990 \times FCI_{middle}$) using the FCI from the middle freeway lane to calculate the FCI for all lanes (Thurgood, 1995).

2.3.4 Combined Congestion Index. The combined congestion index was developed as a measure of congestion for the Albuquerque Metropolitan Planning Area of New Mexico. This index combines the volume to capacity ratio, delay in seconds per mile, and duration of delay. Each measure presents a different aspect of congestion. The volume to capacity ratio focuses on the traffic demand compared to the actual roadway capacity, the delay gives the extended time of travel, and the duration is a version of the volume to capacity ratio that is able to analyze short segments of time during and beyond the peak hour. Combining these measures ensures that the limitations of one measure does not give false estimates of congestion, but instead is addressed by another measure. This index does not seem to calculate a value to summarize the relationship of the three elements, but rather compares the results to view different characteristics of the congestion.

CHAPTER 3 EXISTING CONGESTION MANAGEMENT PROCESSES

In order to evaluate the applicability of the various performance measures from the literature review, an understanding of the existing congestion management processes is needed. The following sections are intended to describe the processes used by the eight MPOs and AHTD.

3.1 Statewide

According the *2006 Arkansas State Highway Needs Study and Highway Improvement Plan* dated February 2007, AHTD is responsible for the maintenance and improvement of 16,419 miles of roadway and 7,120 bridges. Although the State Highway System constitutes only 17% of the total public roadway miles in the State, it carries 80% of the total traffic and 95% of all heavy truck traffic that uses the public road system. Furthermore, the Arkansas Primary Highway Network (APHN) was identified to be a system of 8,447 miles that carries approximately 92% of all travel on the State Highway System. The APHN shown in Figure 3.1 is comprised of the following four components.

- National Highway System (NHS) – 2,693 miles
- Other Arterials – 4,223 miles
- Critical Service Routes – 516 miles
- Other High Traffic Routes – 1,015 miles

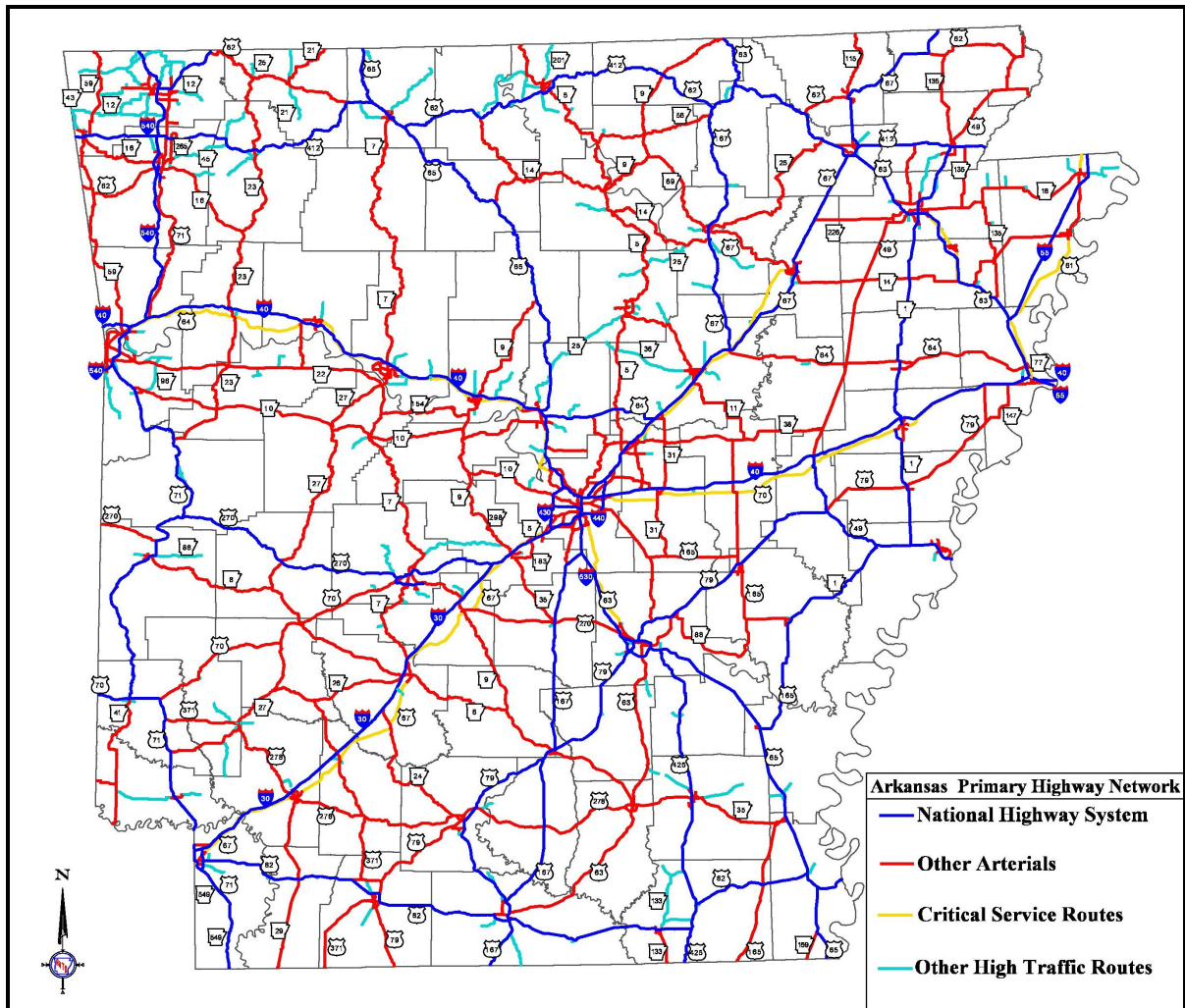


Figure 3.1. Arkansas Primary Highway Network

AHTD currently uses various systems for highway operational performance monitoring and assessments. They include:

- Asset Management System
 - Pavement Inventory
 - Bridge Inventory
 - Sign Inventory
 - Signal Inventory
 - Guardrail Inventory
 - Rest Area Inventory

- Drainage Inventory
- Equipment Inventory
- Traffic Count Program
 - Statewide and Urbanized Area Coverage Counts
 - Vehicle Classification Counts
 - Continuous Automated Traffic Monitoring System
 - Turning Movement Counts
 - Freeway Ramp Counts
- Highway Conditions Reporting System
 - Work Zone Locations
 - Construction Closures and Detour Information
 - Weight Restrictions and Permit Requirements
 - Weather Related Highway Condition Information
- Highway Performance and Monitoring System (HPMS)
- Closed-circuit television (CCTV) cameras on various bridges
- Statewide Traffic Accident Reporting System

In addition to the above systems, AHTD is working closely with the MPOs and other agencies for the implementations of the Intelligent Transportation System (ITS) and Chemical Stockpile Emergency Preparedness Program (CSEPP).

3.2 Bi-State MPO

The Bi-State MPO study area encompasses approximately 315 square miles of southwestern Crawford County and northwestern Sebastian County in Arkansas and over 230 square miles of eastern Sequoyah County and northeastern LeFlore County in Oklahoma (Figure 3.2). The 2000 Census indicated that the Bi-State MPO area has a population of 154,640 individuals. A summary of functionally classified roadways in the Fort Smith/Van Buren Urbanized Area is shown in Table 3.1.

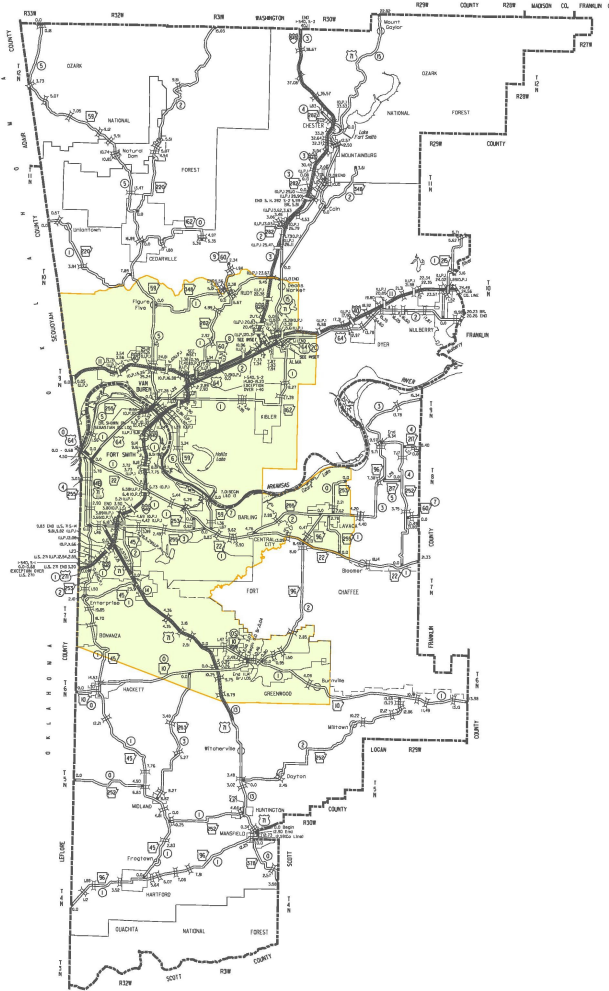


Figure 3.2. Bi-State MPO Boundary Map

In 2006, the Bi-State Region ITS architecture was developed to provide a framework for identifying applicable standards for projects and allowing for cohesive long-range transportation planning. An Advanced Traveler Information System (ATIS) is currently under development by the Bi-State MPO and Fort Smith Transit. This system would include a Geographical Information System (GIS) and various changeable message boards to provide real-time traffic information to motorists.

Since the Bi-State MPO is a non-TMA, a CMP is not required. The Bi-State MPO is presently relying on AHTD, membership cities and counties to provide transportation system performance assessments.

Table 3.1. Functional Classified Roadway Summary
(Fort Smith/Van Buren Urbanized Area)

SUMMARY	Bi-State MPO (AR)		1/1/2008
State Highways	Interstate	20.23	
	Other Freeways and Expressways	-	
	Other Principal Arterials	39.88	
	Minor Arterials	22.54	
	Collector	3.40	
	Local	-	
			86.05
County Road	Other Principal Arterials	-	
	Minor Arterials	1.26	
	Collector	-	
	Local	331.44	
			332.70
City Streets	Other Principal Arterials	10.52	
	Minor Arterials	51.08	
	Collector	64.79	
	Local	578.48	
			704.87
	Total	1,123.62	

3.3 CARTS

The CARTS area comprises almost all of Pulaski County and significant portions of Saline, Faulkner and Lonoke Counties, encompassing 1,531 square miles. The CARTS boundary map is shown in Figure 3.3. A summary of functionally classified roadways in the Little Rock/North Little Rock (LR/NLR) and Conway Urbanized Areas are shown in Table 3.2.

In 2002, the CARTS ITS architecture was developed to provide a framework for cohesive long-range transportation planning. In this plan, existing and planned elements were identified and listed below:

- Regional Traveler Information Systems
- Freeway and Incident Management Systems
- Transit Management Systems
- Advanced Traffic Control Systems
- Highway – Rail Intersections

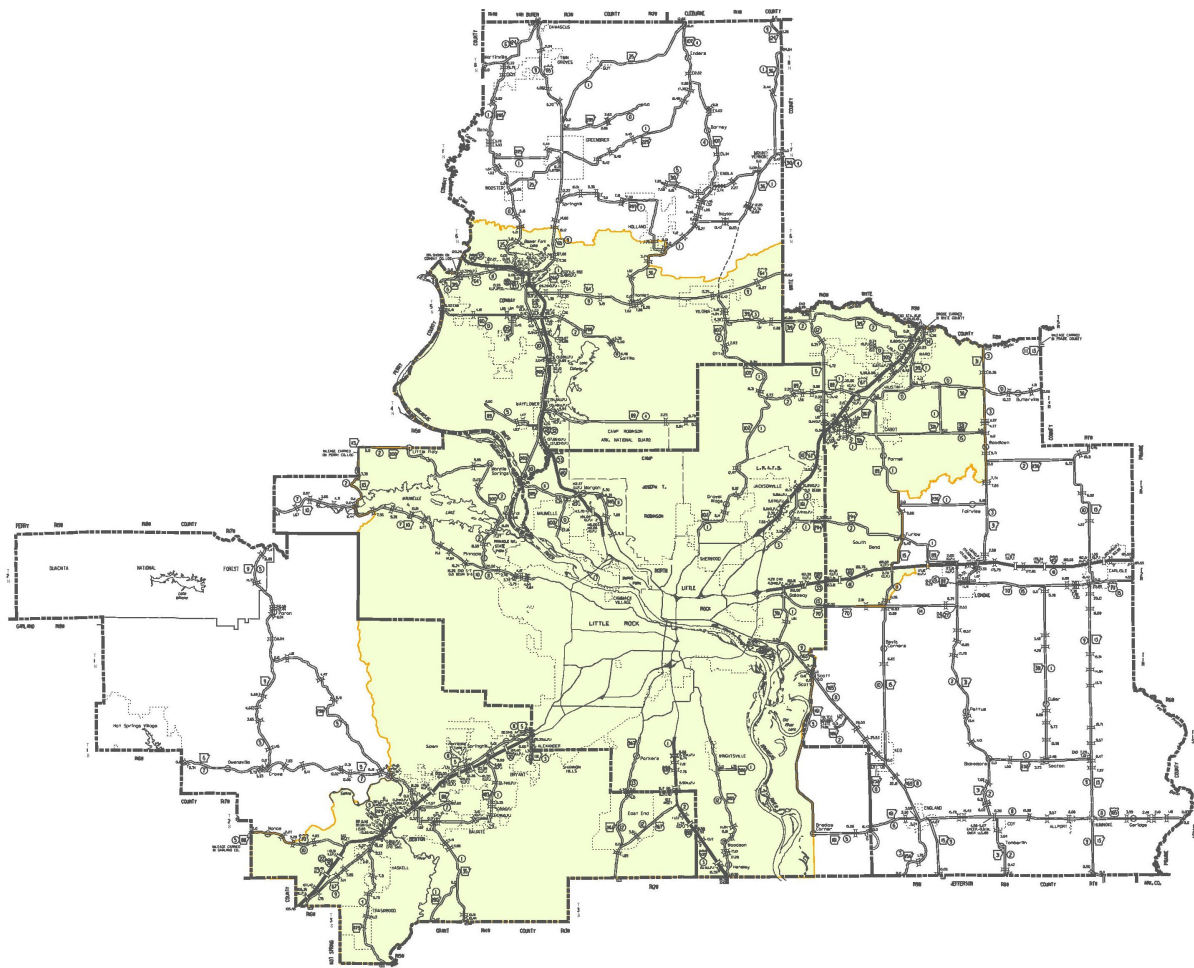


Figure 3.3. CARTS Boundary Map

Additional Automatic Traffic Recorders (ATRs), CCTV cameras and a traffic management center (TMC) will be implemented as a part of the ITS deployment effort.

Metroplan, the responsible agency to carry out the metropolitan planning activities mandated by the Federal government for the CARTS area, maintains a travel demand model utilizing TransCAD for the four-county area. Since 1996, Metroplan has been tracking and evaluating roadway congestion by using the GPS technology. Each year Metroplan performs travel time surveys on freeways and arterials in the study area and uses delay rate as the evaluation tool for measuring congestion on those facilities, which is included in the CARTS CMP analysis.

Table 3.2. Functional Classified Roadway Summary
(Little Rock/North Little Rock and Conway Urbanized Areas)

SUMMARY	CARTS (LR/NLR Urbanized Area)		1/1/2008
State Highways	Interstate	77.80	
	Other Freeways and Expressways	25.12	
	Other Principal Arterials	103.43	
	Minor Arterials	67.47	
	Collector	3.72	
	Local	12.23	
			289.77
County Road	Other Principal Arterials	-	
	Minor Arterials	24.93	
	Collector	29.64	
	Local	227.30	
			281.87
City Streets	Other Principal Arterials	15.32	
	Minor Arterials	169.14	
	Collector	214.39	
	Local	1,711.51	
			2,110.36
	Total	2,682.00	
SUMMARY	CARTS (Conway Urbanized Area)		1/1/2008
State Highways	Interstate	10.37	
	Other Freeways and Expressways	-	
	Other Principal Arterials	21.42	
	Minor Arterials	9.65	
	Collector	-	
	Local	3.81	
			45.25
County Road	Other Principal Arterials	3.16	
	Minor Arterials	4.70	
	Collector	0.54	
	Local	9.86	
			18.26
City Streets	Other Principal Arterials	3.08	
	Minor Arterials	10.28	
	Collector	26.12	
	Local	274.39	
			313.87
	Total	377.38	

Since the CARTS CMP is intended to estimate the average weekday peak congestion, all travel surveys were conducted during the peak time period that is perceived to have the most

severe congestion. The CARTS CMP does not analyze the extent of recurring congestion, the duration of the congestion and congestion caused due to weather or incidents.

3.4 HSATS

The HSATS area encompasses approximately 327 square miles and it comprises of the most highly populated area of Garland County and a very small portion of Hot Spring County. In 2008, the HSATS ITS architecture was developed and it also provides a framework for cohesive long-range transportation planning for the region. The HSATS boundary map is shown in Figure 3.4. A summary of functionally classified roadways in the Hot Springs Urbanized Area is shown in Table 3.3.

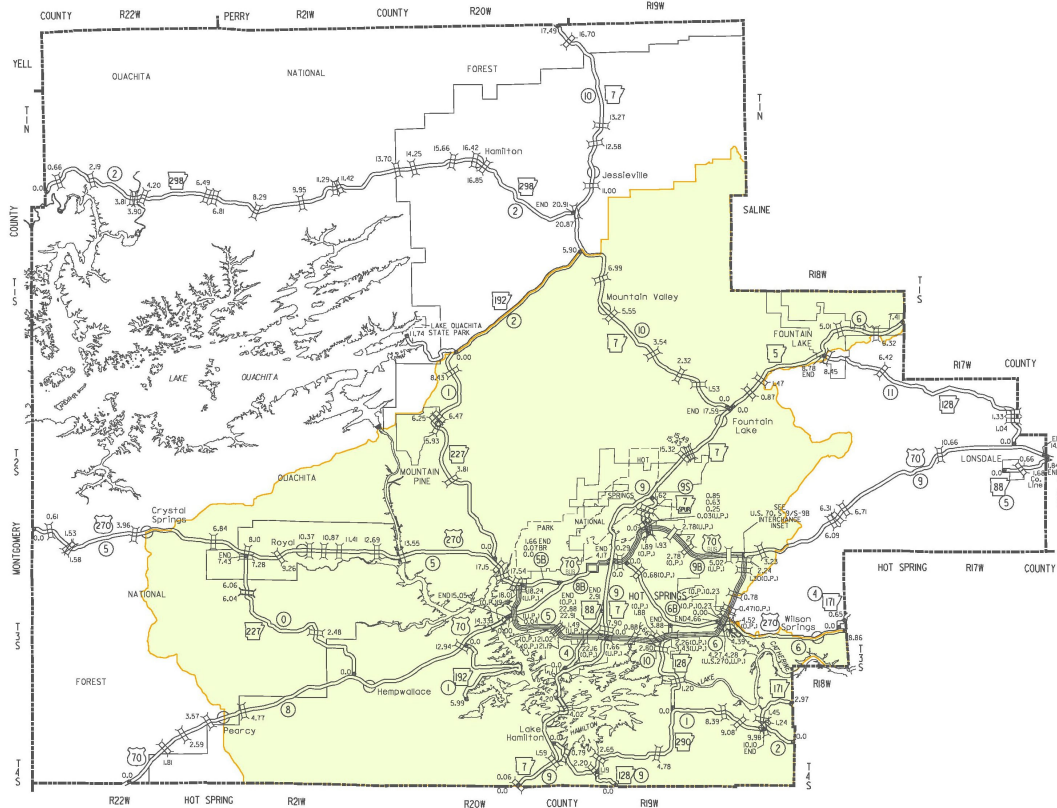


Figure 3.4. HSATS Boundary Map

Table 3.3. Functional Classified Roadway Summary
(Hot Spring Urbanized Area)

SUMMARY	HSATS (Hot Springs Urbanized Area)		1/1/2008
State Highways	Interstate	-	
	Other Freeways and Expressways	14.23	
	Other Principal Arterials	25.26	
	Minor Arterials	7.09	
	Collector	-	
	Local	1.71	
			48.29
County Road	Other Principal Arterials	-	
	Minor Arterials	21.68	
	Collector	32.38	
	Local	266.00	
			320.06
City Streets	Other Principal Arterials	-	
	Minor Arterials	-	
	Collector	4.76	
	Local	58.37	
			63.13
	Total	431.48	

Similar to the Bi-State MPO, HSATS is a non-TMA and a CMP is not required. The HSATS is presently relying on AHTD, membership cities and counties to provide transportation system performance assessments.

3.5 JATS

The JATS area encompasses nearly 245 square miles which includes the Cities of Jonesboro, Brookland, Bay and Bono, and the unincorporated areas of Craighead County that are expected to become urbanized in the next twenty years. The JATS boundary map is shown in Figure 3.5. A summary of functionally classified roadways in the Jonesboro Urbanized Area is shown in Table 3.4.

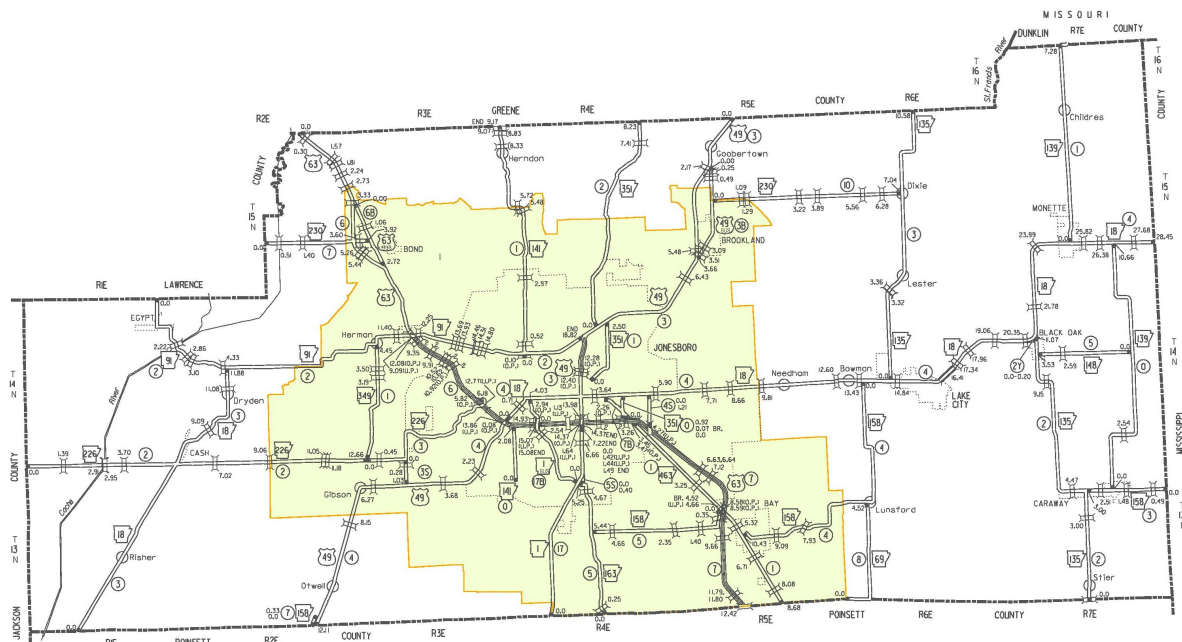


Figure 3.5. JATS Boundary Map

Table 3.4. Functional Classified Roadway Summary
(Jonesboro Urbanized Area)

SUMMARY	JATS (Jonesboro Urbanized Area)		1/1/2008
State Highways	Interstate	-	
	Other Freeways and Expressways	11.75	
	Other Principal Arterials	25.14	
	Minor Arterials	28.26	
	Collector	2.63	
	Local	11.26	
			79.04
County Road	Other Principal Arterials	2.11	
	Minor Arterials	16.93	
	Collector	38.80	
	Local	416.59	
			474.43
City Streets	Other Principal Arterials	-	
	Minor Arterials	2.01	
	Collector	2.59	
	Local	32.87	
			37.47
	Total	590.94	

Since JATS is a non-TMA, a CMP is not required. However, in 2007, JATS contracted a consultant to conduct a Travel Time and Delay Study using GPS technology to evaluate travel conditions on approximately ten major roadways in the MPO area. The analysis of travel times and congestion was intended to form a baseline of congestion on Jonesboro's roadways as the region grows and to allow strategic planning for future improvements. JATS intends to repeat the study every two to three years. Currently, the MPO relies on AHTD, membership cities and the county to provide additional transportation system performance assessments.

3.6 NARTS

The NARTS area comprises the entire Benton and Washington Counties. The NARTS boundary map is shown in Figure 3.6. A summary of functionally classified roadways in the Fayetteville/Springdale Urbanized Area is shown in Table 3.5.

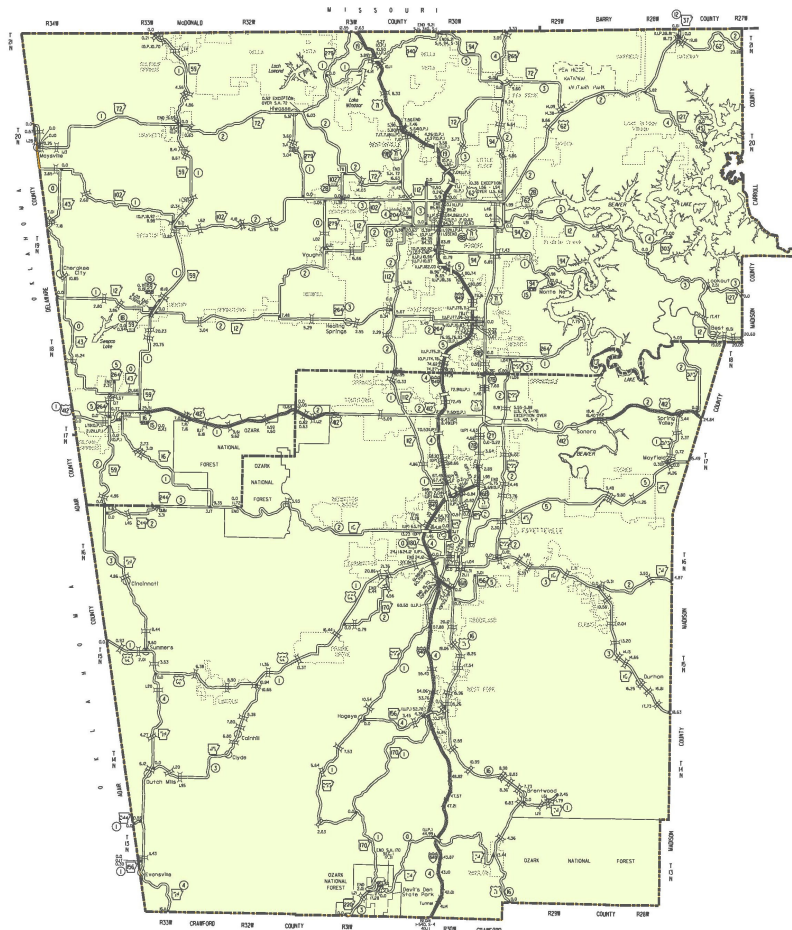


Figure 3.6. NARTS Boundary Map

In 2007, the Northwest Arkansas Regional ITS Architecture was developed. This architecture also provides the framework for implementing ITS projects, encouraging resource sharing among agencies and promoting cohesive long-range planning. In this plan, identified ITS projects include a Regional Joint TMC, various CCTV, a Toll Authority TMC, and other systems among stakeholders.

Furthermore, NARTS is in the process of developing a travel demand model. The base year (2005) model is complete and the forecast model (2030) will be completed by the end of 2008.

Similarly, NARTS is a non-TMA and a CMP is not required. Currently, the MPO relies on AHTD, membership cities and counties to provide transportation system performance assessments.

Table 3.5. Functional Classified Roadway Summary
(Fayetteville/Springdale Urbanized Area)

SUMMARY	NARTS (Fayetteville/Springdale Urbanized Area)	1/1/2008
State Highways	Interstate	28.27
	Other Freeways and Expressways	8.88
	Other Principal Arterials	84.75
	Minor Arterials	44.95
	Collector	7.52
	Local	11.44
		185.81
County Road	Other Principal Arterials	-
	Minor Arterials	0.77
	Collector	5.15
	Local	16.31
		22.23
City Streets	Other Principal Arterials	7.99
	Minor Arterials	42.89
	Collector	101.15
	Local	817.81
		969.84
	Total	1,177.88

3.7 PBATS

The PBATS area encompasses 135 square miles in Jefferson County in southeastern Arkansas and includes two major cities. The PBATS boundary map is shown in Figure 3.7. A summary of functionally classified roadways in the Pine Bluff/White Hall Urbanized Area is shown in Table 3.6.

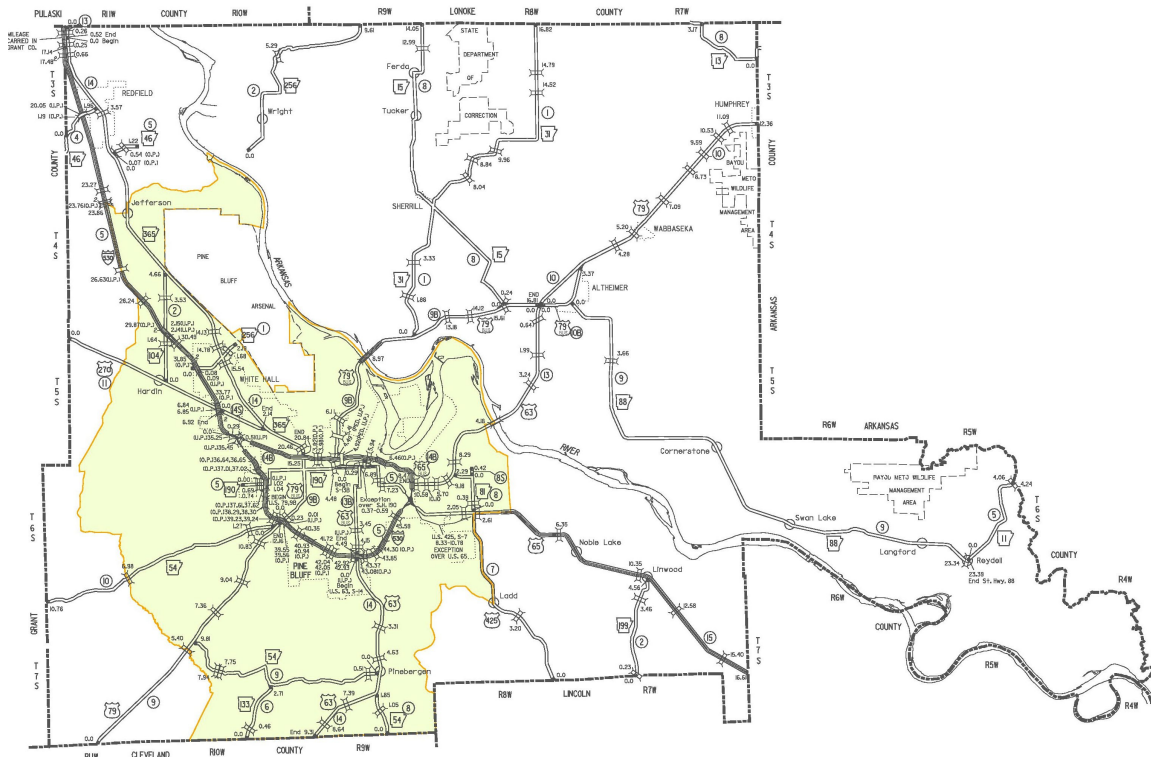


Figure 3.7. PBATS Boundary Map

In 2006, the Pine Bluff – White Hall Regional ITS Architecture was developed. In this plan, an inventory of ITS elements was included which identified Statewide emergency operations center (EOC), CSEPP CCTV, dynamic message signs (DMS) from the Arkansas Department of Emergency Management in addition to AHTD's highway operational performance monitoring systems.

Table 3.6. Functional Classified Roadway Summary
(Pine Bluff/White Hall Urbanized Area)

SUMMARY		PBATS (Pine Bluff/White Hall Urbanized Area)	1/1/2008
State Highways		Interstate	15.15
		Other Freeways and Expressways	9.52
		Other Principal Arterials	14.88
		Minor Arterials	18.55
		Collector	2.67
		Local	2.25
			63.02
County Road		Other Principal Arterials	-
		Minor Arterials	2.09
		Collector	3.59
		Local	112.08
			117.76
City Streets		Other Principal Arterials	4.71
		Minor Arterials	37.25
		Collector	34.56
		Local	438.33
			514.85
		Total	695.63

Similarly, PBATS is a non-TMA and a CMP is not required. Currently, the MPO relies on AHTD, membership cities and counties to provide transportation system performance assessments.

3.8 TUTS

The TUTS area encompasses approximately 195 square miles of northwestern Miller County in Arkansas and eastern Bowie County in Texas (Figure 3.8). It is located 130 miles from Little Rock, Arkansas, 180 miles from Dallas, Texas, 70 miles from Shreveport, Louisiana. A summary of functionally classified roadways in the Arkansas portion of the Texarkana Urbanized Area is shown in Table 3.7.

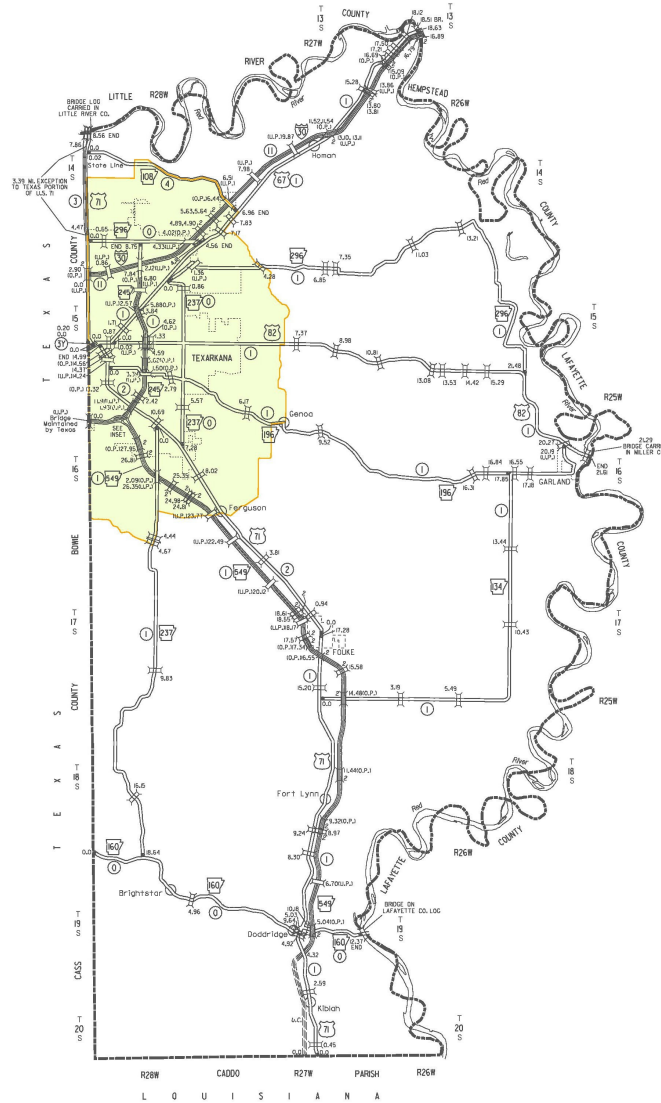


Figure 3.8. TUTS Boundary Map

In 2003, the Texas Department of Transportation developed the Regional ITS Architecture for the Atlanta Region in northeastern Texas. This plan not only covered the counties in Texas, but also included Caddo Parish in Louisiana and the entire Miller and Little River Counties in Arkansas. In this plan, an inventory of ITS elements were included which identified various CCTV, TMC, and traveler information systems.

Table 3.7. Functional Classified Roadway Summary
(Texarkana, Arkansas Urbanized Area)

SUMMARY		TUTS (Texarkana, AR)	1/1/2008
State Highways		Interstate	2.94
		Other Freeways and Expressways	9.83
		Other Principal Arterials	14.27
		Minor Arterials	6.13
		Collector	0.87
		Local	-
			34.04
County Road		Other Principal Arterials	-
		Minor Arterials	-
		Collector	2.22
		Local	3.46
			5.68
City Streets		Other Principal Arterials	2.78
		Minor Arterials	9.95
		Collector	22.09
		Local	231.24
			266.06
		Total	305.78

Since TUTS is a non-TMA, a CMP is not required. However, travel time studies have been conducted in 1965, 1975 and 2005 to evaluate travel conditions on approximately thirteen major roadways in the urbanized area. TUTS intends to repeat the travel time study every two to three years. Furthermore, the MPO has conducted a one-way frontage road study in 2001 and a freeway study in 2005. Currently, the MPO relies on AHTD, membership cities and the county to provide additional transportation system performance assessments.

3.9 WMATS

The WMATS area encompasses 500 square miles in Crittenden County in eastern Arkansas. The WMATS boundary map is shown in Figure 3.9. A summary of functionally classified roadways in the West Memphis Urbanized Area is shown in Table 3.8.

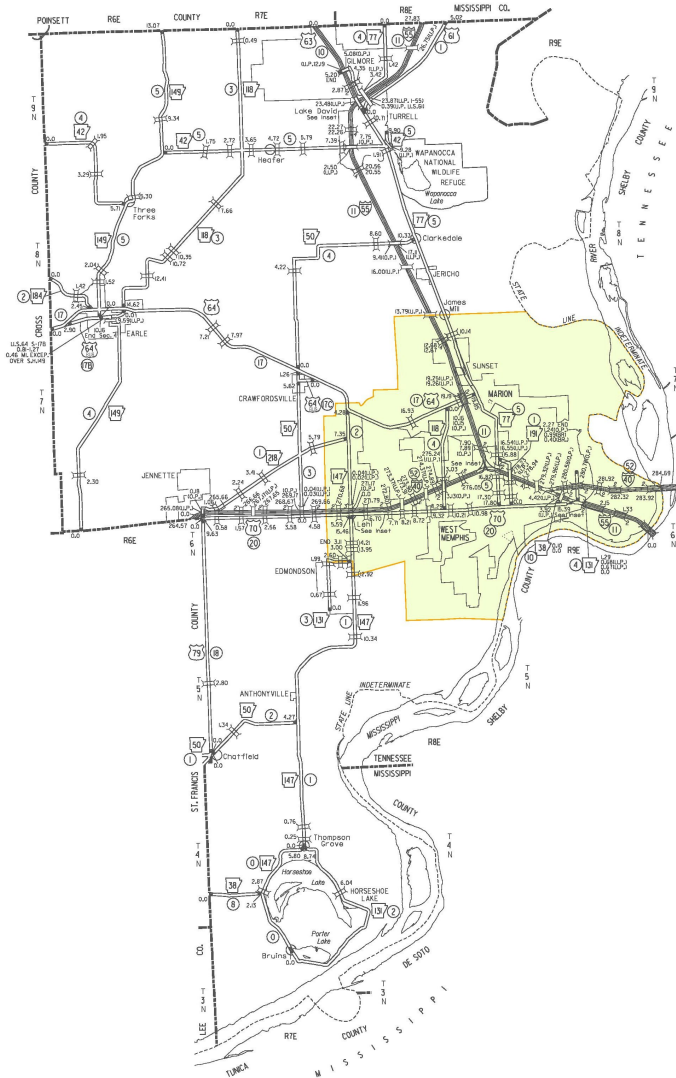


Figure 3.9. WMATS Boundary Map

In 2006, the WMATS ITS architecture was developed to provide a framework for cohesive long-range transportation planning. In this plan, existing and planned elements include CCTV cameras, ATRs and TMCs.

Table 3.8. Functional Classified Roadway Summary
(West Memphis Urbanized Area)

SUMMARY		WMATS (West Memphis Urbanized Area)	1/1/2008
State Highways		Interstate	17.90
		Other Freeways and Expressways	-
		Other Principal Arterials	7.20
		Minor Arterials	9.11
		Collector	1.01
		Local	-
			35.22
County Road		Other Principal Arterials	-
		Minor Arterials	-
		Collector	-
		Local	7.15
			7.15
City Streets		Other Principal Arterials	4.74
		Minor Arterials	11.08
		Collector	16.24
		Local	225.63
			257.69
		Total	300.06

The WMATS CMP has identified the following primary performance measures for evaluation of the transportation system in the region.

- V/C Ratio
- Travel Times (peak/off peak, mid-block, % below posted speed limits)
- Incident Response Time

The MPO continues monitoring congestion in the region by using limited travel time and spot delay studies and vehicle occupancy surveys on selected major routes. Currently, the MPO relies on AHTD, membership cities and counties to provide additional transportation system performance assessments.

CHAPTER 4 RECOMMENDATION

After the literature review and assessment of the available resources and assets, a set of appropriate congestion performance measures was identified. A detailed work plan was developed to test these performance measures.

4.1 Selection of Performance Measures

A set of performance measures was reviewed for their ability to meet the following criteria and a selection matrix is shown in Table 4.1:

- Available resources or minimum to moderate level of data collection effort
- Determination of the intensity, duration and causes of congestion
- Be a robust system that can accommodate changes
- Easy to understand and to relate to the public

Based on their ability to meet the above criteria, the following performance measures were selected:

- Delay
- Total Delay
- Average Speed
- Speed Ratio
- Travel Time
- Travel Time Index
- Delay Rate Index

4.2 Development of Phase II Work Plan

In order to validate the performance measure selection, a work plan was developed which defined the Phase II study scope, selected the data collection sites, outlined data collection procedures, and identified the methodology to qualify congestion.

Table 4.1. Performance Measure Review Matrix

Performance Measures	Available Resources	Effort of Data Collection	Adequate Results	Robust System	Easy to Understand	Selected (Y/N)]
v/c Ratio	Y	Minimum	N	Y	Y	N
<i>Comment: It is currently used for development of the State LOS maps. However, it is difficult to distinguish between levels of congestion and its duration once congested conditions are reached.</i>						
Delay	N	Moderate	Y	Y	Y	Y
<i>Comment: None</i>						
Total Delay	N	Moderate	Y	Y	Y	Y
<i>Comment: Not all the locations have hourly or real time traffic volumes. It will be used when there is adequate data available.</i>						
Average Speed	N	Moderate	Y	Y	Y	Y
<i>Comment: None</i>						
Speed Ratio	N	Moderate	Y	Y	Y	Y
<i>Comment: None</i>						
Travel Time	N	Moderate	Y	Y	Y	Y
<i>Comment: None</i>						
Travel Time Index	N	Moderate	Y	Y	Y	Y
<i>Comment: None</i>						
Buffer Index	N	Moderate	Y	Y	Y	N
<i>Comment: It is somewhat similar to Travel Time Index.</i>						
Loss of Productivity	N	High	Y	Y	Y	N
<i>Comment: It requires extensive traffic data.</i>						
Lane-Mile Duration Index	N	High	N	Y	N	N
<i>Comment: Results may be unreliable since not all freeway segments have detailed traffic data.</i>						
Planning Time Index	N	Moderate	Y	Y	Y	N
<i>Comment: It is somewhat similar to Travel Time Index.</i>						
Congestion Severity Index	N	Moderate	N	Y	N	N
<i>Comment: It is difficult to convey to the public.</i>						
Delay Rate Index	N	Moderate	Y	Y	Y	Y
<i>Comment: None</i>						
Capacity Adequacy Index	N	Moderate	N	N	N	N
<i>Comment: It only works satisfactorily when the analysis area consists of similar roadway and travel conditions.</i>						
Texas Congestion Index	N	Moderate	N	Y	Y	N
<i>Comment: Only four out of eight MPOs have travel demand models that can provide adequate inputs for the calculation of TCI. In addition, TCI does not address the extent and duration of the congestion.</i>						
Roadway Congestion Index	N	Moderate	N	Y	Y	N
<i>Comment: It only provides the congestion estimates at a daily level. Also, it does not address the duration of the congestion.</i>						
Freeway Congestion Index	N	Moderate	N	N	Y	N
<i>Comment: It is only applicable for freeway system.</i>						

4.1.1 Phase II Study Scope. Under Phase II, travel time and speed studies utilizing the global positioning system (GPS) technology will be conducted on principal arterials and commuting corridors in three metropolitan areas. Through database setup, data reduction and travel time and delay analysis, the selected performance measures will be calculated. With this initial data collection effort, a statistical analysis will be conducted to determine the proper sample size and reliability of the results. Ultimately, a field implementation plan will be developed to extend this practice to other areas of the state.

4.12 Site Selection. In order to test the performance measures, metropolitan areas of different sizes were selected for study. They are CARTS with a population of over 500,000, NARTS with a population of approximately 200,000, and HSATS with a population of just over 50,000. The regional arterial network routes identified for analysis included freeways and principle arterials. They are listed in the following tables.

Table 4.2. Selected Routes in CARTS Area

Route #	Route	From	To	Length (mile)
1	Highway 5	Interstate 30	Interstate 430	10.5
2	Highway 10	Highway 300	Reservoir Road	7.5
3	Highway 10	Sam Peck Road	Cumberland/President Clinton Ave.	10
4	Hwy 60 (Dave Ward)	Hogan Lane	Interstate 40	4.5
5	Highway 89 (Cabot)	Douglas Road	Highway 321	5
6	Highway 365 & 70	Military Road	Roosevelt	6
7	Hwy 300, 5 & 70 (Colonel Glenn, Asher and Roosevelt)	Bowman Road	Broadway	8
8	Highway 107 (JFK)	Hwy 176 (Kiehl)	Interstate 40	4.5
9	Hwy 70 (University)	Interstate 30	Highway 5 (Asher)	3
10	Interstate 30 & 430	Highway 5	Colonel Glenn	16
11	I-30 Frontage Road & Hwy 5	Salt Creek @ Hwy 5	Baseline Rd	15
12	Hwy 67/167 – I-440	Highway 89	Hwy 70	17
13	Hwy 67 – I-40 – I-30	Redmond Road	I-630	13
14	I-40 & I-430	Highway 365 (Morgan)	Interstate 630	12
15	I- 40	Highway 65 (Conway)	Highway 365 (Morgan)	17
16	I-630, I-30 & I-530	Fair Park Exit	Highway 338 (Dixon Rd)	8.5
17	I-430 & I-630	Colonel Glenn exit	Woodrow Exit	7.5
18	Highway 100	Highway 365	Interstate 430	10

Table 4.3. Selected Routes in NARTS Area

Route #	Route	From	To	Length (mile)
1	Highway 71B	Peach Orchard Rd./ Co. Rd. 40	Hwy. 71B/8th Street/ Walnut Street	12.5
2	Highway 102/62	Highway 279	Rogers Airport on Hwy 62	11.5
3	Highway 412/265	Highway 112	Highway 45	12
4	Highway 71B	Hwy. 71B/8th St./Walnut	Highway 412	11.5
5	Highway 71B	Highway 412	Highway 16	8.5
6	Highway 62/180	Prairie Grove	Highway 71B	12
7	I-540/Highway 71	Hwy. 62/180 (6th St.)	Hwy. 71/Joyce Blvd. (U-turn)	7
8	Hwy. 12/112	XNA Airport Road	Hwy. 102	10
9	I-540	Highway 62/102	Highway 264	7
10	Highway 16/112	Double Spring	Agri Park	6
11	I-540	Highway 264	Highway 112	12

Table 4.4. Selected Routes in HSATS Area

Route #	Route	From	To	Length (mile)
1	Highway 88	Highway 7 South	Highway 7 North	3
2	Highway 7 (Central Ave.)	Highway 88 South	Highway 70	5
3	Highway 7	Highway 70 (Grand Ave.)	Highway 5	7.5
4	Highway 70B/270B	Highway 7S	Highway 270	6
5	Highway 128	Highway 290	Highway 270B	4.5
6	Highway 70/270	Highway 70	Highway 270B	13

In addition, major commutes from the following communities into the Little Rock Metropolitan area were also selected as a part of this project:

- Maumelle
- Cabot
- Benton
- Conway
- Pine Bluff/Sheridan
- Lonoke

4.1.3 Data Collection Program. Two tracks of data collection efforts will be conducted simultaneously. The first track will be performed on the identified routes shown in the previous section while the second track will be performed on the major commutes from various communities into and out of the major metropolitan areas.

First Track

Two instrumented vehicles that equipped with video cameras, GPS devices and laptops will be used for this effort. An example of the setup is shown in Figure 4.1.



Figure 4.1. Instrumented Vehicle

Data will be collected on most of the arterial routes during the peak periods including AM (6:45 a.m. – 8:30 p.m.), Noon (11:00 a.m. – 1:30 p.m.) and PM (3:30 p.m. – 6:00 p.m.) while data will be collected only during the AM and PM peak periods on freeway routes and a few arterial routes.

Second Track

Small commuter GPS devices containing a data storage unit were distributed to volunteers who commute from the various communities to the southwest and Downtown Little Rock areas. Data will be collected during the AM and PM peak commuting periods. Figure 4.2 shows the GPS device that will be used for this track of data collection.



Figure 4.2. Commuter GPS Device

4.1.4 Data Processing. Data collected in the field will be imported into a database software. Any irrelevant data will be removed from the database. Finally, the reduced data will be plotted using a Geographic Information System (GIS) for visual presentation while the various performance measures will be calculated. With this information, a data collection sample size will be determined and a reliability analysis will be conducted.

APPENDIX A

State of the Art Survey

Agency	Area Type	Facilities	Data collection	Data Collected	Performance Measures
Transportation Networks, Alabama Department of Transportation	Urban/rural	N/A	RoadStateNetwork Traffic Count Database, database converted to GIS shapefile.	Volumes	Volume to capacity ratio and LOS
Birmingham Regional Planning Commission and Alabama Department of Transportation	Urban	Freeways and Arterials	Traffic counts (including 24 hour and peak hour), crash data, floating car technique, and ITS.	N/A	Occupancy, travel time, delay, speed, duration of delay, capacity, traffic volumes
South Alabama Regional Planning Commission	N/A	Freeways and arterials	Travel time runs	Travel speeds	Area-Wide Congestion Index based on VMT weighted travel speed
Arizona Department of Transportation	Urban/ rural	Freeways and arterials	Use of ITS at traffic operation centers and street signal systems. ADOT highway traffic database.	Travel time at free flow and at peak hours. Other travel time based data, such as speed.	Travel time index, and other travel time-based measures (buffer index, % travel congested, and delay)
Maricopa Association of Governments - Phoenix, Arizona	Urban/rural	Freeways and arterials	Local agencies collect data	N/A	Volume to capacity ratio and subsequent LOS
California State Highway Congestion Monitoring Program, CA Department of Transportation	Urban	Freeways only	Floating vehicle method, probe contains sensor in line with the speedometer cable, a signal conditioner, and laptop. Loop detectors also used.	Duration, travel time, and hourly volumes (number of lanes x vehicles per hour per lane)	Average daily vehicle-hours of delay and congested directional miles.
Solano County, CA	N/A	State highways and arterials	Travel demand model	Speed, travel time, volume, capacity, ease of maneuverability, traffic interruptions, comfort and safety	LOS
Marin County, CA	Urban and Suburban	State highways and principal arterials	Traffic counts and travel demand model	Volumes, capacity, and measures of delay	LOS, Peak-hour travel time, person throughput, and vehicle miles of congestion. Also looks at jobs and housing balance
San Bernardino County, CA	Urban	State highways, arterials	Traffic counts, turning movement counts, and travel demand modeling	N/A	Average person trip travel time, average speed, v/c ratio, LOS
Freeway Performance Measurement System (PeMS), University of California	Urban	Freeways	Loop detectors and vehicle detector stations, 7 databases, 2 backup tapes, and 135 disks.	Travel time data	Delay, travel time, loss of productivity
Santa Barbara County Association of Governments, CA	Urban	Highways and principal arterials	Traffic counts	Vehicle density (cars per lane per mile), v/c ratio	LOS
San Diego Association of Governments (SANDAG), CA	Urban	Highways, freeways, and principal arterials	Traffic counts, Average Annual Daily Traffic volumes from previous year. Computation Method- intersection delay. Floating Car Method- time and distance. Loop detectors.	Density (pc/mi/ln). Both the methods calculate speed	LOS determined by density and speed
Bay Area Metropolitan Transportation Commission -- San Francisco, CA	Regional, county, and superdistrict levels	Highways and arterials	Travel demand forecasted by BAYCAST-90	N/A	Mobility, safety, economic vitality, community vitality, environment, equity
Colorado Department of Transportation (CDOT)	Urban/ rural	Freeways and arterials	Automatic traffic recorders collect data 24 hours a day, 365 days a year. Accident records examined for occupancy averages.	Average vehicle occupancy, average daily traffic, peak hour volumes, v/c ratios, peak/off- peak travel times.	Travel time Index, V/c ratios, Person miles of travel, number and duration of road closures.
South Western Regional Planning Agency, CT	N/A	N/A	Census 2000, DOT 2003 CMS Data Book	Functional classification, VMT, peak hour counts, historical volume, peak and off peak volumes, daily traffic, travel time and speed.	V/c ratio, LOS, accident rates, hours of congestion, and percent increase in travel speed.
Council of Governments of the Central Naugatuck Valley Region, CT	Urban/ rural	Principal arterials only	GPS receiver connected to handheld computer in probe vehicle. GIS aggregates data.	Volumes, travel time data	V/c ratio. If classified congested, travel time and speed are examined.
Wilmington Area Planning Council - Wilmington, Delaware	Urban/ rural	Arterials, expressways, interstates, and some collectors	Travel time runs, ITS message signs, coordinated signals, traffic cameras, completed fiber optic cable installation, and Average Annual Daily Traffic counts	Database contains: travel time, average travel speed, amount delay	Roadway segment volume to capacity ratio/LOS, intersection LOS, and percent under posted speed
Hillsborough County MPO - Tampa, Florida	Urban	N/A	N/A	N/A	Average vehicle occupancy, percent trucks, average travel speed, accident rates, facilities LOS and others

Agency	Area Type	Facilities	Data collection	Data Collected	Performance Measures
Brevard MPO - Brevard County, Florida	N/A	N/A	N/A	N/A	Total travel
Metropolitan Orlando - Orlando, Florida	Urban	Freeways and arterials	N/A	N/A	LOS, number of lane miles and percentage of lane miles congested, and percentage of daily vehicle miles traveled operating under congestion
Broward County CMS, FL	N/A	Interstates, highways, and arterials	Traffic count data from county and FDOT, radar, video, and loop detection devices.	Traffic volumes, speeds, vehicle classification, incident information, work zone information.	Tier 1: v/c ratio and LOS Tier 2: ART_PLAN program, a more detailed analysis of LOS, with respect to measured delays
Palm Beach County CMS, FL	N/A	N/A	Traffic counts, Smart Zone portable traffic management Systems (retractable tower supports sensors, communications antennas, CCTV)	Travel conditions for travelers.	Tier 1: v/c ratio > 1 Tier 2: time congestion lasts, intersection critical sum > 1400 Tier 3: Full CMS analysis
Miami-Dade MPO, CMS Update, FL	Urbanized area	Expressways, highways, and arterials	Data obtained from state, county, and municipal agencies. Processes include: traffic counts, GIS database, transportation models, air quality baseline	Roadway name, location, maximum capacity, current traffic counts, vested trips	V/C ratios, LOS determined from ART_PLAN, duration, and delay
Charlotte County-Punta Gorda MPO, Florida	N/A	Freeways, highways, arterials, collectors	Travel time studies every five years, traffic counts from local and state agencies	Travel times, traffic volumes	Peak period delay, LOS based on v/c ratio, peak period LOS based on speed
Lee County MPO, FL	Urbanized area	Arterials	Extensive traffic counts	N/A	Level of Service
Collier County MPO, Florida	N/A	Arterials	ITS system, Data obtained from FDOT and Collier County Annual Update and Inventory Report	N/A	Traffic volumes, v/c ratio, LOS
Capital Region Transportation Planning Agency, Tallahassee-Leon County, Florida	Urbanized Area	Arterials and interstates	ITS systems with monitoring cameras and traveler information signs, traffic counts	Volumes	Tier 1- LOS based on v/c ratio Tier 2- Strategy for improvement
Volusia County MPO, FL	Urbanized area	N/A	ITS systems and state and local agency traffic counts.	Volumes	LOS, Vehicle miles of travel
The Georgia Regional Transportation Authority, Atlanta, GA	Urban	Freeways and Arterials	Video detection cameras and aerial photography	N/A	Travel time index, LOS, and daily vehicle miles traveled per licensed driver
Oahu MPO, Hawaii	N/A	N/A	Traffic counts, floating car technique, compiling accident data.	Traffic volume, speed, laser speed studies, turning movement counts, queues, delay studies, travel time data	LOS, visual observations, travel times, accident records, volumes
Northeastern Illinois	N/A	Expressways, tollways, highways, and arterials	CATS simulation models, Strategic Regional Arterial activities, IDOT's Illinois Roadway Information System, travel time runs, IDOT expressway surveillance.	Speed data, volumes, occupancy, travel time data.	Travel time and speed, v/c ratio, density, LOS, delay, % trucks, households and employment near expressways, person throughput
Indianapolis MPO, Indiana	Urban	Freeway and Arterials	Database with detailed information on 1,570 miles of roadway based on Streets Facility Inventory	Database: road name, functional class, segment length, average daily traffic volumes, number of through lanes, capacity and v/c ratio estimates.	Tier 1: v/c ratio Tier2: travel time Others: LOS, average travel time, percentage of lane-miles and daily VMT that are congested
Northeastern Indiana Regional Coordinating Council	Urban	Interstates, state highways, and arterials	Traffic counts by direction of travel every 3 years. Database stores roadway characteristics.	Volume, vehicle classification, intersection turning movements, signal phasing, travel time/delay, VMT, v/c ratio	Percent of weekday VMT with volume capacity greater than threshold, Total weekday VMT with v/c greater than threshold
Wichita-Sedgwick County MPO, Kansas	Urban	Interstates, freeways, expressways, and paved arterials	GPS probe vehicles, Traffic counts, Database with annual average daily traffic from other agencies	GPS- real-time position and speed data.	LOS, v/c ratio, travel times (peak and off peak, mid-block, percent of posted speed limit)
Lexington Area MPO, Kentucky	Urban/ rural	Major and minor arterials and freeways	GPS probe vehicles capture, store and plot data on map to determine location and severity of congestion	Data: date, time, latitude, longitude, altitude. Derived: Distance, time, speed, direction, location of and duration of delay	Congestion level 1-4 (uncongested to severely) based on average travel speed. Travel rate index compares roadways.
Northwest Louisiana Council of Governments - Shreveport, Louisiana	Urban	N/A	GPS used to collect position, time, and attribute data	Travel speed	Difference between off-peak speeds and peak speeds.

Agency	Area Type	Facilities	Data collection	Data Collected	Performance Measures
Montgomery County, Maryland Capital Parks	N/A	Freeways and Arterials	Probe vehicles equipped with GPS technology and turning movement counts	Throughput and conflicting movement volume data, signal phasing	Critical Lane Volume (ideal for intersections), travel time, and speed.
Pioneer Valley Region CMS, Massachusetts	N/A	Interstates, highways, and arterials	Travel time runs, data goes into a travel time database to analyze congestion	Travel time data, length of roadway	V/c ratio, delay ratio, and congestion ratio
Northern Middlesex Region MPO, MA	Urban/rural	Freeways and arterials	Floating car technique	Travel time data	Average travel speeds, control delay, LOS
Boston MPO, Massachusetts	N/A	Arterials, expressways, and freeways	Floating car technique with GPS and laptop. GIS database system. Traffic counts	Travel times and distances recorded in one second intervals from GPS. Volumes (average daily traffic) from counts.	Average travel speeds related to LOS, speed index (ratio of observed speed to posted speed), control delay
Southeastern Massachusetts MPO	N/A	N/A	Turning movement counts, database for intersections, travel demand forecasting model	Database: LOS, lane configuration, signal timing and phasing for intersections.	Intersections: LOS based on average delay in seconds per vehicle. Road Segments: v/c ratio
Southeast Michigan CMS Plan, Southeast Michigan Council of Governments	Urban	Freeways and arterials	Traffic counts	Roadway facility, number of lanes, posted speed limits, on-board transit survey data, household survey data	LOS and v/c ratios
Tri-County Region, Michigan DOT CMS	Urbanized area	Freeways and arterials	Speed studies, queue studies, Micro-simulation models, ITS, travel demand modeling	Roadway characteristics, demographics, incident information, traffic volumes	V/c ratios related to classification of deficient or near deficient.
St. Louis Region Congestion Management System, MO	Urban	Interstates, highways, freeways, and arterials	Aerial survey, travel time runs, traffic counts, loop detectors, transit monitoring programs, IRIS, ITS, and travel demand models	Travel time data, volume, occupancy, speed, vehicle length, geometric data	V/c ratio, speed, density, vehicle miles of travel, transit peak load factor, person throughput, and park and ride lot utilization
New Jersey's Congestion Management System	Databases describe roadway conditions for the entire state	Freeways and Arterials	Post Processor for Air Quality Software packages, Surface Transportation software packages responsible for calculating LOS	Time and distance based measures	Lane miles, vehicle miles of travel, vehicle hours of congestion
South Jersey Transportation Planning Organization	Urban, rural, recreation/seasonal, rural center	Freeway, expressway, arterial, collector, and local	Travel demand model	N/A	V/c ratio, VMT by LOS by trip purpose, peak period vehicle unacceptable delay, VHT by LOS by facility type
Middle Rio Grande Council of Governments and New Mexico State Highway and Transportation Department	N/A	Arterials	Congestion Information Surveillance System consist of LIDAR technology, traffic counts, and travel surveys	Tracks air pollutants, traffic volumes, vehicle classifications, turning movements, delays, lane volumes, and speeds	LOS
Middle Rio Grande Council of Governments and Albuquerque MPA, New Mexico	Urban/ Suburban	Freeways and arterials	Travel time runs, GPS probe vehicles, data summarized in GIS database, crash data, vehicle occupancy observation stations and camera monitoring counts.	Vehicle occupancy, vehicle miles of travel, travel time data.	Combined Congestion Index with v/c ratio, travel delay (sec/mi), and duration of congestion
Capital District Transportation Committee (CDTC) - Albany, NY	Urban	Freeways and arterials	CDTC collects traffic volumes every 3 years (some continuous counters), Passenger count monitoring program	Travel time data, existing and acceptable delay	Excess Delay, and access, accessibility, flexibility, and the planning time index.
New York Metropolitan Transportation Council (NYMTC)	Urban	Minor arterials and high classifications	Traffic counts, Best Practice Model- Congestion Management System (BPM-CMS) used to analyze travel (uses TransCAD and GIS).	Speed and volumes data, vehicle occupancy rates	LOS, Vehicle/ person hours of delay. Secondary: Average travel speed, Lane miles congestion, Travel time index, Roadway Congestion Index
Greater Buffalo-Niagara Regional Transportation Council (GBNRTC), NY	Metropolitan area, sub-area, or rural area	N/A	Traffic counts, Intersection turning movement counts (MPO), vehicle classification counts, travel demand model, GIS demographic database, ITS	Information on travel patterns, the transportation network and demographics.	LOS, vehicle/ person hours of delay
Genesee Transportation Council, NY	N/A	N/A	Traffic counts, Travel demand model	N/A	V/c ratio, volume per hour/estimated capacity, congested speed, vehicle/person hours of delay

Agency	Area Type	Facilities	Data collection	Data Collected	Performance Measures
Syracuse Metropolitan Transportation Council (SMTC), NY	Urban	Freeways and arterials	Traffic counts collected in a three year cycle, one third of the counts done each year, Intersection turning movement counts, speed counts	Location of roadway, volumes	V/c ratio and excess delay, LOS Intersections - seconds of vehicle delay
Mid-Hudson Transportation Management Area CMS, NY	Urban	Freeways and highways	Travel demand modeling using TransCAD or Visum software, data obtained from various sources (transportation departments and census). GPS also used.	Number of households, employment statistics, travel time data, demographics, traffic counts	V/c ratio related to 3 classifications, travel time, speed, delay, and travel time index
Durham-Chapel Hill-Carrboro MPO (DCHC), North Carolina	Urban	Interstates, freeways, and arterials	Bi-annual collection of annual average daily traffic counts. GIS database.	Roadway type, volumes, number of through lanes	VTM and number, percent, and location of lane miles operating and approaching unacceptable LOS
Ohio-Kentucky-Indiana (OKI) Regional Council of Governments, Congestion Management System Analysis	N/A	Interstates, Highways, Expressways, Collectors, Local, and Arterials	GPS unit aquired in 2003, Input only required for initializing the trip. Data goes into GIS. Before the GPS unit they had dash-mounted digital voice recorders.	Distance and volume data	LOS, v/c ratio, speed, delay, distance traveled, trip-based measure and combination of speed and distance traveled
Mid-Ohio Regional Planning Commission	Urban/rural	Freeways, arterials, expressways, and collectors	Traffic counts	Volume	LOS based on speed and maneuverability, Vehicle miles of travel, vehicle hours of travel
Northeast Ohio Areawide Coordinating Agency	N/A	Freeways and arterials	Traffic counts from ODOT, Travel time studies, accident reports, ITS	Most recent 24 hr traffic volumes, length of segment, number of lanes, roadway width, travel speeds	V/c ratio-LOS, bottleneck evaluations: travel speed related to 4 levels of congestion, crashes per million VMT
Indian Nations Council of Governments, Tulsa Transportation Management Area, OK	N/A	N/A	24 hour traffic counts, peak period counts/ intersection counts, traffic incidents on roadway segments and at intersections	N/A	V/c ratio and accident rates
Oregon Department of Transportation	Urban	Freeways, expressways, arterials	Traffic counts, GPS track vehicles, household surveys, and speed sensors, and motor fuel sales and weight-mile tax records	Travel time data, volumes, speed. Motor fuel sales and weight-mile tax records give average vehicle miles of travel	Travel time, travel speeds, Travel time index, and v/c ratio.
Metro - Portland, Oregon	Urban/urban surroundings	Freeways and arterials	"CutlineTraffic Count Program" collects traffic counts every two years	N/A	LOS and Areas of Special Concern (physical or environmental constraints)
Southwestern Pennsylvania commission	N/A	N/A	Floating car technique	Travel times, average speeds, and distance measurements	Travel time, speed, and delay. These used to calculate delay per vehicle per mile, total delay, and total delay per mile
Harrisburg Area Transportation Study, PA	Urban/rural	Freeways, and arterials	ITS systems	Volume	LOS and v/c ratios
Rhode Island Department of Transportation	Urban/ rural	Interstates, Freeways, expressways, principal (urban and rural) and minor (rural) arterials	ITS system with 13 speed stations	N/A	Percent under posted speed related to LOS, v/c ratio
Rhode Island Department of Transportation Traffic and Safety Management	Urban/rural	Interstates, freeways, and arterials	Travel time data collected at route level using floating car technique. ITS used for surveillance and communication with users.	Travel time data	Volume to capacity ratio and speed/travel time. Reccommended that speed/travel time be sole indicator of congestion
Knoxville Regional Transportation Planning Organization, TN	N/A	Freeways and arterials	GPS unit placed in probe vehicle to collect data, data also received from Tennessee Roadway Information System	Geometric data and traffic counts. GPS - travel time and amounts of delay	Volume to capacity ratio, roadway corridor and segment travel time, and stopped delay at intersections
Chattanooga Hamilton County North Georgia TPO, TN	Urban	Arterials, interstates, freeways, expressways, collectors	Travel time runs with GPS technology. ITS	N/A	V/c ratio, time delay peak vs.off peak travel times, stopped delay at intersections (average time spent at intersections less than 20 mph

Agency	Area Type	Facilities	Data collection	Data Collected	Performance Measures
Nashville Area MPO, TN	Urban only, exception: rural roadways examined if 3 or more compliants are filed on roadway	Arterials and freeways	Annual average daily traffic counts, accident studies, topographic maps, aerial photographs, vehicle occupancy updates (2 yrs), turning movement counts (as-needed)	Travel time data, roadway data from Tennessee Roadway Information Management System	Average route speed- 30 percent of free flow speed is congested. VMT-effectiveness of strategies.
North Central Texas Council of Governments - Dallas/Fort Worth, TX	Urban	HOV lanes, rail, freeway, regional arterial systems	Information collected every five years with pneumatic tubes. Aerial photography every 3 years for LOS calculations.	Vehicular volume data, urban activity, trip frequency, destination choice, and mode choice.	Vehicle density/ LOS
Houston-Galveston Area Council - Houston, TX	Urban/rural	Urban - major arterials or higher Rural - minor arterials and higher	REMI for future developments, future congestion estimated	Population increases and employment	Volume to capacity Ratio
San Antonio -- Bexar County MPO (San Antonio, TX)	Urban	Freeways and arterials	Manually	Vehicle occupancy counts and travel time data	Volume to capacity Ratio
Hidalgo County (Rio Grande Valley), TX	Urban	Freeways and arterials	Travel time runs are done annually using GPS technology	Free flow and average speeds	LOS using average speeds
Corpus Christi MPO (Corpus Christi, TX)	Urban/rural	Arterials	Travel time data collected every 2 years using floating car technique.	Travel time data, free flow speeds, and traffic volume data	Travel speed and delay
CAMPO, Austin, TX	Urban/rural	Arterials	Probe vehicle with GPS, GIS database	Volumes and travel speed data	V/c ratio and travel speed, travel time index and Texas congestion index
Texas Congestion Index Guidebook, Texas	Urban, suburban, rural, urban fringe, and downtown	Freeways, Arterials, HOV, and other.	TransCAD model output data processed by TCINPUT which estimates vehicle hours and vehicle miles of travel for basis of calculations.	Free flow speeds, delay, car and truck statistics, person-, vehicle-, and peak period- travel time,	Texas Congestion Index, travel delay, travel time, cost and emission index
Monitoring Urban Roadways in 2002:Using Archived Operations Data for Reliability and Mobility Measurement (A Texas Study)	Urban, Study of various cities	Freeways	Sensor technologies, inductance loops, microwave radar, passive, acoustic, video processing, AVI systems, spot speed detectors.	Traffic speed and volume.	Travel time index, percent of congested travel, planning time index and buffer index.
Brigham Young University/ Utah Department of Transportation	Urbanized area	Freeway	Three probe vehicles with distance measuring instrument, laptop, and Moving Vehicle Run Analysis Package	Volume, speed, position, length of congested section, and duration.	Freeway Congestion Index
Mountainland Association of Governments (MAG), Utah	N/A	Freeways, arterials, and associated intersections	GPS speed runs, GIS linked to MAG regional travel model and direct links to inputs and outputs of MAG Model. Travel time surveys and traffic counts. ITS.	Volumes and travel speed data	Peak time delay, LOS, vehicle miles of travel reduction
Wasatch Front Regional Council, Utah	Urban	Freeways and arterials	Travel time runs with GPS technology	Peak/off peak period speed, travel time, and delay data	Peak delay for congestion comparison, VMT reduction for TDM strategy impact measure.
Virginia Department of Transportation	N/A	N/A	Loop detectors, side fired radar, and count stations	N/A	Speed, extent and duration of congestion (%), vehicle/ person, throughput, HOV performance, and average travel time
Hampton Roads Planning District Commission- Norfolk, Virginia	N/A	Interstates, Freeways, expressways, arterials, and some collectors	Video monitoring at 36 sites. GPS in probe vehicle and GIS database. ITS, LOS software determines LOS for each direction for the roadway, Traffic count program	Travel time and speed data using GPS, volume, vehicle miles of travel	Point to Point Travel time, speed ratio, LOS
University of Virginia and Virginia Department of Transportation	Urban	Interstates	Hampton Roads Smart Traffic Center. They use 203 stationary vehicle detectors and 38 surveillance cameras. Data received at Smart Travel Lab at 2 minute intervals.	Traffic volume, lane occupancy, time mean speed, time, location	Total Delay and Buffer Index

Agency	Area Type	Facilities	Data collection	Data Collected	Performance Measures
Richmond, Virginia CMS	Urban	Interstates, highways, freeways, and arterials	Probe vehicle with GPS	Travel time, speed, and volumes	Operating speed versus posted speed, v/c ratio and LOS
Tri-Cities Area Transportation Management Area, Virginia	Urban	Arterials and freeways	Database- Statewide Highway Plan. Vehicle surveys and observation areas .	Database contains roadway characteristics, traffic counts, and service volumes. Surveys give vehicle occupancy rates	LOS, v/c ratio, vehicle occupancy rates
Washington State Department of Transportation	N/A	Freeways and arterials	Loop detectors, looking into Automated License Plate recognition, Floating car technique used on arterials	Vehicle miles of travel, volumes, and travel times	Travel Delay and Lost Throughput Productivity
Puget Sound Regional Council, WA	N/A	Freeways and arterials	GIS database and loop detectors	Volume, speed, and percentage time loop detects vehicle	V/c ratio and lane occupancy
Southwest Washington Regional Transportation Council, WA	N/A	Freeways and arterials	Traffic counts, auto occupancy at 15 locations, GPS probe vehicles, other data is provided by other agencies and counties.	Travel time, automobile occupancy, volumes, speed.	Peak hr volumes, v/c ratio, travel speed, speed as percent of speed limit, auto occupancy, stopped delay at intersections, truck percentage
Madison Area MPO, Wisconsin	N/A	Arterials and collectors	Regular traffic counts every 2 years, a few locations with continuous counts, origin-destination surveys every 10 years. ITS program	Volumes, socio-economic data from surveys.	LOS and v/c ratios
British Columbia, Ministry of Transportation, Canada	N/A	N/A	ITS databases	N/A	Percentage of urban vehicle-kilometers traveled in congested conditions.
Performance Measurement Related to Traffic Congestion in Road Administration, Japan	N/A	N/A	Probe vehicles with GPS units. And traffic counters stations.	Location and time roadway types and lengths.	Volume and speed

TRC - 0805

Development of Mobility and Congestion Measures for Metropolitan Areas

Phase II



October 2010

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Prepared by the
Planning and Research Division
Arkansas State Highway and Transportation Department
In Cooperation with the Federal Highway Administration

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EXECUTIVE SUMMARY

Under Phase II, travel time and speed data utilizing the global positioning system (GPS) technology was collected on major arterials and commuting corridors in three metropolitan areas. Based on travel time and delay analyses, travel time indices and average speeds were calculated. The findings and observations are summarized below:

- The methodology utilized for this project is an effective way to identify bottlenecks/chokepoints in the roadway and can be applied to other areas and routes.
- Because the data collected in this project was processed using a Geographic Information System (GIS), it can be easily shared and utilized in various studies. The digital video can substitute for field visits, saving time and money.
- The database can be used to establish baselines for performance measures of future transportation improvement projects.
- Some of the congested segments identified in this project are caused by bottlenecks. When a bottleneck is relieved, the downstream segment may become congested.
- Lower average speeds on some principal arterial routes are often caused by controlled delays, i.e. traffic signals.
- The duration of peak periods on most of the routes is less than one hour.
- There is not a distinct AM peak period on most of the routes in the Hot Springs area.
- The travel time data collection should envelop the bottlenecks on a selected route. It is advantageous to capture the end of the queue to accurately assess the congestion level.
- Comprehensive data collection at a congested interchange should be developed in order to correctly define the performance of an interchange.
- The floating-car technique should be applied consistently.

CHAPTER 1 INTRODUCTION

In Phase II, travel time and speed studies utilizing the global positioning system (GPS) technology was conducted on interstate routes, principal arterials and major commuting corridors in three metropolitan areas. Through database setup, data reduction and travel time and delay analysis, travel time indices and average speeds were calculated. Ultimately the congestion levels were compared among the various routes.

Chapter 2 compiles the information from the data collection using two instrumented vehicles with customary software. The 2008 Average Daily Traffic and speed maps are included for each route.

Chapter 3 contains the data collected using volunteers on major commuter routes. The speed maps, travel time indices and speed maps are include for those routes.

Chapter 4 summarizes the travel time indices and average speed for all the routes. Congested segments are identified along with conclusions and lessons learned for future implementation projects.

CHAPTER 2 DATA COLLECTION (PART I)

For Part I of the Data Collection Program, two instrumented vehicles equipped with video cameras, GPS devices and laptops were used. An example of the set up is shown below.



FIGURE 2.1: Instrumented Vehicle

The customary software can acquire and store GPS location, speed and time every second. In addition, it can acquire video through IEEE 1394 and store directly to an external hard drive.

Data was collected during the peak periods in the following metropolitan areas:

- CARTS with a population of over 500,000;
- NARTS with a population of approximately 200,000; and
- HSATS with a population of just over 50,000.

2.1 Central Arkansas Area (CARTS)

The selected routes in the CARTS area are listed in Table.2.1.

Table 2.1 Selected Routes in CARTS Area

Route #	Route	From	To	Length (mile)
C-1	Highway 5	I-30	I-430	10.5
C-2	Highway 10	Highway 300	Reservoir Road	7.5
C-3	Highway 10	Sam Peck Road	President Clinton Ave.	9.7
C-4	Hwy 60 (Conway)	I-40	Hogan Lane	4.3
C-5	Highway 89 (Cabot)	Douglas Road	Highway 321	4.8
C-6	Highway 365 & 70	Roosevelt Road	I-40	4.7
C-7	Highways 300/5/70	Bowman Road	Arch Street	8.1
C-8	Highway 107 (JFK)	I-40	Highway 176	4.8
C-9	Hwy 70 (University)	I-30	Highway 5 (Asher)	2.5
C-10	Interstate 30/430	Congo Road	Highway 300 (Colonel Glenn)	14
C-11	I-30 Frontage Road/Hwy 5	Congo Road	Highway 338 (Baseline Rd)	12.4
C-12	Highway 67/I-440	Highway 89	I-40	16.7
C-13	Highway 67/I-40/I-30	Redmond Road	Roosevelt Road	13.4
C-14	I-40/I-430	Highway 365 (Morgan)	Lile Drive	12.2
C-15	I-40	Highway 65 (Conway)	Highway 365 (Morgan)	17
C-16	I-630/I-30/I-530	Fair Park Blvd.	Highway 338 (Dixon Road)	8.5
C-17	I-430/I-630	Highway 300	Woodrow Street	7.5
C-18	Highway 100/I-430	Highway 10	Highway 365	9.7

2.1.1 Route C-1 - Highway 5. Multiple sets of travel time data were collected during the morning, noon and afternoon peak periods on 3/5/2008 and 3/6/2008. Figure 2.2 shows the 2008 Average Daily Traffic (ADT) for the subject route.

Travel time information was recorded for traveling on Highway 5 in both directions between Point A (I-30 in Benton, AR) and Point B (I-430 in Little Rock, AR). Speed maps were plotted for each data set where beginning point is shaded in blue and ending point is shaded in purple. Figure 2.3 shows the worst AM and PM peak travel conditions.

Travel time index is commonly used as an indicator of congestion levels. It is the ratio between the actual travel time and the travel time during non-peak periods on a particular route. For example, a travel time index of 1.70 shows that a motorist spends 70%

more time to travel from Point A to Point B at a specific departure time. Average speed is calculated by dividing the travel distance by the travel time. It is often easier to convey the level of congestion to the public when compared to the posted speed. Summaries of the travel time, travel time indices and average speeds for all routes are included in Appendix A.

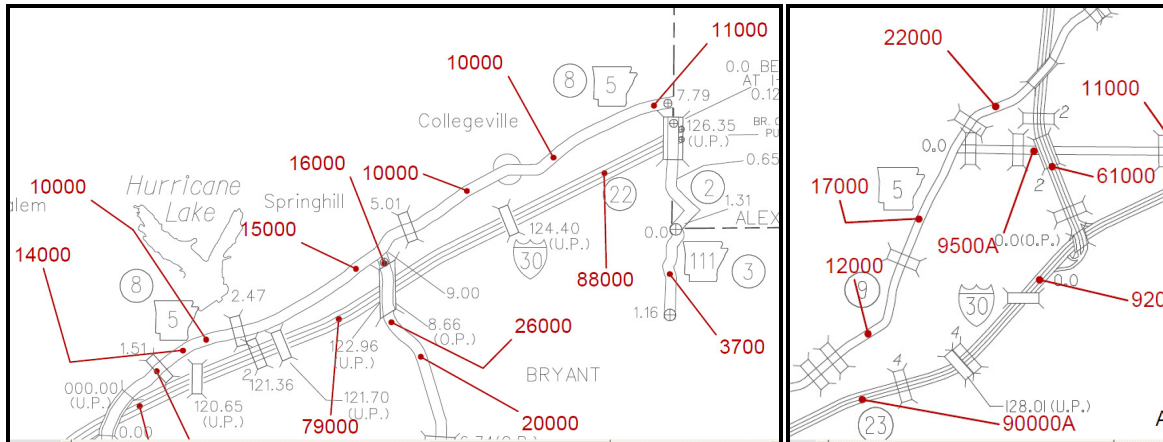


FIGURE 2.2: Route C-1 - 2008 ADT (Saline & Pulaski Counties)

2.1.2 Route C-2 - Highway 10. Travel time data was collected during the morning, noon and afternoon peak periods on 3/17/2008 for traveling on Highway 10 in both directions between Point A (Highway 300 in Pulaski County, AR) and Point B (Reservoir Road in Little Rock, AR). Figure 2.4 shows the 2008 ADT on the subject route and Figure 2.5 shows the worst AM and PM peak travel conditions. As shown, most of the congestion and delay occurs east of the Sam Peck Road.

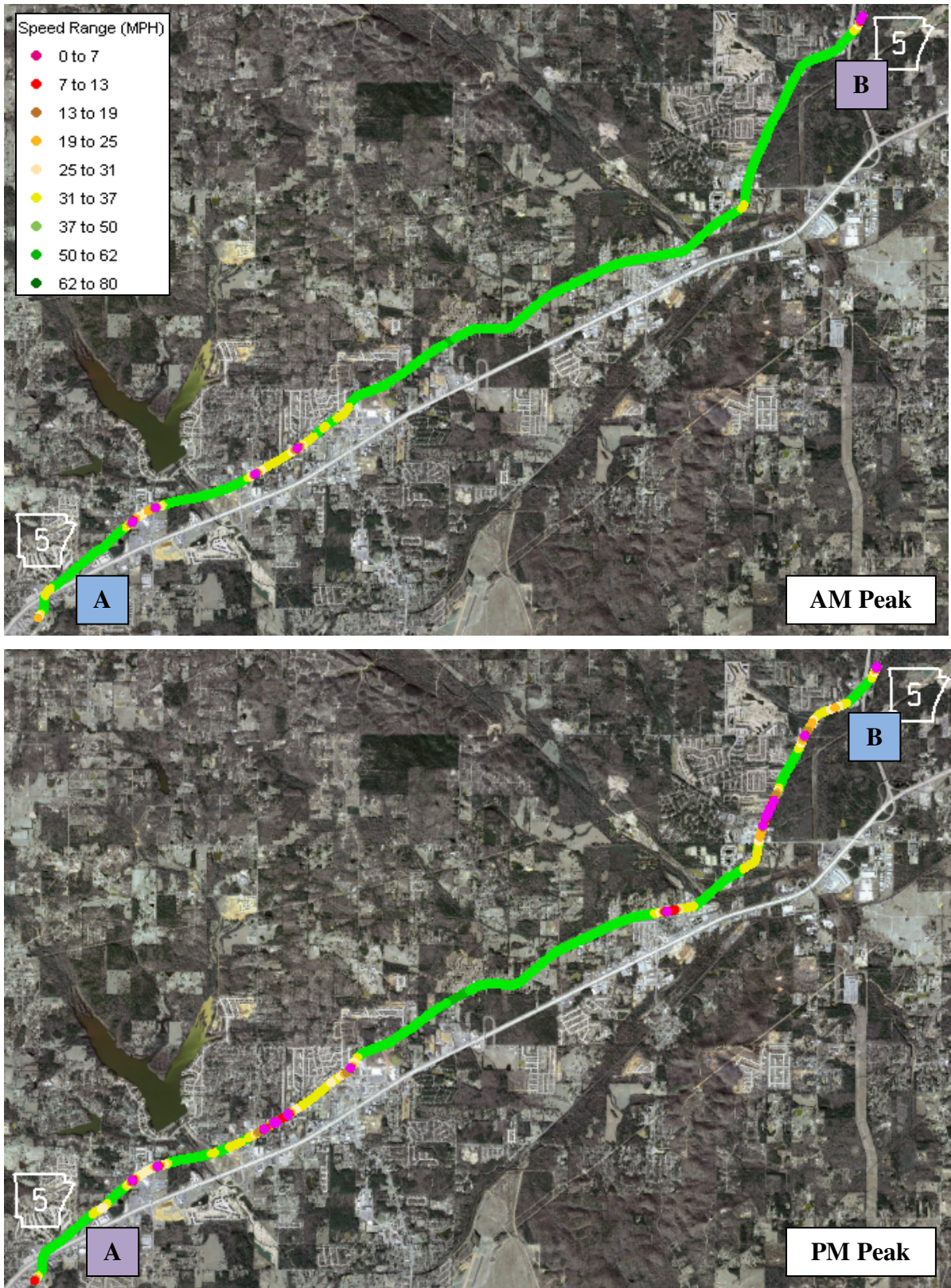


FIGURE 2.3: Route C-1-Highway 5 Speed Map
(A @ I-30, B @ I-430)

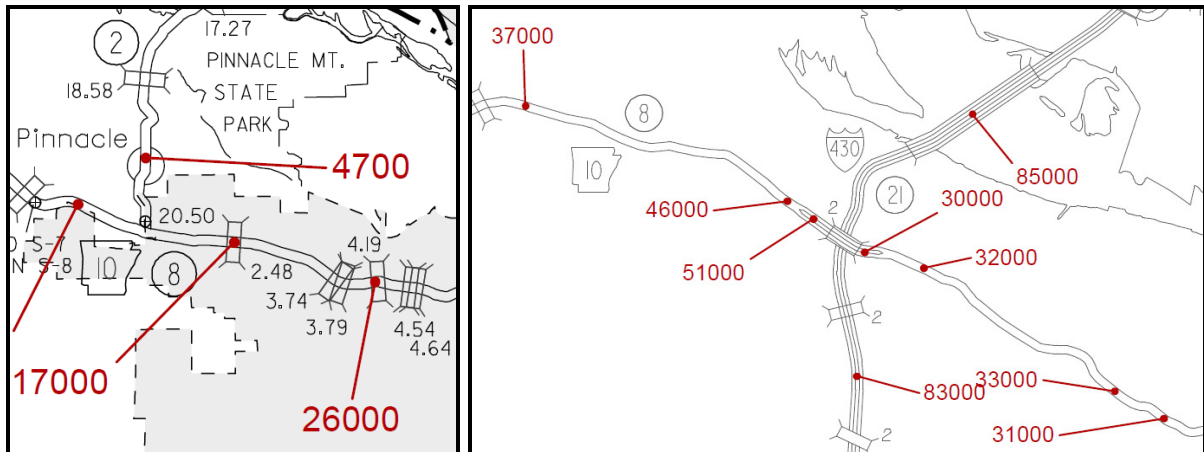


FIGURE 2.4: Route C-2 - 2008 ADT (Pulaski County)

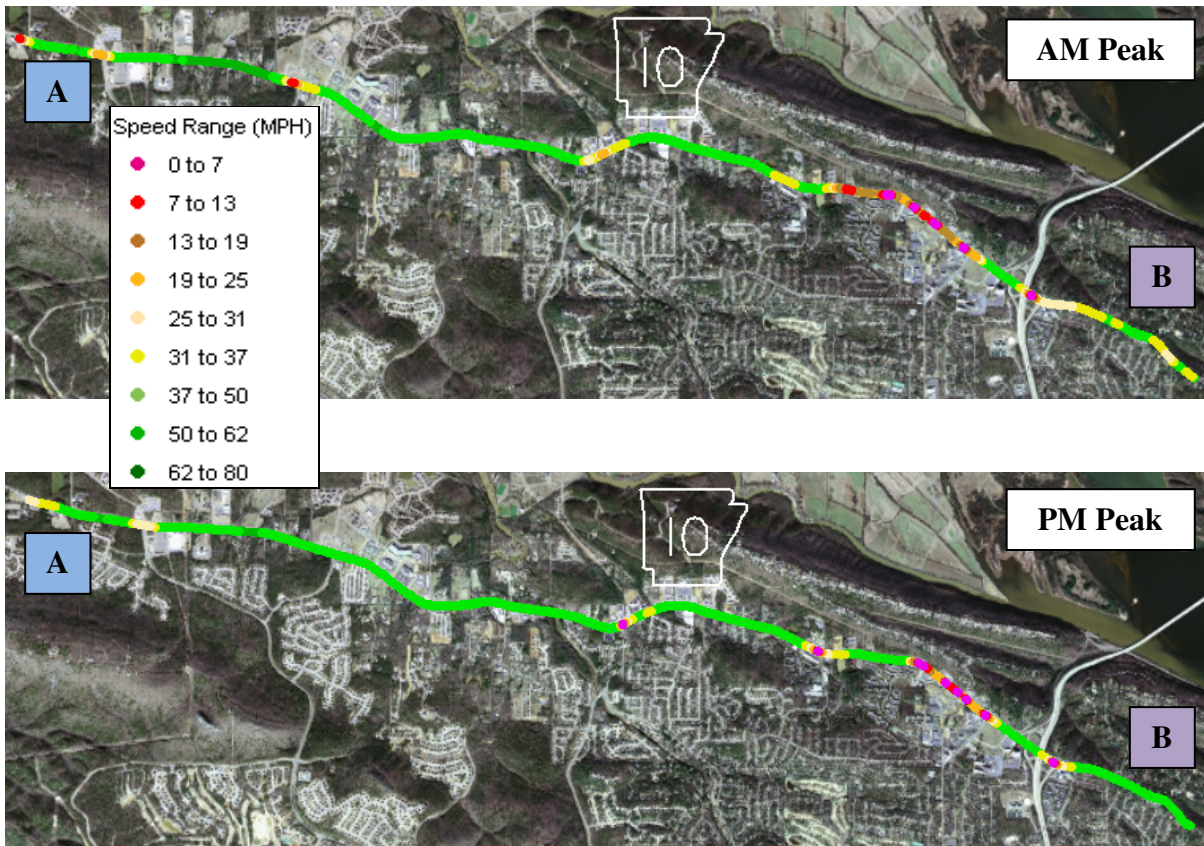


FIGURE 2.5: Route C-2-Highway 10 Speed Map
(A @ Hwy. 300, B @ Reservoir Road)

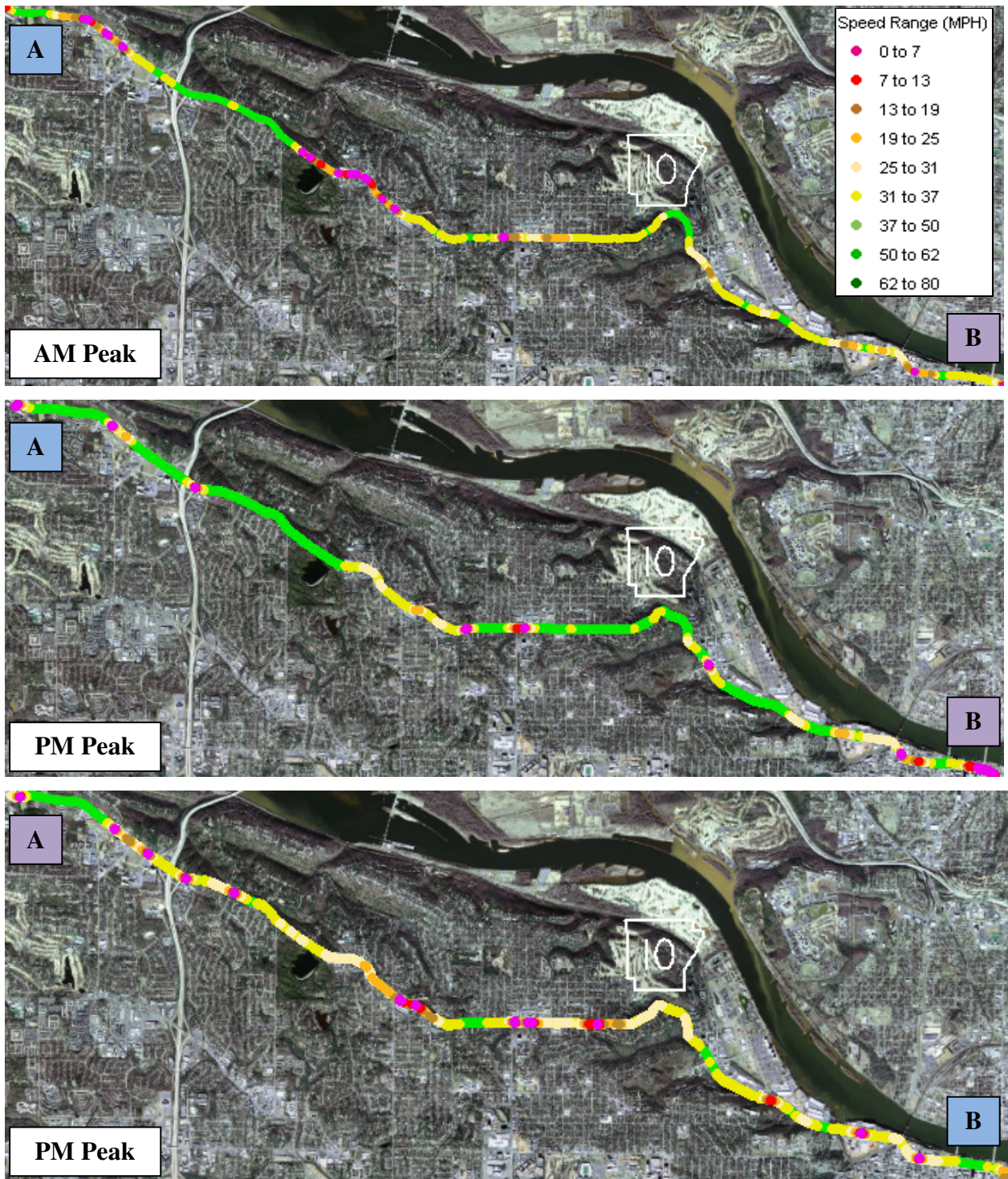


FIGURE 2.7: Route C-3-Highway 10 Speed Map

(A @ Sam Peck, B @ Markham Street)

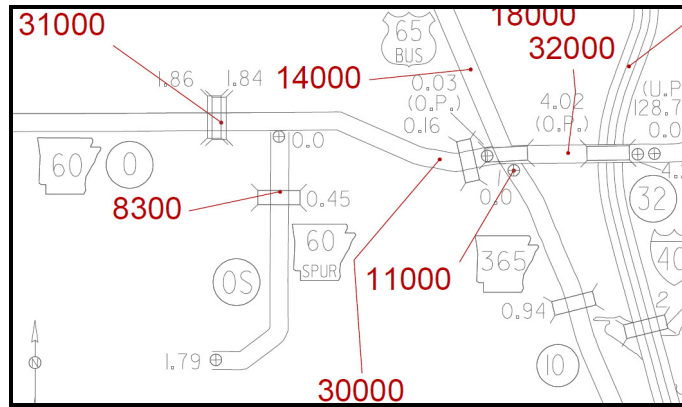


FIGURE 2.8: Route C-4 - 2008 ADT (Faulkner County)

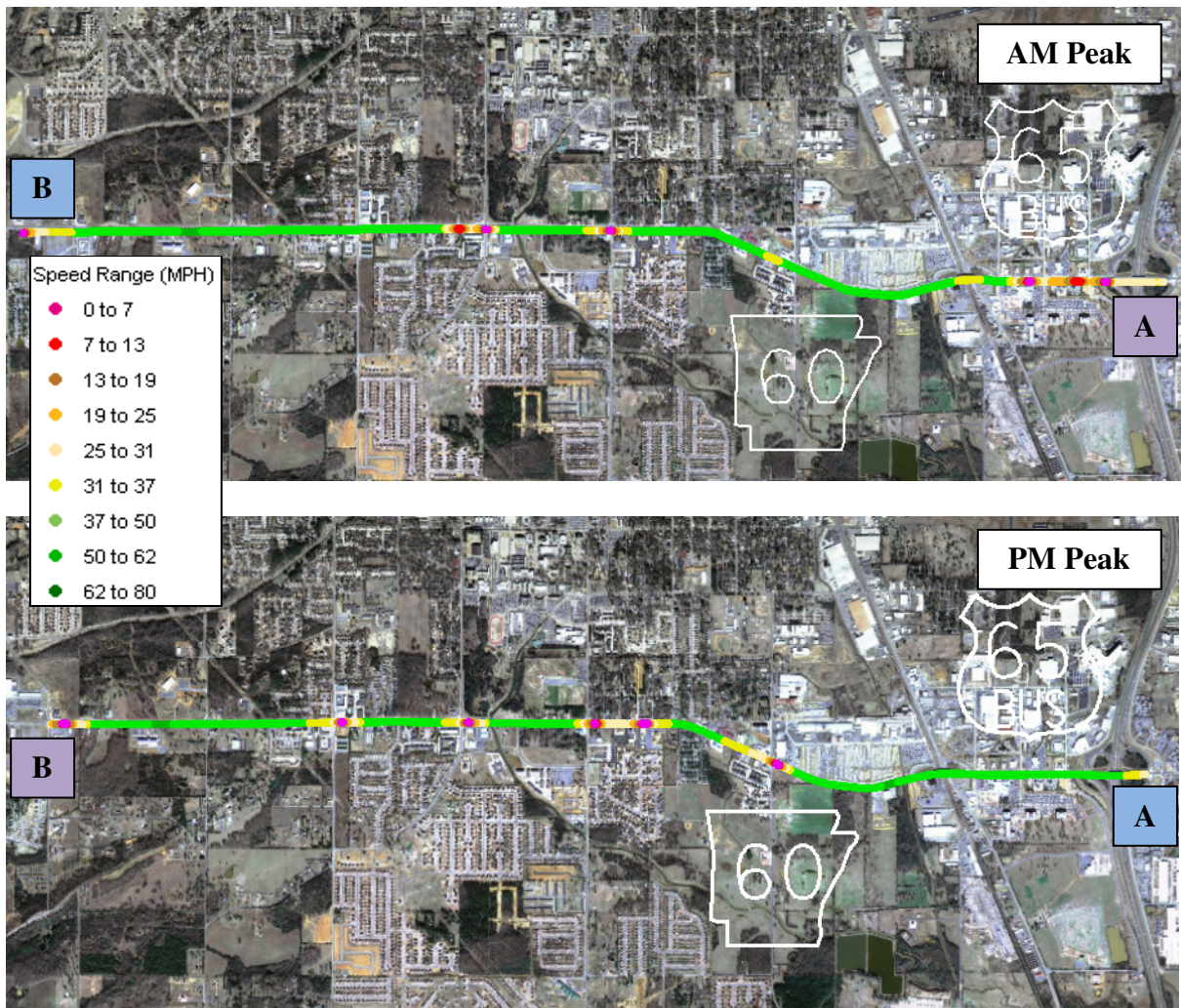


FIGURE 2.9: Route C-4-Highway 60 Speed Map
(A @ I-40, B @ Hogan Lane)

2.1.5 Route C-5 - Highway 89. Travel time data was collected during the morning, noon and afternoon peak periods on 3/19/2008 for traveling on Highway 89 in both directions between Point A (Douglas Road in Cabot, AR) and Point B (Highway 321 in Cabot, AR). Figure 2.10 shows the 2008 ADT for the subject route and Figure 2.11 shows the worst AM and PM peak travel conditions.

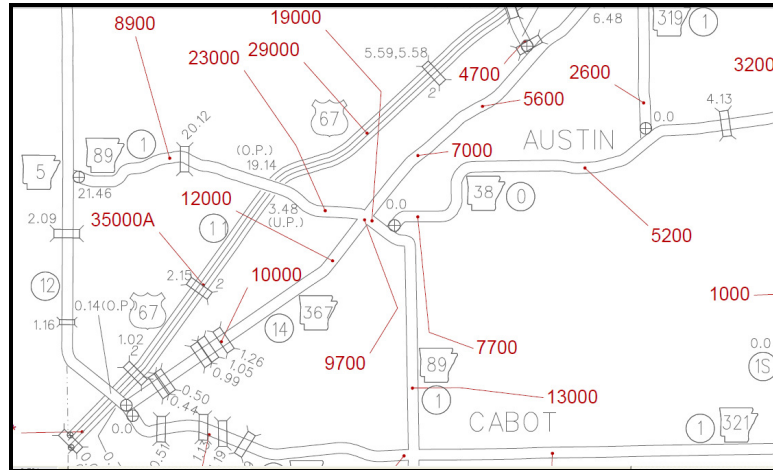


FIGURE 2.10: Route C-5 - 2008 ADT (Lonoke County)

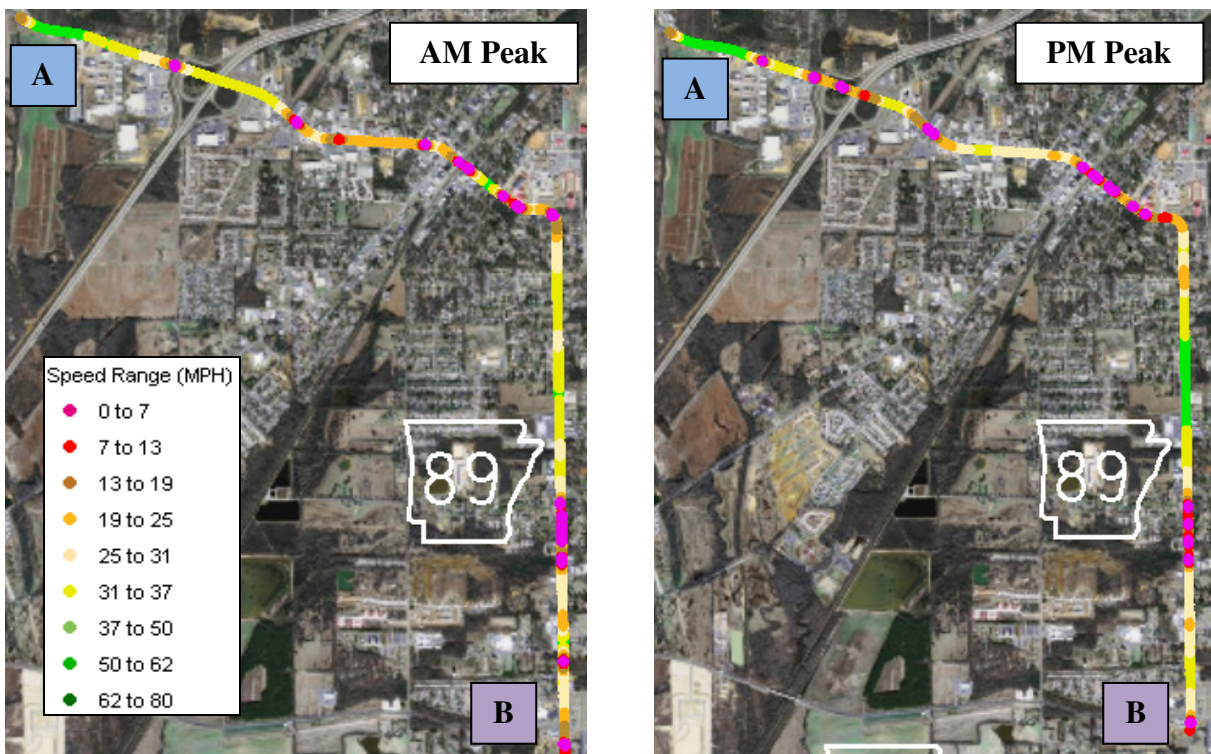


FIGURE 2.11: Route C-5-Highway 89 Speed Map

(A @ Douglas Road, B @ Hwy. 321)

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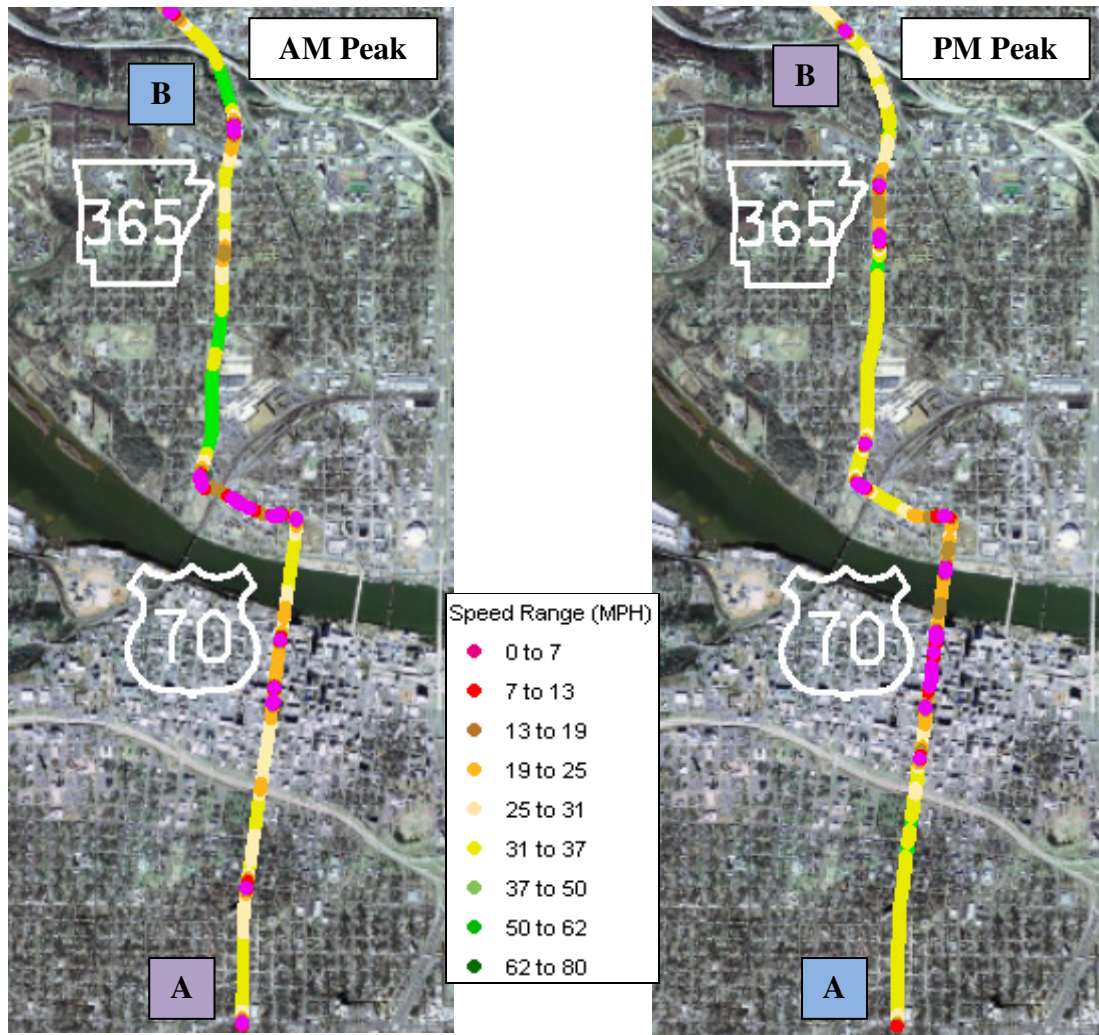


FIGURE 2.13: Route C-6-Highways 365/70 Speed Map
(A @ Roosevelt Road, B @ I-40)

2.1.7 Route C-7 - Highways 300/5/70. Travel time data was collected during the morning, noon and afternoon peak periods on 4/2/2008 for traveling on Highways 300/5/70 in both directions between Point A (Bowman Road in Little Rock, AR) and Point B (Arch Street in Little Rock, AR). Figure 2.14 shows the 2008 ADT for the subject route and Figure 2.15 shows the worst AM and PM peak travel conditions.

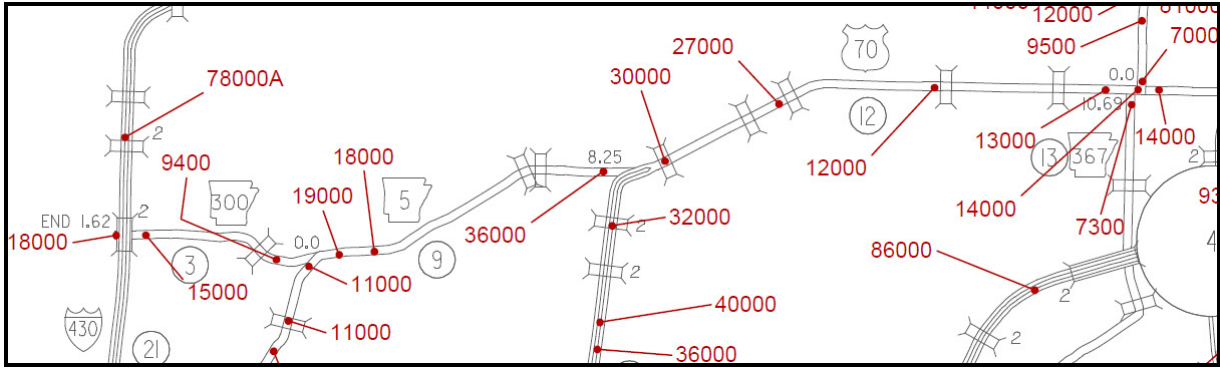


FIGURE 2.14: Route C-7 - 2008 ADT (Pulaski County)

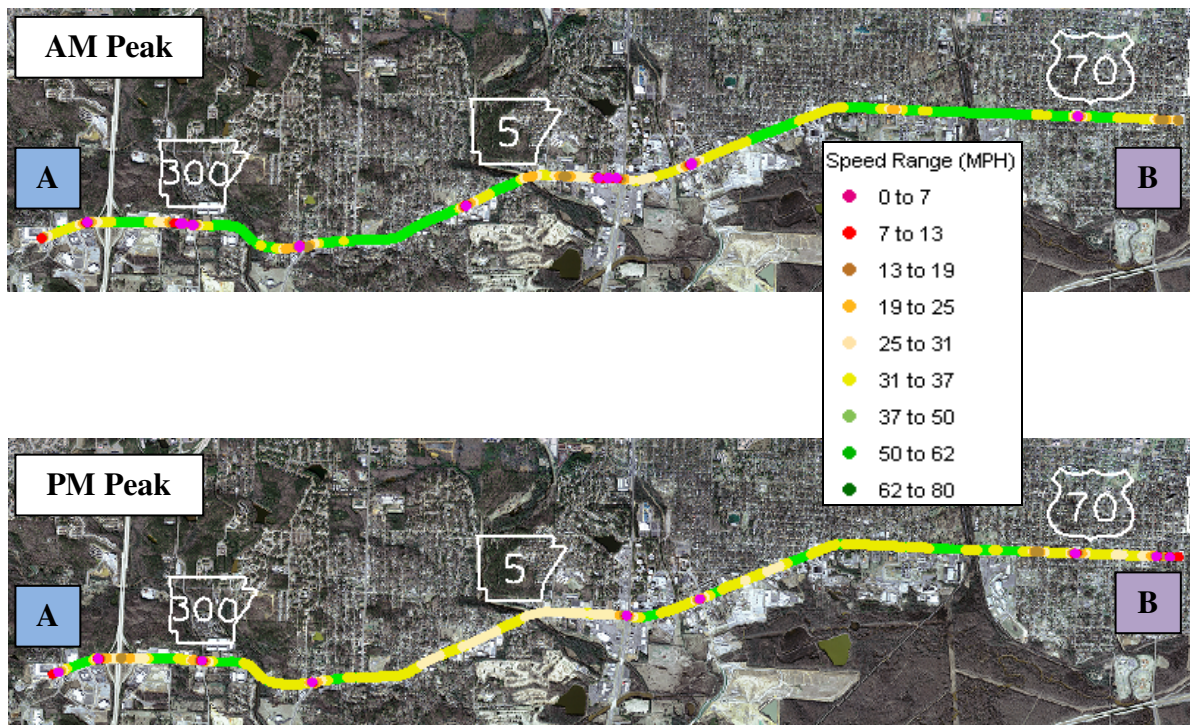


FIGURE 2.15: Route C-7-Highways 300/5/70 Speed Map

(A @ Bowman Road, B @ Arch Street)

2.1.8 Route C-8 - Highway 107. Travel time data was collected during the morning period on 5/9/2008 and the afternoon peak period on 4/21/2008 for traveling on Highway 107 in both directions between Point A (I-40 in North Little Rock, AR) and Point B (Highway 176 in Sherwood, AR). Figure 2.16 shows the 2008 ADT on the subject route and Figure 2.17 shows the worst AM and PM peak travel conditions.

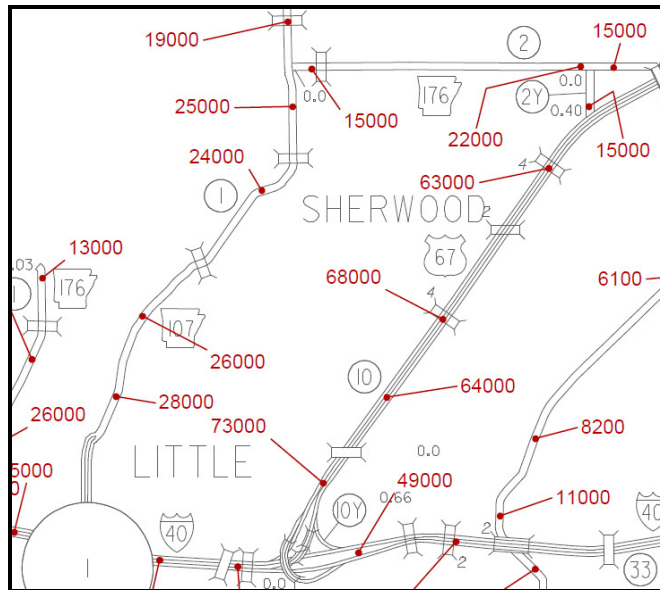


FIGURE 2.16: Route C-8 - 2008 ADT (Pulaski County)

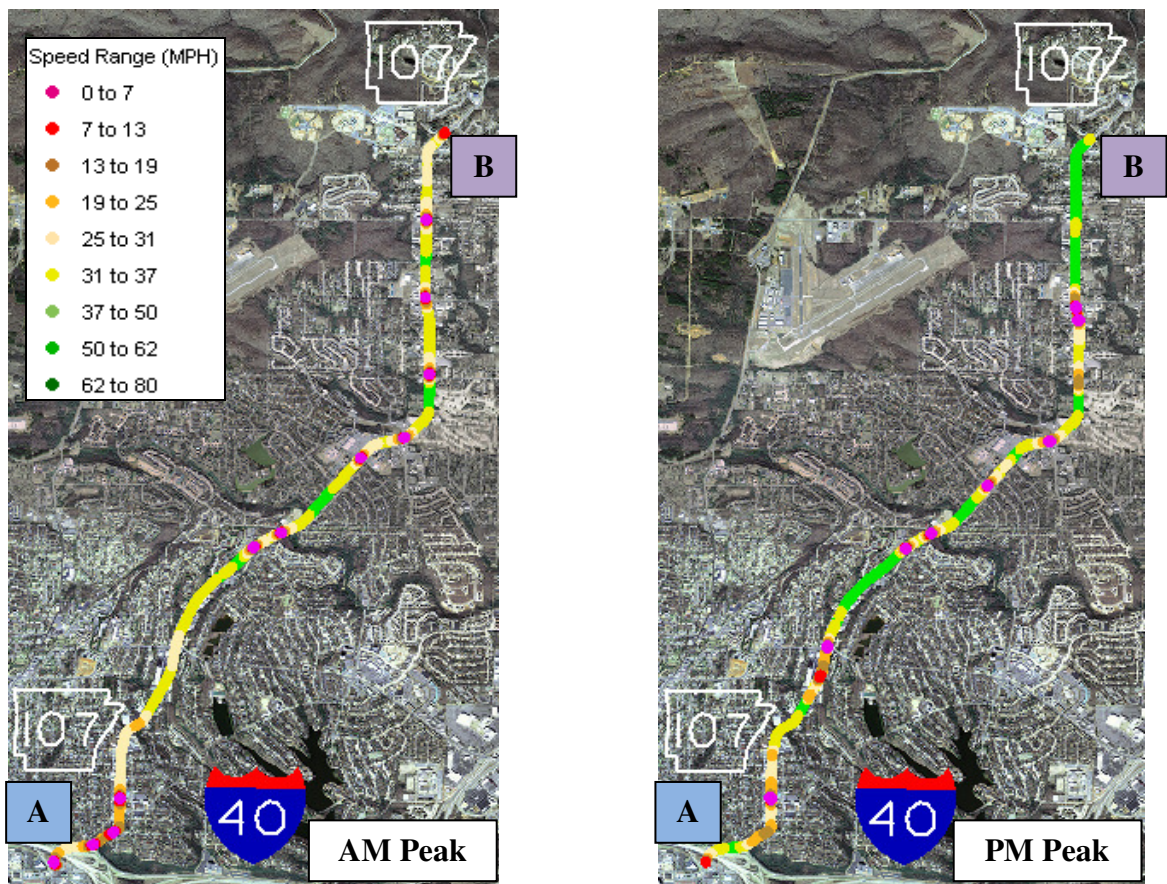


FIGURE 2.17: Route C-8-Highway 107 Speed Map

(A @ I-40, B @ Hwy. 176)

2.1.9 Route C-9 - Highway 70. Travel time data was collected during the morning peak period on 5/5/2008 and the afternoon peak period on 4/21/2008 for traveling on Highway 70 in both directions between Point A (I-30 in Little Rock, AR) and Point B (Highway 5 in Little Rock, AR). Figure 2.18 shows the 2008 ADT on the subject route and Figure 2.19 shows the worst AM and PM peak travel conditions.

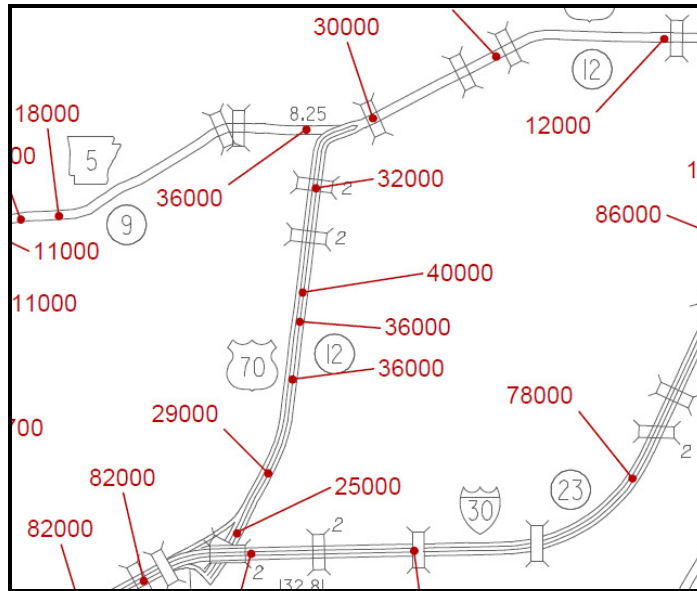


FIGURE 2.18: Route C-9 - 2008 ADT (Pulaski County)

2.1.10 Route C-10 – I-30/I-430. Travel time data was collected during the morning and the afternoon peak periods on 4/15/2008 for traveling on I-30 and I-430 in both directions between Point A (Congo Road in Benton, AR) and Point B (Highway 300 in Little Rock, AR). Figure 2.20 shows the 2008 ADT on the subject route and Figure 2.21 shows the worst AM and PM peak travel conditions.

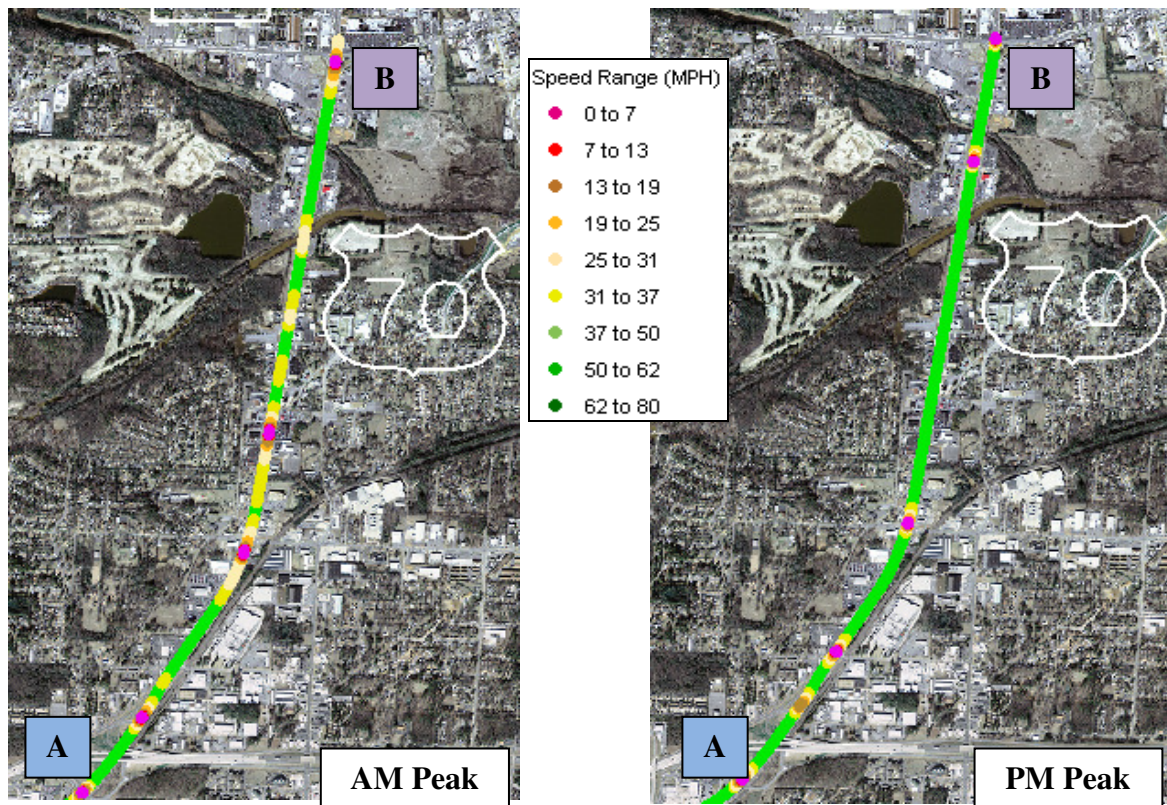


FIGURE 2.19: Route C-9-Highway 70 Speed Map
(A @ I-30, B @ Hwy. 5)

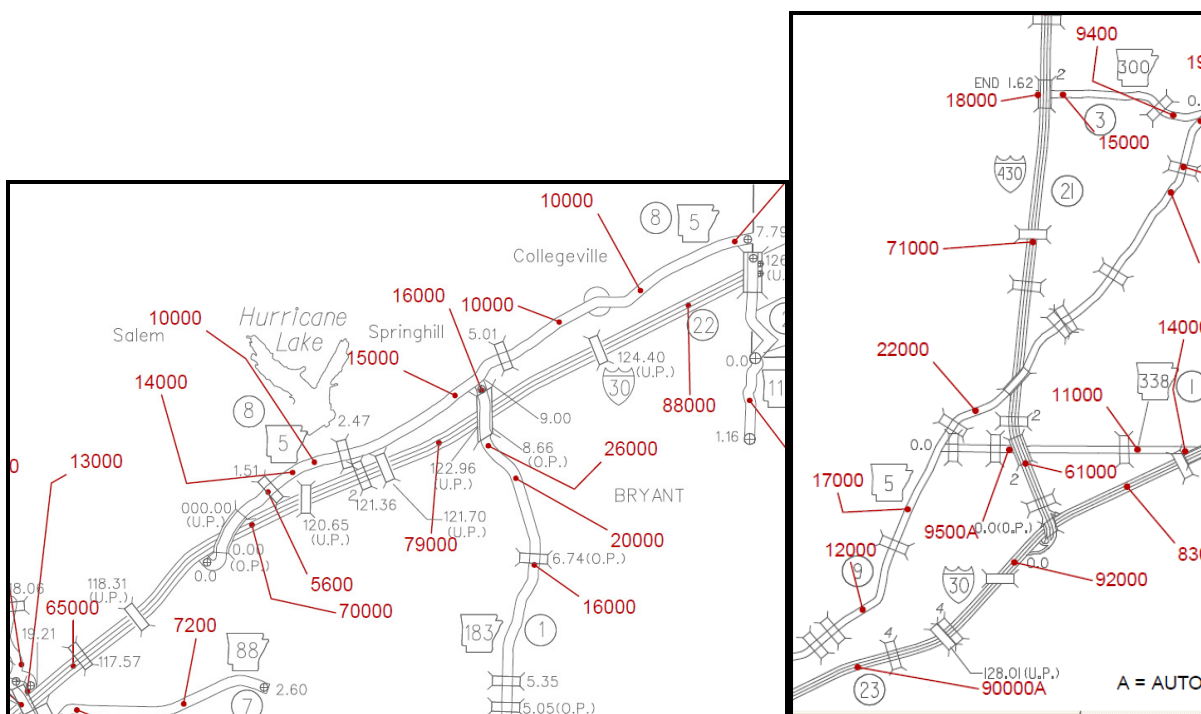


FIGURE 2.20: Route C-10 - 2008 ADT (Saline and Pulaski Counties)

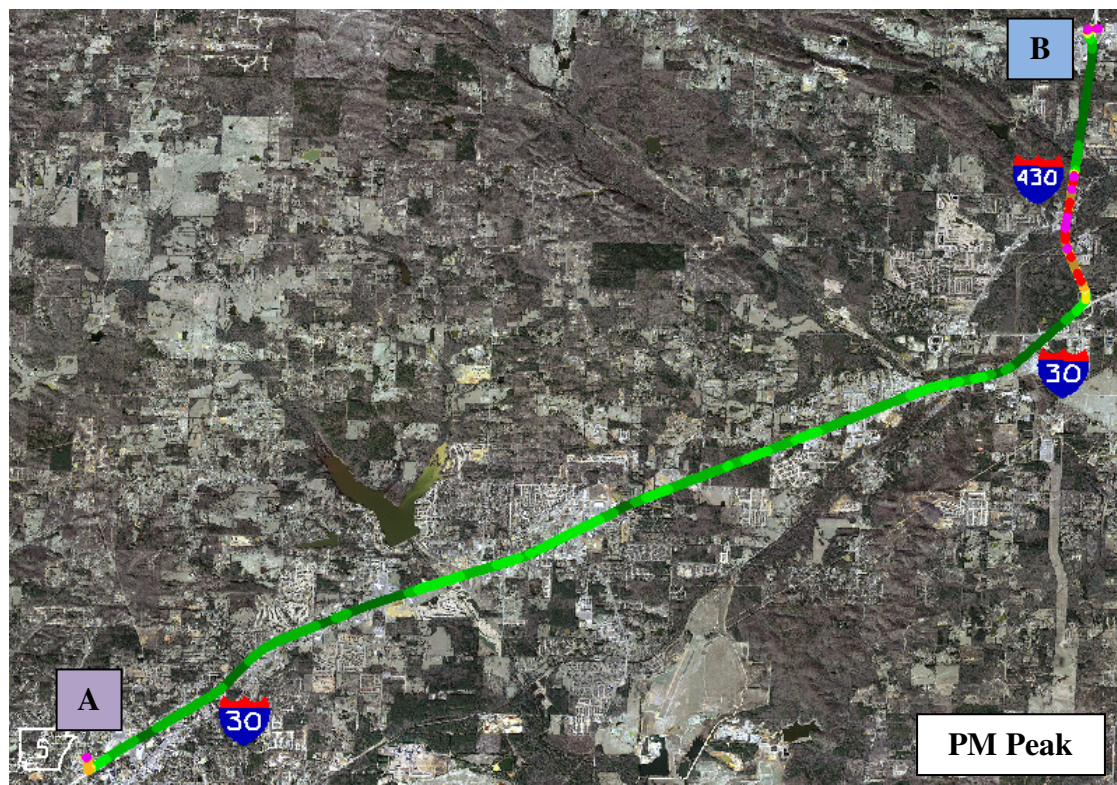
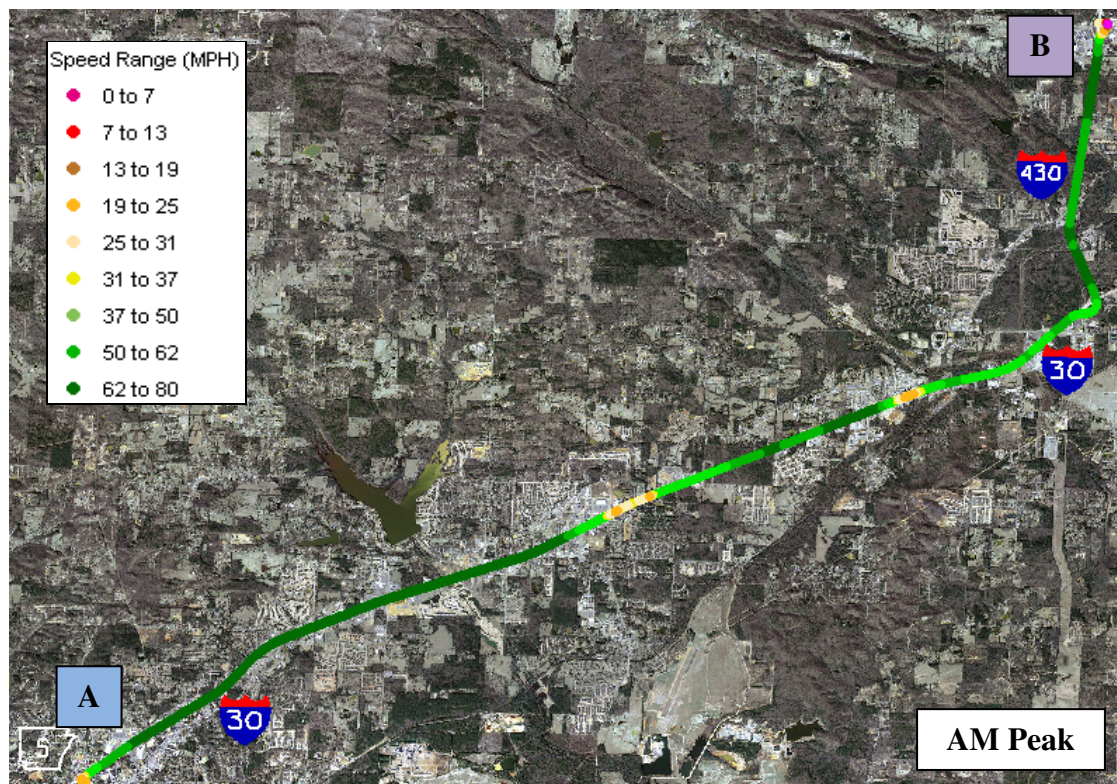


FIGURE 2.21: Route C-10-I-30/I-430 Speed Map
(A @ Congo Road, B @ Hwy. 300)

2.1.11 Route C-11 – I-30 Frontage Road/Highway 5. Travel time data was collected during the morning and the afternoon peak periods on 4/16/2008 for traveling on I-30 Frontage Road/Highway 5 in both directions between Point A (Congo Road in Benton, AR) and Point B (Highway 338 in Little Rock, AR). Figure 2.22 shows the worst AM and PM peak travel conditions.

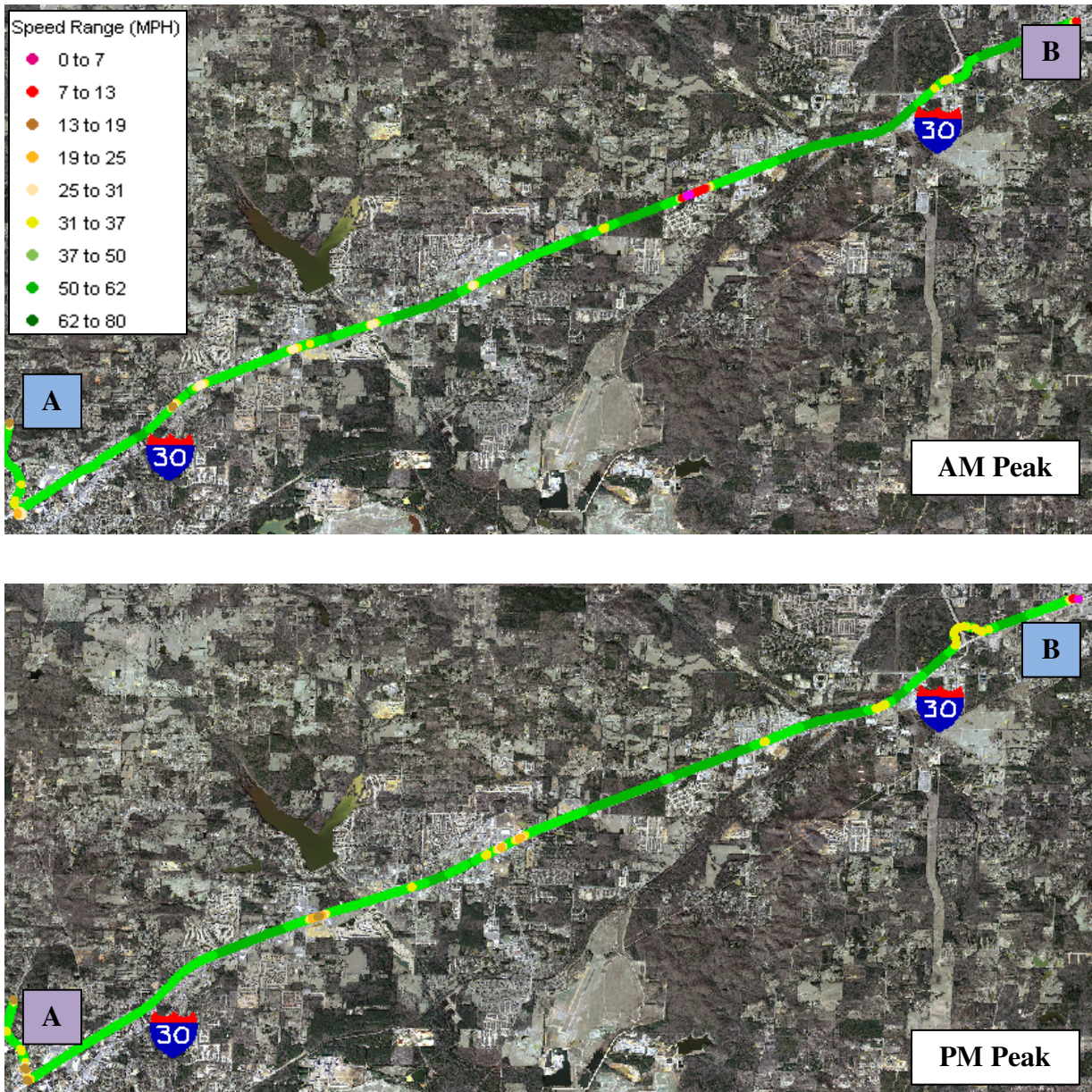


FIGURE 2.22: Route C-11-I-30 Frontage Road/Highway 5 Speed Map
(A @ Congo Road, B @ Hwy. 338)

2.1.12 Route C-12 – Highway 67/I-440. Travel time data was collected during the morning and the afternoon peak periods on 4/17/2008 for traveling on Highway 67/I-440 in both directions between Point A (Highway 89 in Cabot, AR) and Point B (I-40 in North Little Rock, AR). Figure 2.23 shows the 2008 ADT on the subject route and Figure 2.24 shows the worst AM and PM peak travel conditions.

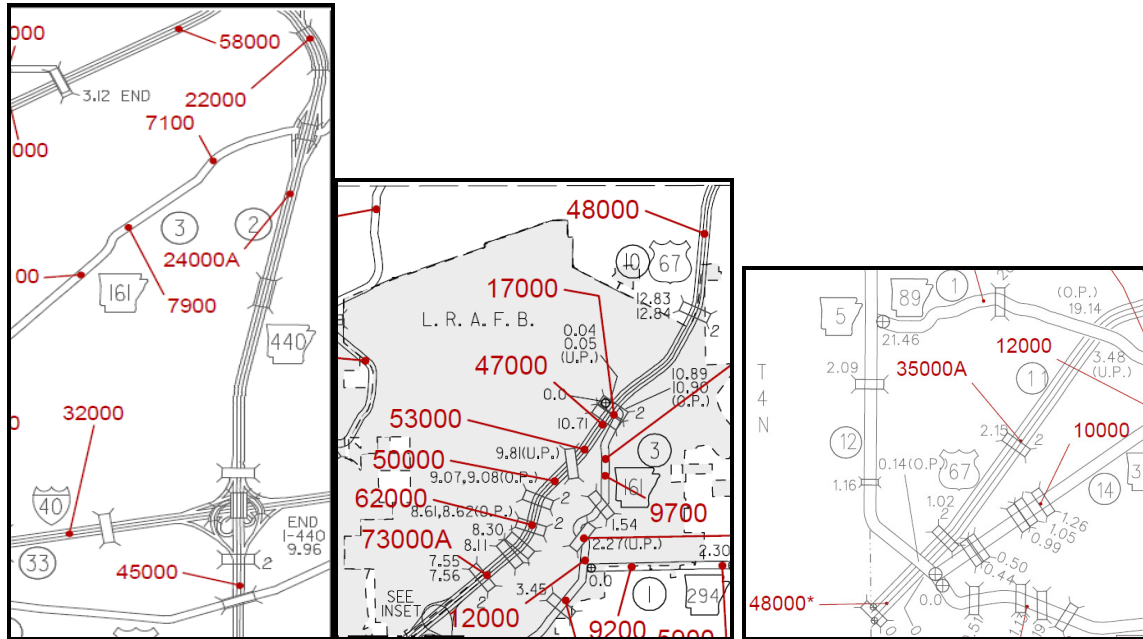


FIGURE 2.23: Route C-12 - 2008 ADT (Pulaski and Lonoke Counties)

2.1.13 Route C-13 – Highway 67/I-40/I-30. Travel time data was collected during the morning and the afternoon peak periods on 4/22/2008 for traveling on Highway 67/I-40/I-30 in both directions between Point A (Redmond Road in Jacksonville, AR) and Point B (Roosevelt Road in Little Rock, AR). Figure 2.25 shows the 2008 ADT on the subject route and Figure 2.26 shows the worst AM and PM peak travel conditions.

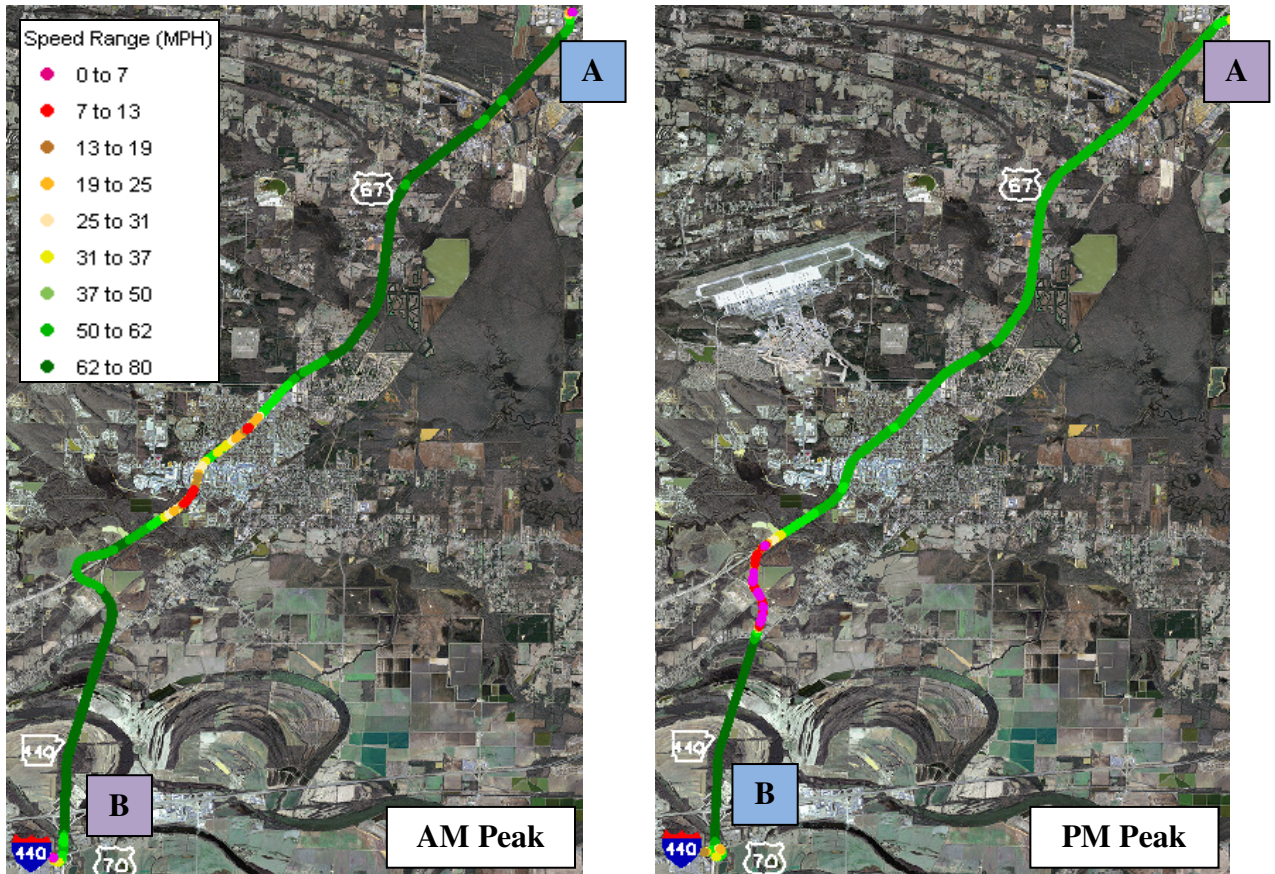


FIGURE 2.24: Route C-12- Highway 67/I-440 Speed Map
(A @ Hwy. 89, B @ I-40)

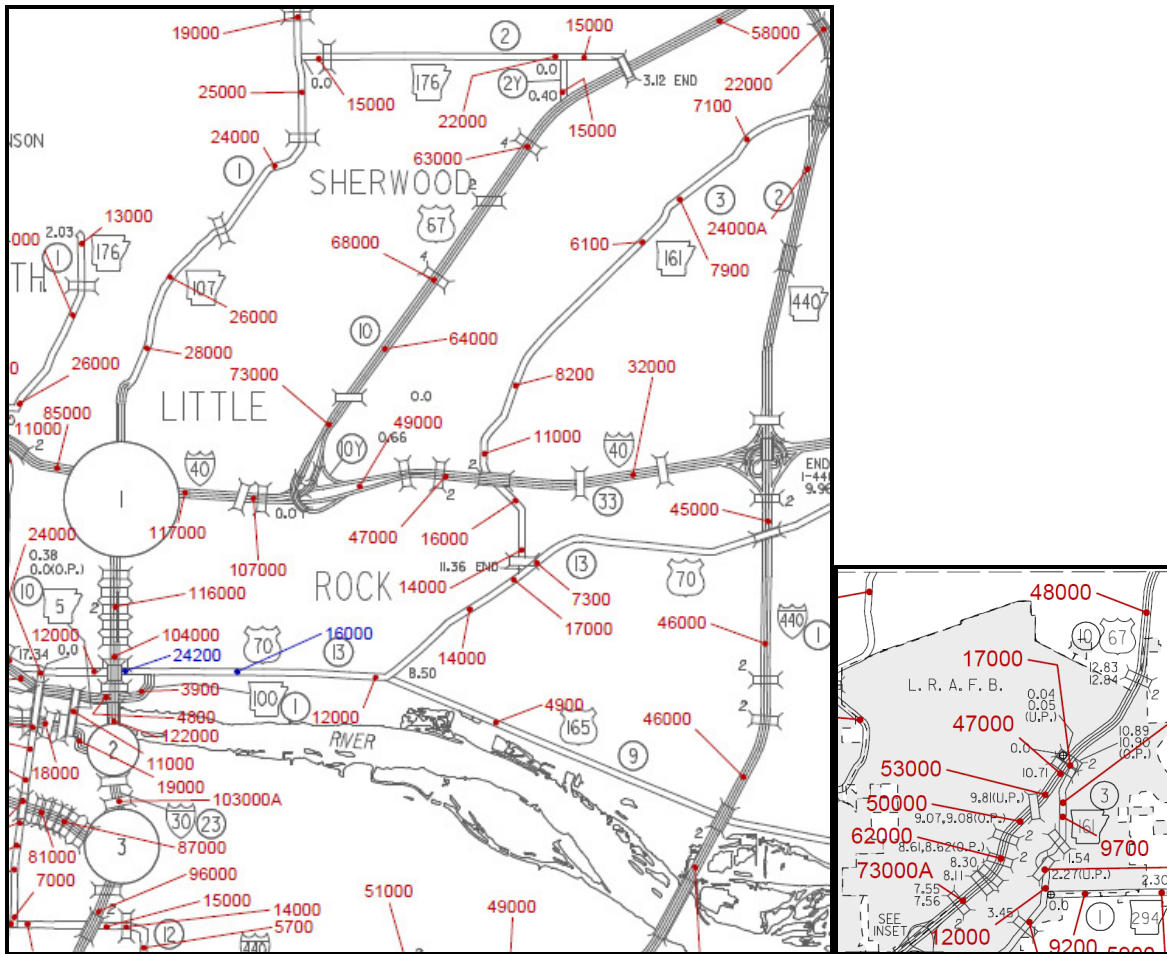


FIGURE 2.25: Route C-13 - 2008 ADT (Pulaski County)

2.1.14 Route C- 14 –I-40/I-430/I-630. Travel time data was collected during the morning peak period on 4/23/2008 and the afternoon peak period on 5/5/2008 for traveling on I-40/I-430/I-630 in both directions between Point A (Highway 365 in Morgan, AR) and Point B (Lile Drive in Little Rock, AR). Figure 2.27 shows the 2008 ADT on the subject route and Figure 2.28 shows the worst AM and PM peak travel conditions.

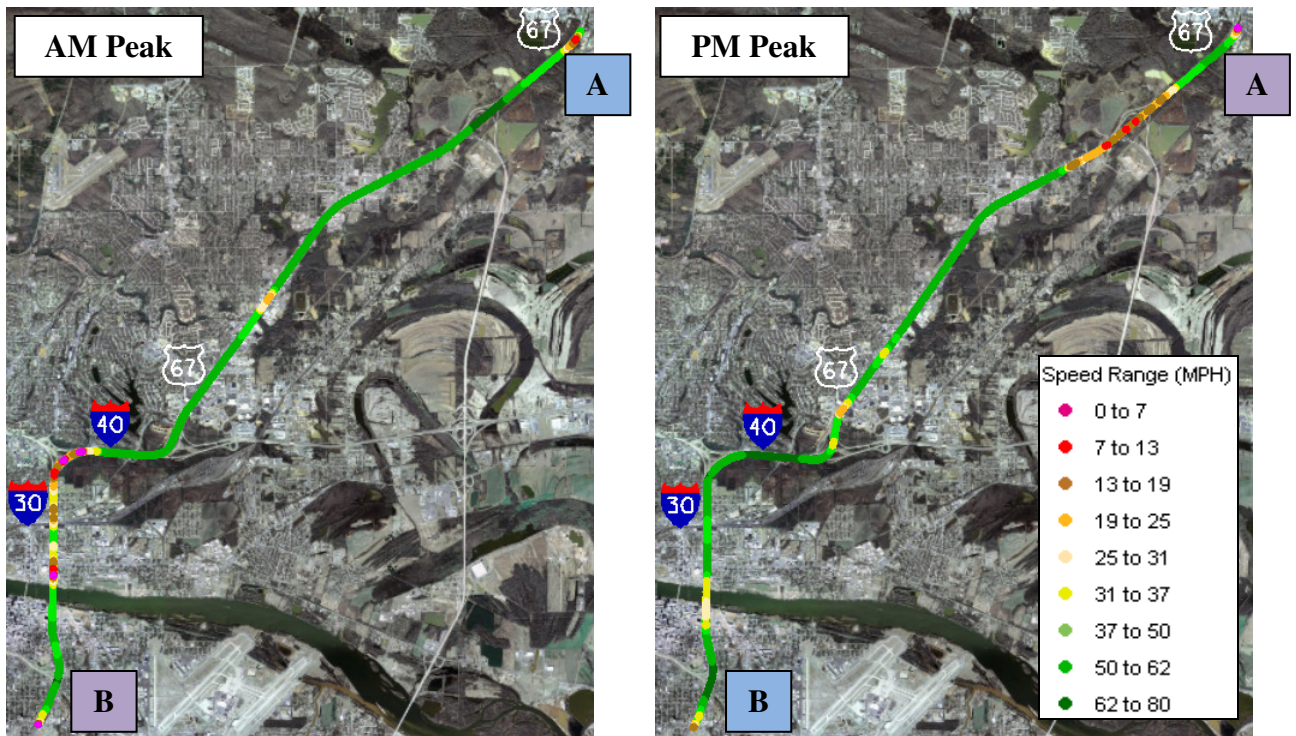


FIGURE 2.26: Route C-13- Highway 67/I-40/I-30 Speed Map

(A @ Redmond Road, B @ Roosevelt Road)

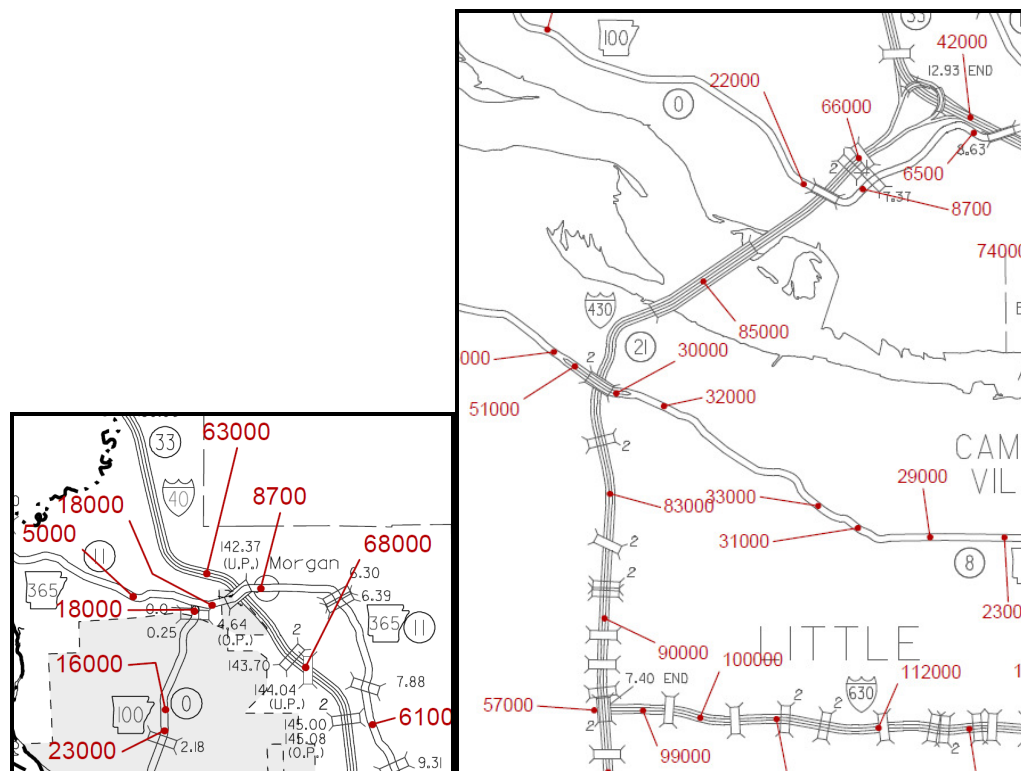


FIGURE 2.27: Route C-14 - 2008 ADT (Pulaski County)

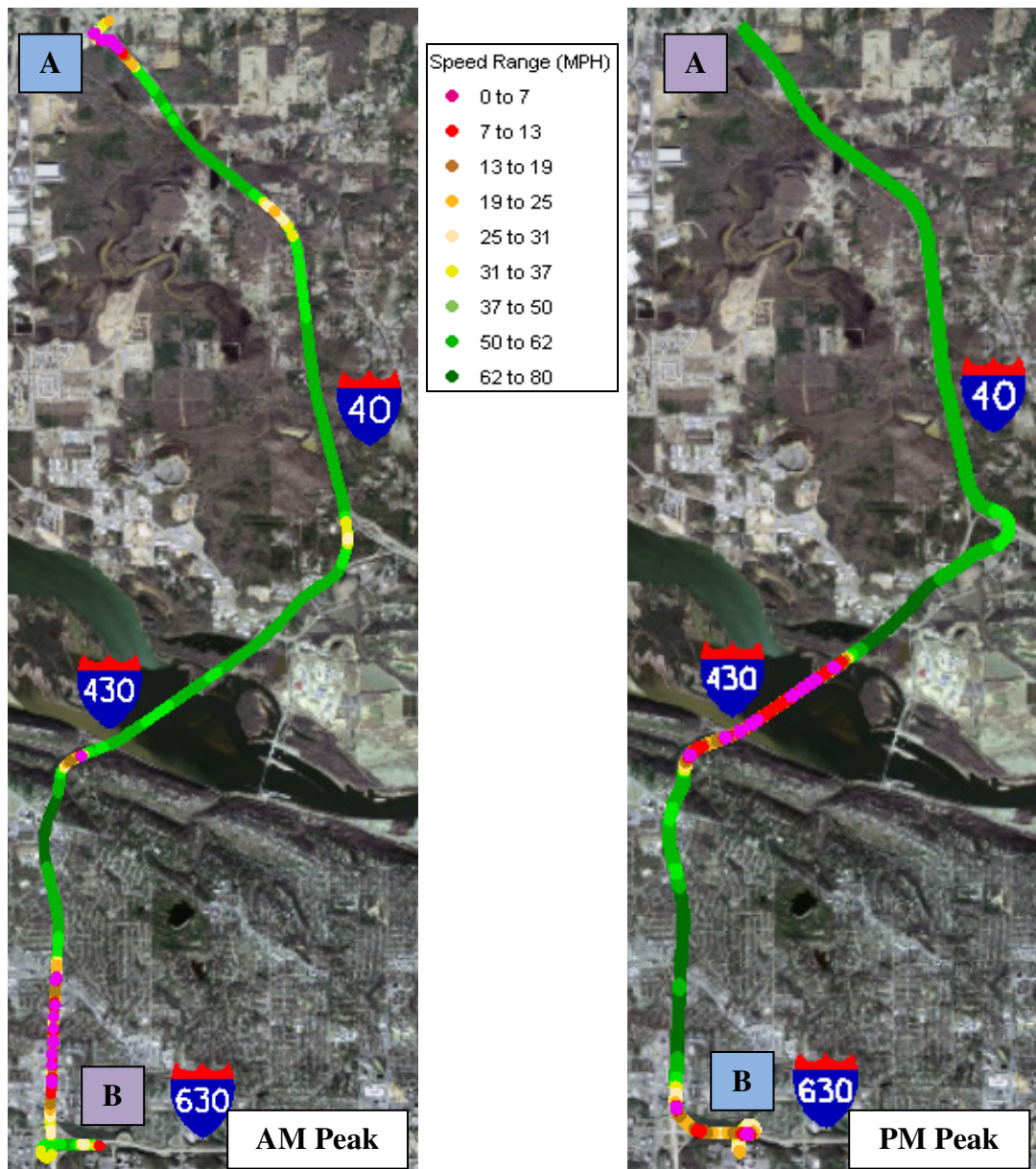


FIGURE 2.28: Route C-14- I-40/I-430/I-630 Speed Map
(A @ Hwy. 365, B @ Lile Dr.)

2.1.15 Route C-15 –I-40. Travel time data was collected during the morning and the afternoon peak periods on 4/24/2008 for traveling on I-40 in both directions between Point A (Highway 65 in Conway, AR) and Point B (Highway 365 in Morgan, AR). Figure 2.29 shows the 2008 ADT on the subject route and Figure 2.30 shows the worst AM and PM peak travel conditions.

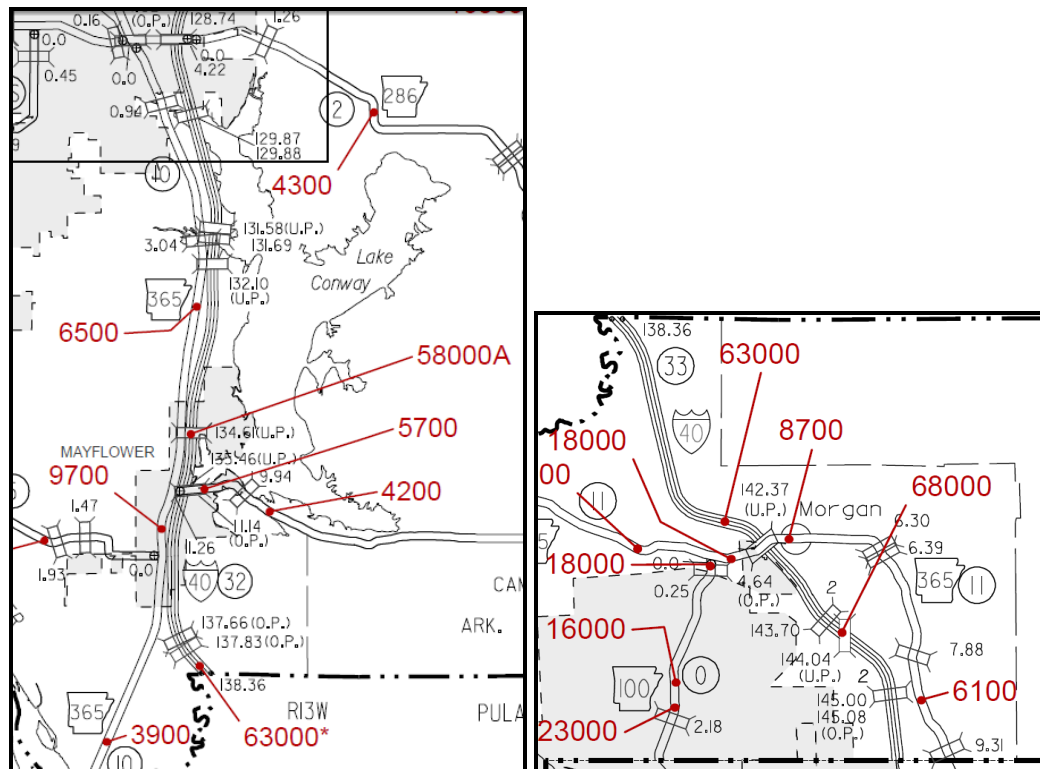


FIGURE 2.29: Route C-15 - 2008 ADT (Faulkner and Pulaski Counties)

2.1.16 Route C-16 –I-630/I-30/I-530. Travel time data was collected during the morning and the afternoon peak periods on 5/6/2008 for traveling on I-630/I-30/I-530 in both directions between Point A (Fair Park Blvd. in Little Rock, AR) and Point B (Highway 338 in Little Rock, AR). Figure 2.31 shows the 2008 ADT on the subject route and Figure 2.32 shows the worst AM and PM peak travel conditions.

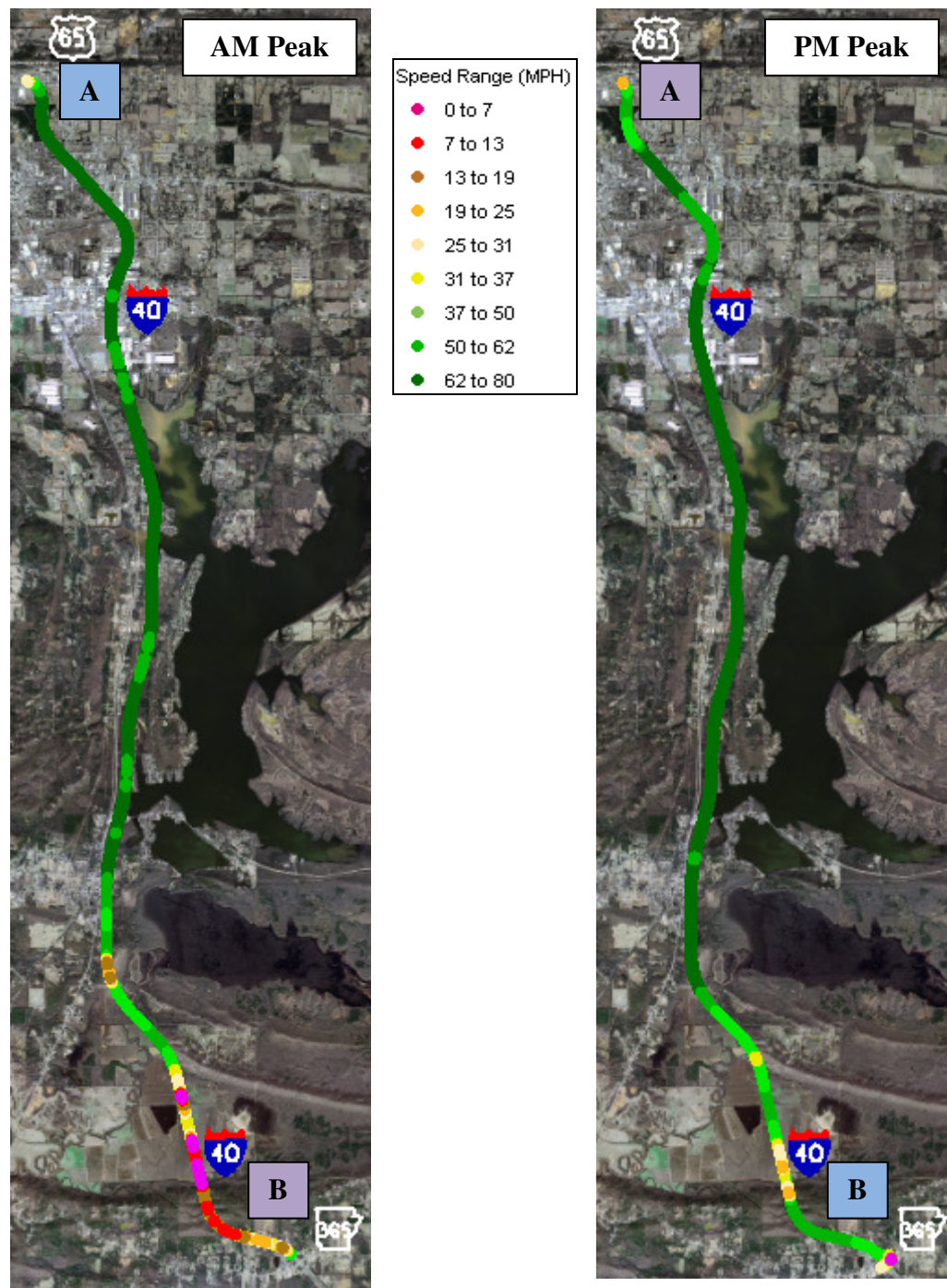


FIGURE 2.30: Route C-15- I-40 Speed Map
(A @ Hwy. 65, B @Hwy. 365)

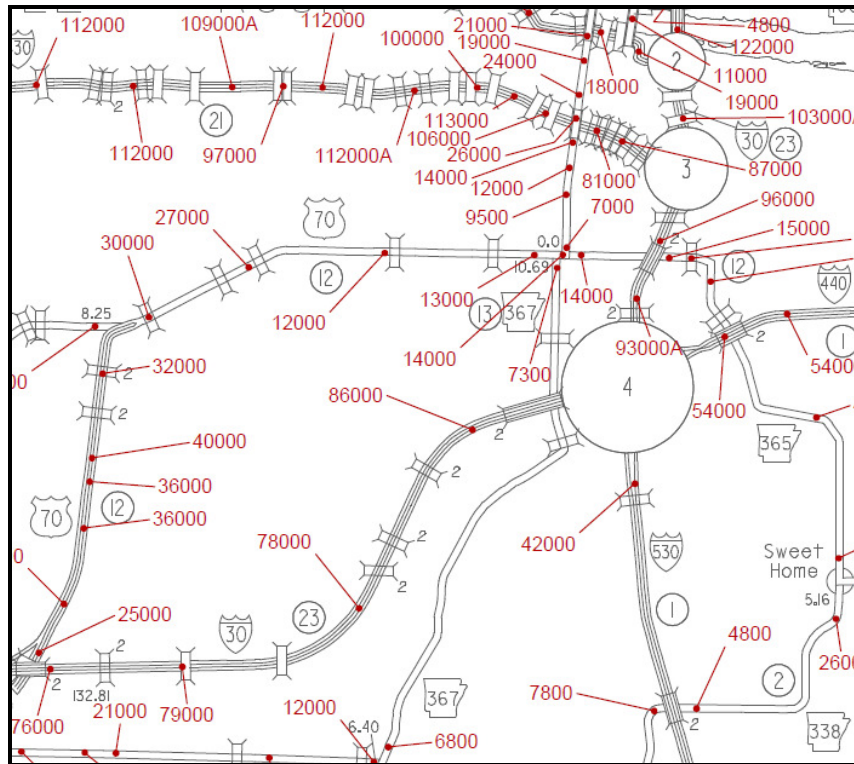


FIGURE 2.31: Route C-16 - 2008 ADT (Pulaski County)

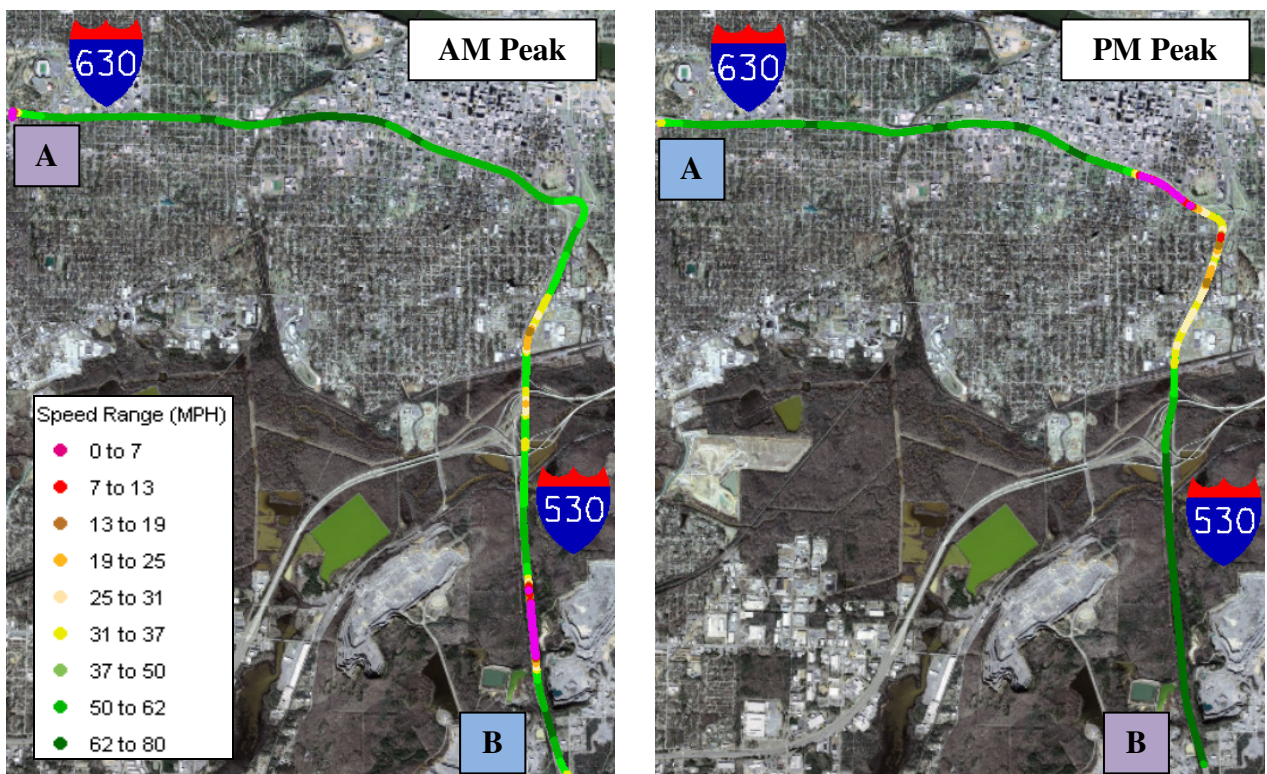


FIGURE 2.32: Route C-16- I-630/I-30/I-530 Speed Map

(A @ Fair Park Blvd., B @Hwy. 338)

2.1.17 Route C-17 –I-430/I-630. Travel time data was collected during the morning and the afternoon peak periods on 5/7/2008 for traveling on I-430/I-630 in both directions between Point A (Highway 300 in Little Rock, AR) and Point B (Woodrow Street in Little Rock, AR). Figure 2.33 shows the 2008 ADT on the subject route and Figure 2.34 shows the worst AM and PM peak travel conditions.

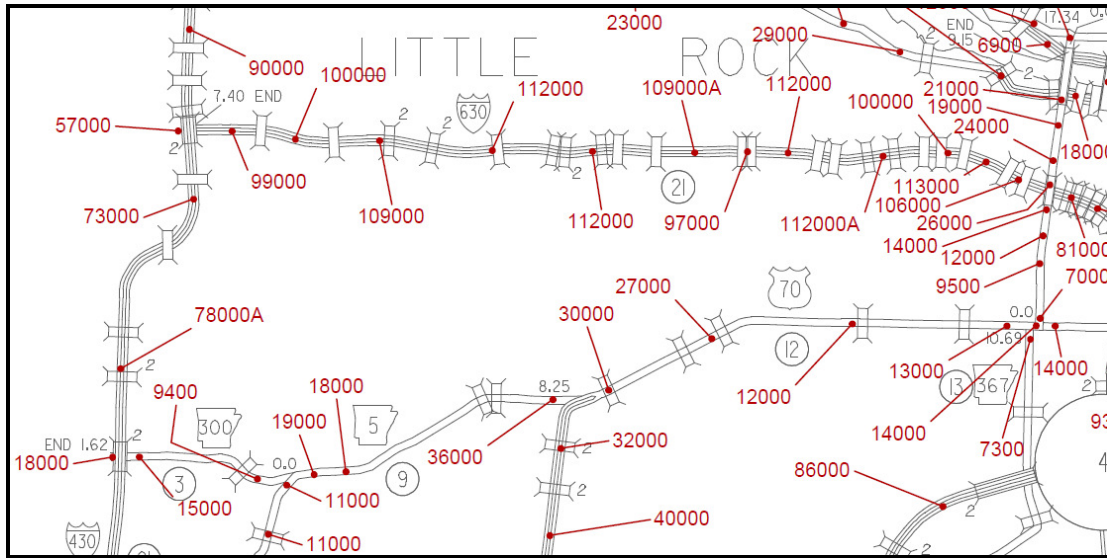


FIGURE 2.33: Route C-17 - 2008 ADT (Pulaski County)

2.1.18 Route C-18 –Highway 100/I-430. Travel time data was collected during the morning and the afternoon peak periods on 5/8/2008 for traveling on Highway 100/I-430 in both directions between Point A (Highway 10 in Little Rock, AR) and Point B (Highway 365 in Morgan, AR). Figure 2.35 shows the 2008 ADT on the subject route and Figure 2.36 shows the worst AM and PM peak travel conditions.

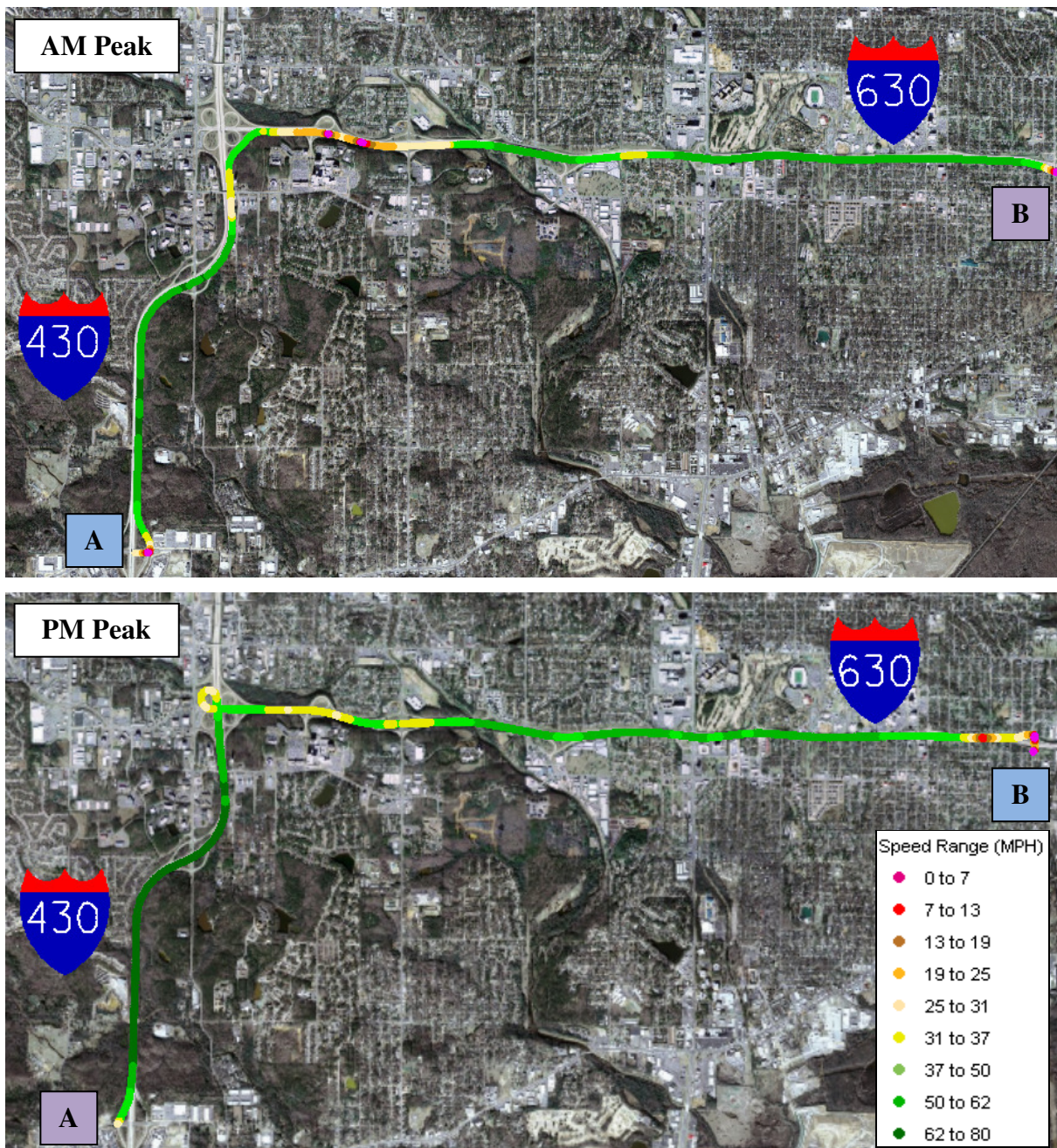


FIGURE 2.34: Route C-17- I-430/I-630 Speed Map
(A @ Hwy. 300, B @ Woodrow St.)

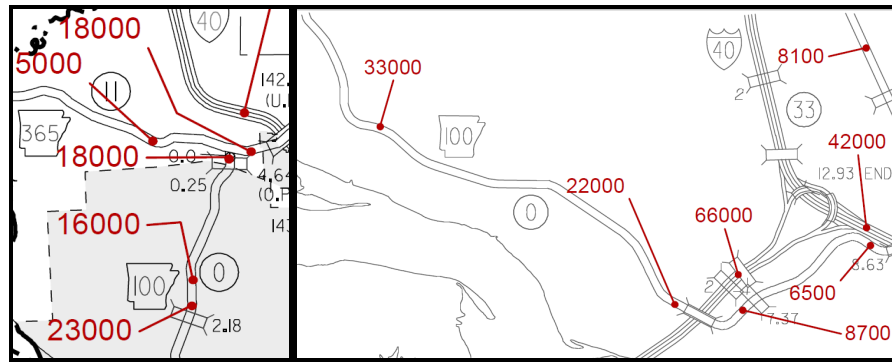


FIGURE 2.35: Route C-18 - 2008 ADT (Pulaski County)

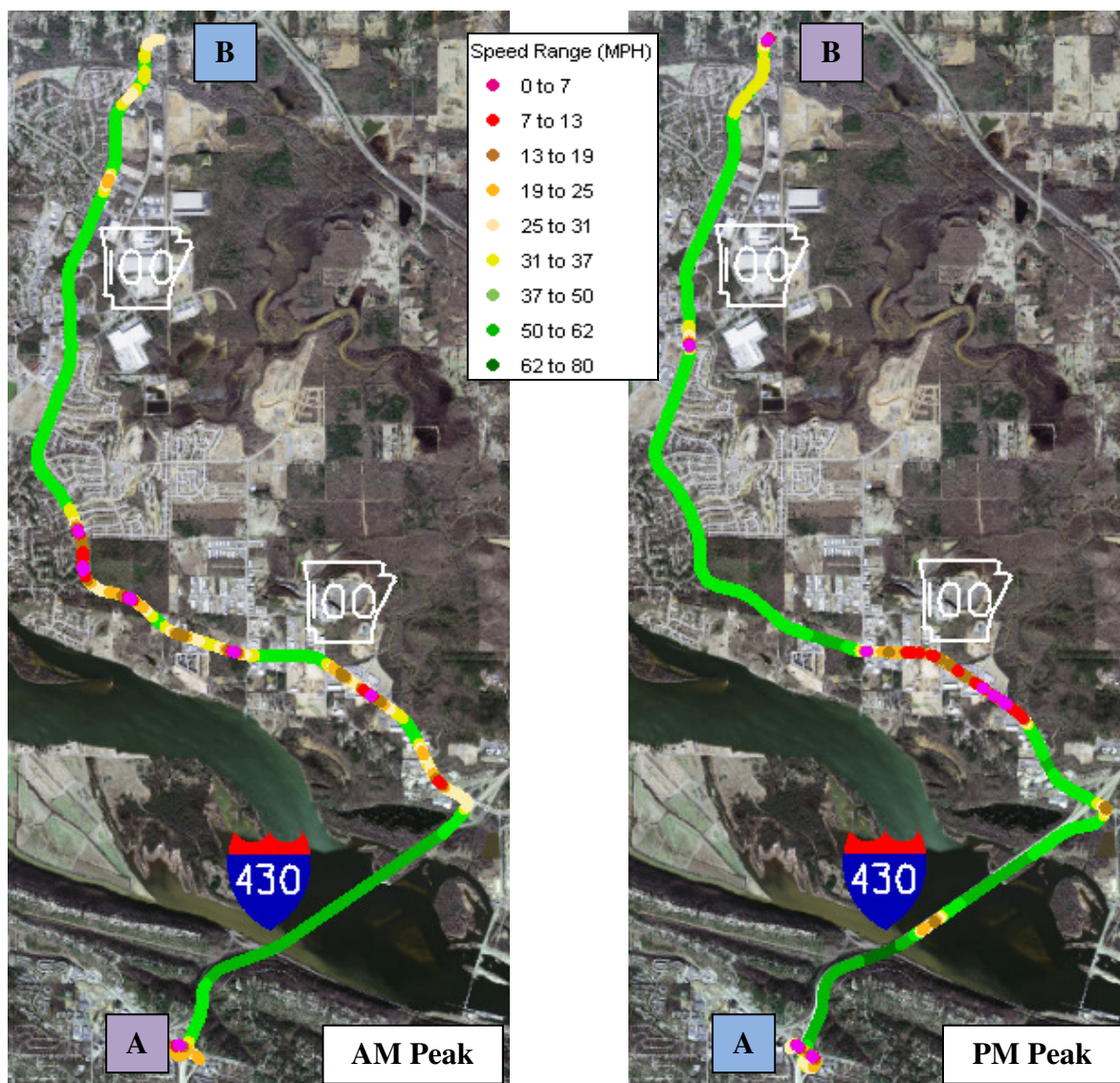


FIGURE 2.36: Route C-18- Highway 100/I-430 Speed Map
(A @ Hwy. 10, B @Hwy. 365)

2.2 Northwest Arkansas Area (NARTS)

The selected routes in the NARTS area are listed in Table.2.2.

Table 2.2. Selected Routes in NARTS Area

Route #	Route	From	To	Length (mile)
NW-1	Highway 71B	Peach Orchard Rd./ Co. Rd. 40	Hwy. 71B/8th Street/ Walnut Street	12.5
NW-2	Highway 102/62	Highway 279	Rogers Airport on Hwy 62	11.5
NW-3	Highway 412/265	Highway 112	Highway 45	12
NW-4	Highway 71B	Hwy. 71B/8th St./Walnut	Highway 412	11.5
NW-5	Highway 71B	Highway 412	Highway 16	8.5
NW-6	Highway 62/180	Prairie Grove	Highway 71B	12
NW-7	I-540/Highway 71	Hwy. 62/180 (6th St.)	Hwy. 71/Joyce Blvd. (U-turn)	7
NW-8	Hwy. 12/112	XNA Airport Road	Hwy. 102	10
NW-9	I-540	Highway 62/102	Highway 264	7
NW-10	Highway 16/112	Double Spring	Agri Park	6
NW-11	I-540	Highway 264	Highway 112	12

2.2.1 Route NW-1 –Highway 71B. Travel time data was collected during the morning and noon peak periods on 3/11/2008 and the afternoon peak period on 3/10/2008 for traveling on Highway 71B in both directions between Point A (County Road 40 in Benton County, AR) and Point B (Highway 71B/8th Street/Walnut Street in Rogers, AR). Figure 2.37 shows the 2008 ADT on the subject route and Figure 2.38 shows the worst AM and PM peak travel conditions.

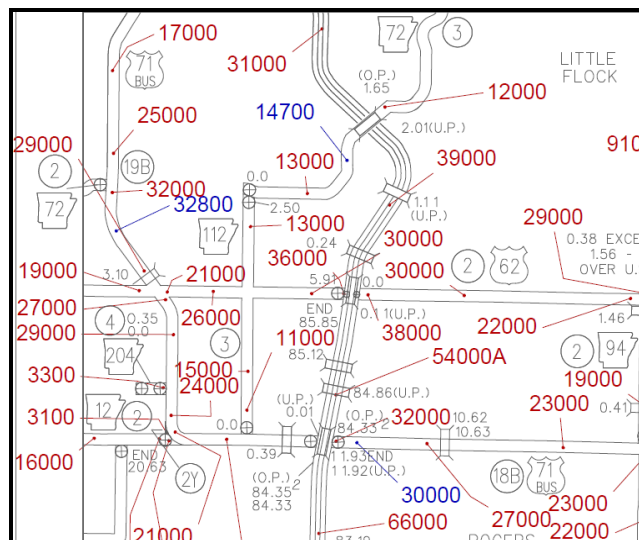


FIGURE 2.37: Route NW-1 - 2008 ADT (Benton County)

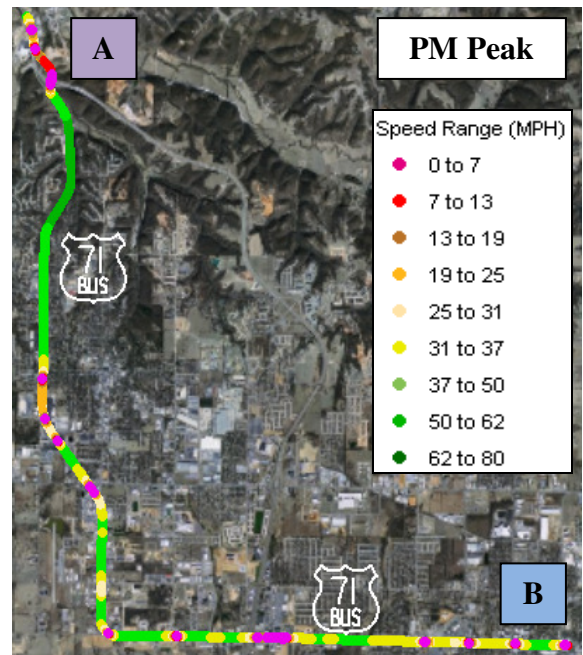
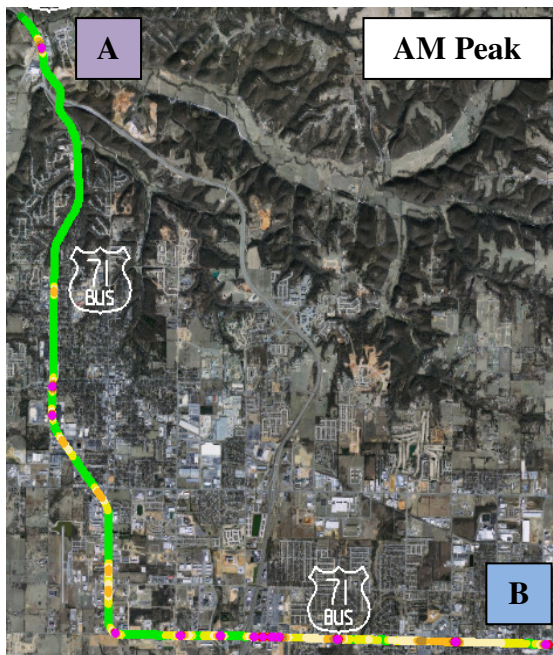
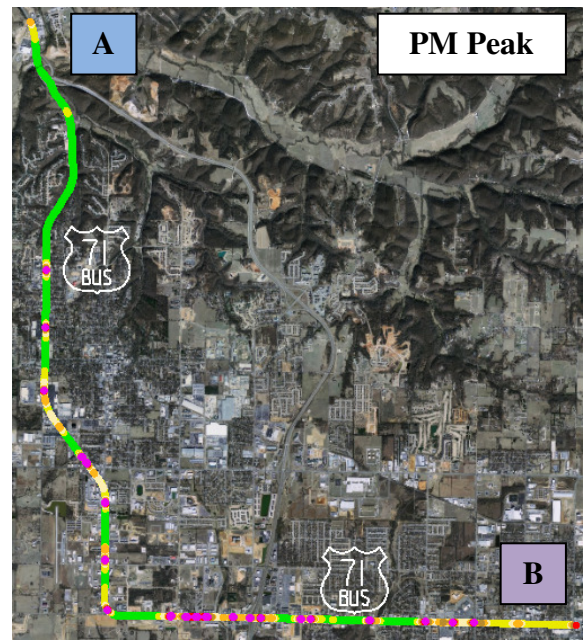


FIGURE 2.38: Route NW-1- Hwy. 71B Speed Map
(A @ Co. Rd. 40, B @Hwy. 71B/8th St./Walnut St.)

2.2.2 Route NW-2 –Highways 102/62. Travel time data was collected during the morning and noon peak periods on 3/12/2008 and the afternoon peak period on 3/11/2008 for traveling on Highways 102/62 in both directions between Point A (Highway 279 in Centerton, AR) and Point B (Rogers Airport in Rogers, AR). Figure 2.39 shows the 2008 ADT on the subject route and Figure 2.40 shows the worst AM and PM peak travel conditions.

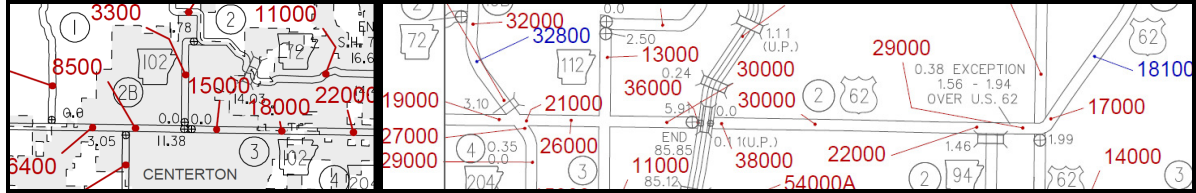


FIGURE 2.39: Route NW-2 - 2008 ADT (Benton County)

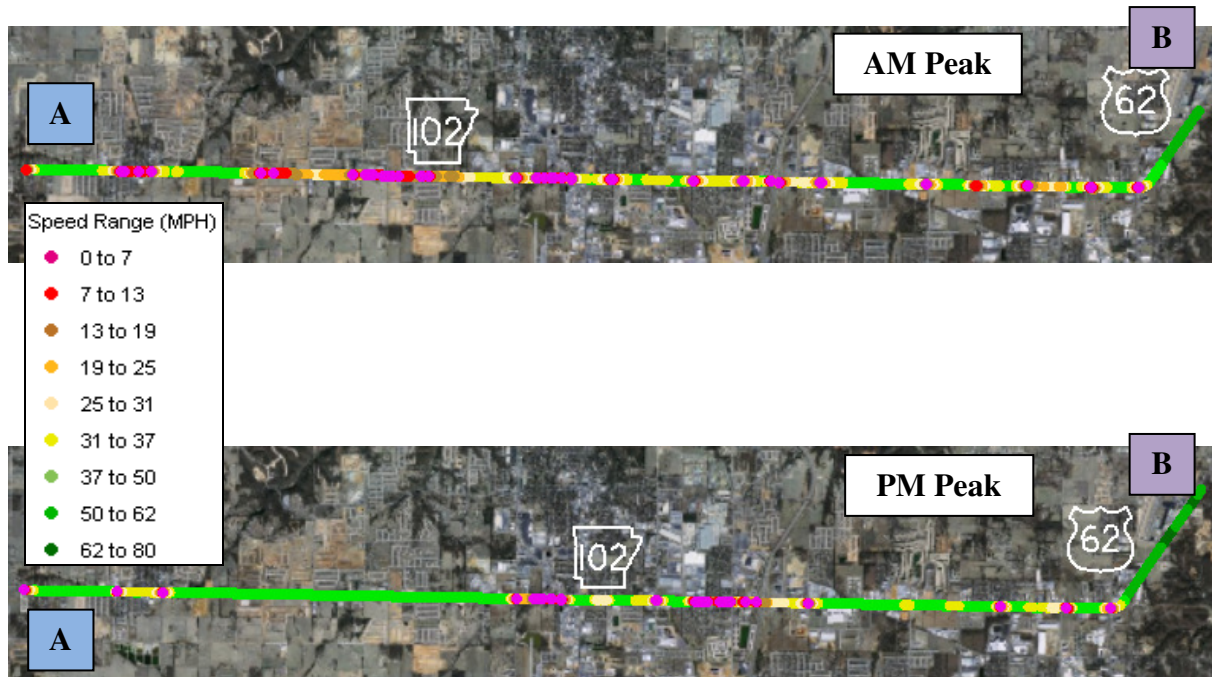


FIGURE 2.40: Route NW-2- Highways 102/62 Speed Map

(A @ Hwy. 279, B @Rogers Airport)

2.2.3 Route NW-3 –Highways 412/265. Travel time data was collected during the morning and noon peak periods on 3/14/2008 and the afternoon peak period on 3/13/2008 for traveling on Highways 412/265 in both directions between Point A (Highway 112 in Tontitown, AR) and Point B (Highway 45 in Fayetteville, AR). Figure 2.41 shows the 2008

ADT on the subject route and Figure 2.42 shows the worst AM and PM peak travel conditions.

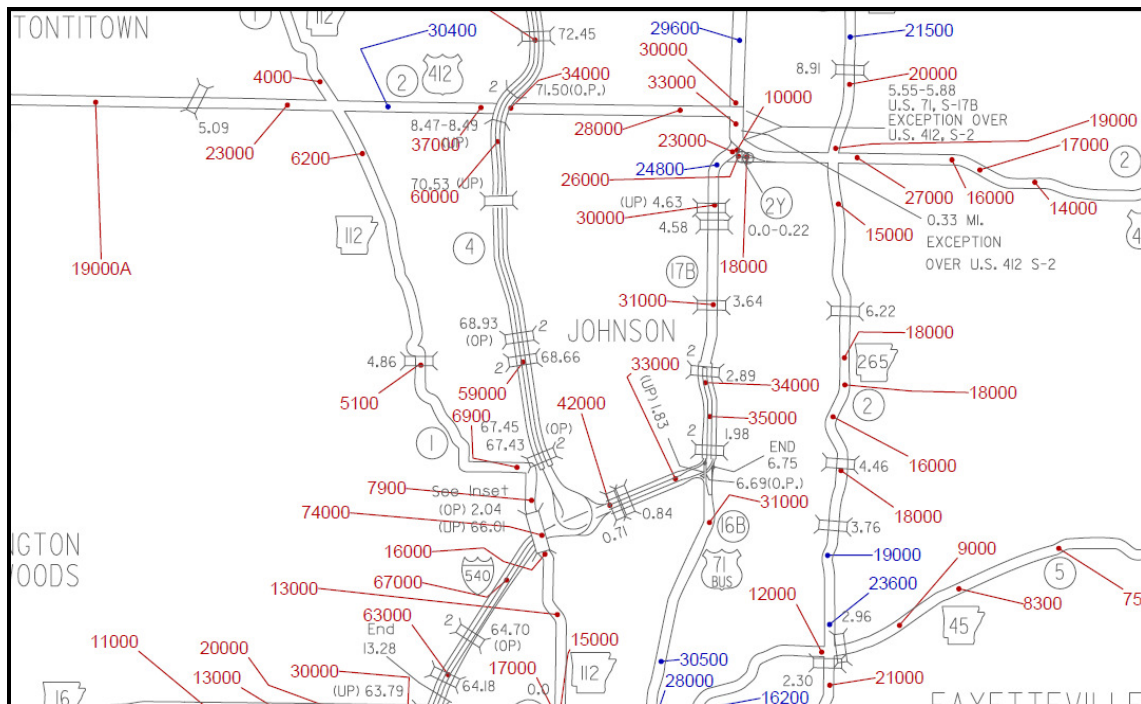


FIGURE 2.41: Route NW-3 - 2008 ADT (Washington County)

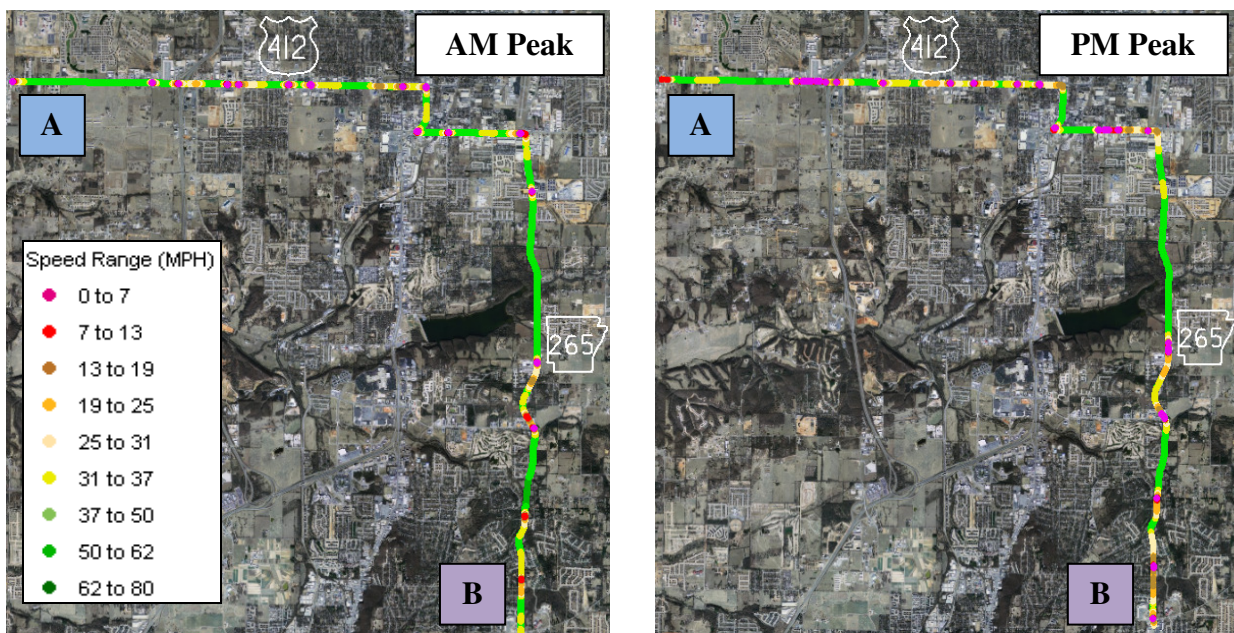


FIGURE 2.42: Route NW-3- Highways 412/265 Speed Map
(A @ Hwy. 112, B @Hwy. 45)

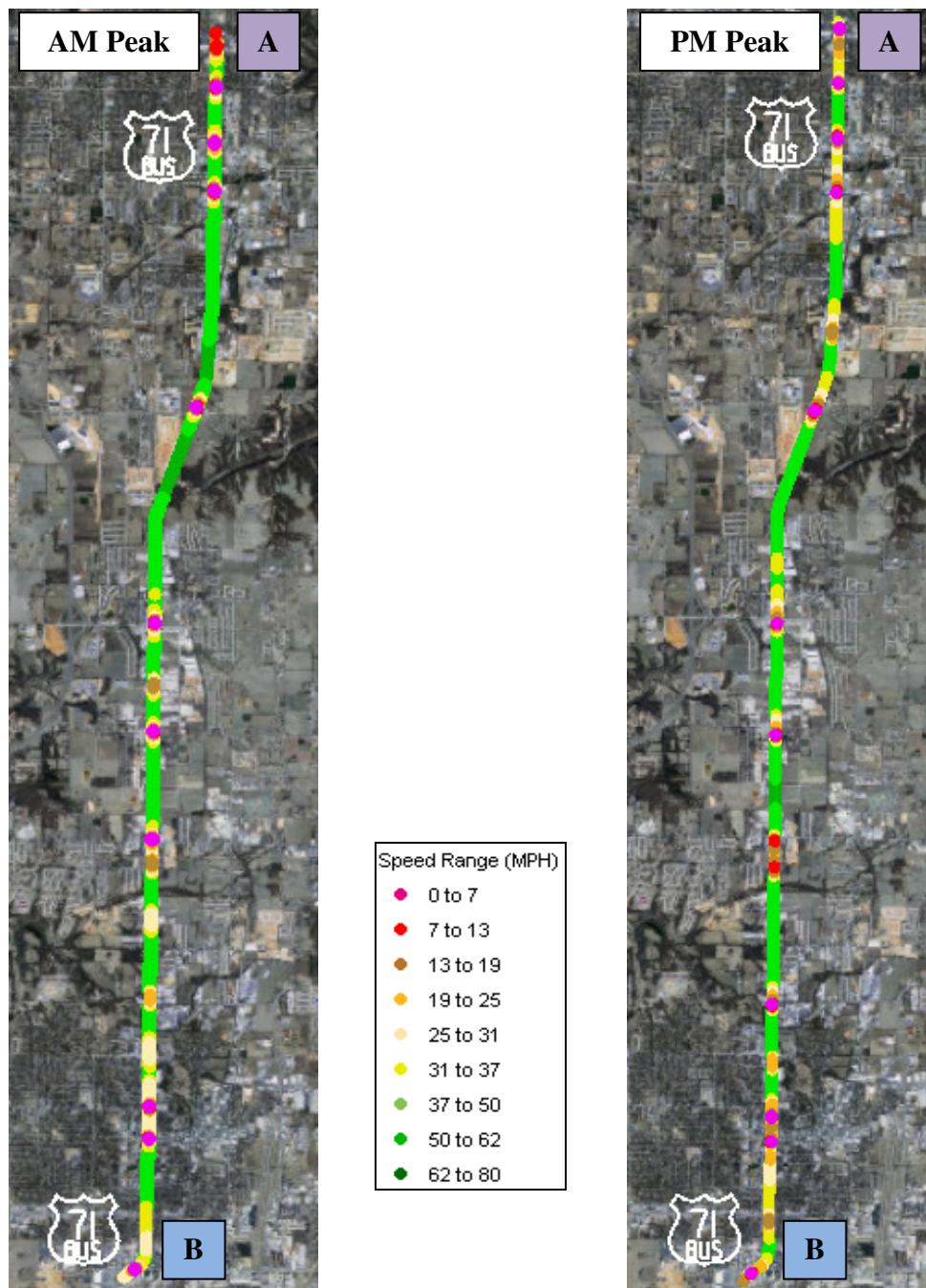


FIGURE 2.44: Route NW-4- Hwy. 71B Speed Map
(A @ Hwy. 71B/8th St/Walnut St., B @Hwy. 412)

2.2.5 Route NW-5 –Highway 71B. Travel time data was collected during the morning peak period on 4/9/2008 and the noon and afternoon peak periods on 4/8/2008 for traveling on Highway 71B in both directions between Point A (Highway 412 in Springdale,

AR) and Point B (Highway 16 in Fayetteville, AR). Figure 2.45 shows the 2008 ADT on the subject route and Figure 2.46 shows the worst Noon and PM peak travel conditions.

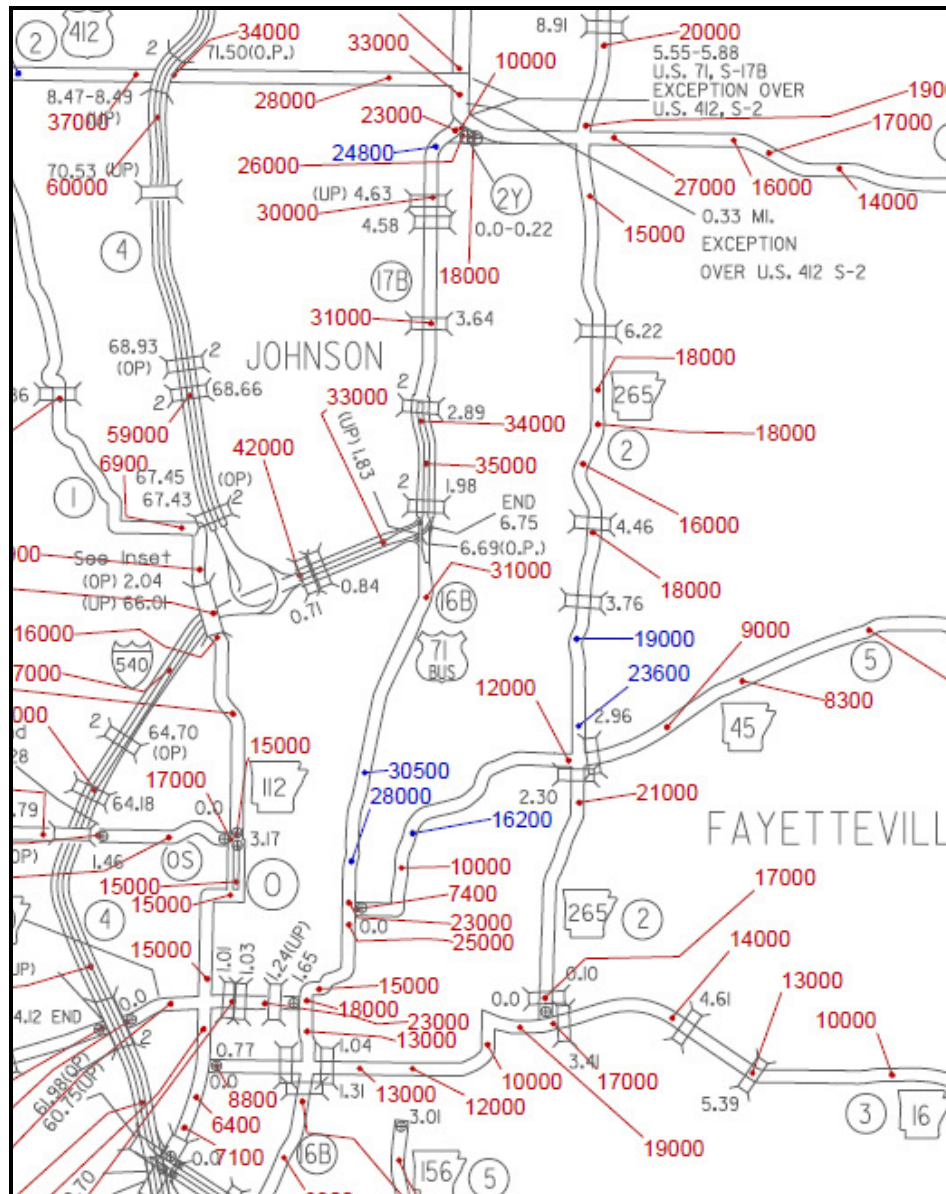


FIGURE 2.45: Route NW-5 - 2008 ADT (Washington County)

2.2.6 Route NW-6 –Highways 62/108. Travel time data was collected during the morning peak period on 4/10/2008 and the noon and afternoon peak periods on 4/9/2008 for traveling on Highways 62/108 in both directions between Point A (Prairie Grove, AR) and Point B (Highway 71B in Fayetteville, AR). Figure 2.47 shows the 2008 ADT on the subject route and Figure 2.48 shows the worst AM and PM peak travel conditions.

FIGURE 2.47: Route NW-6 - 2008 ADT (Washington County)

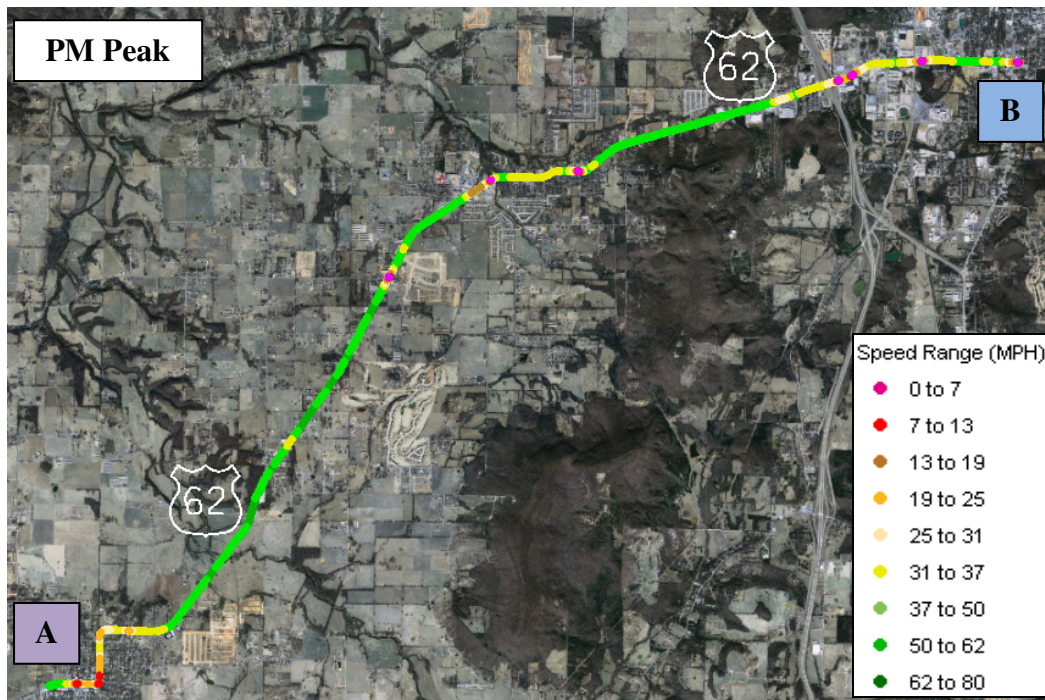
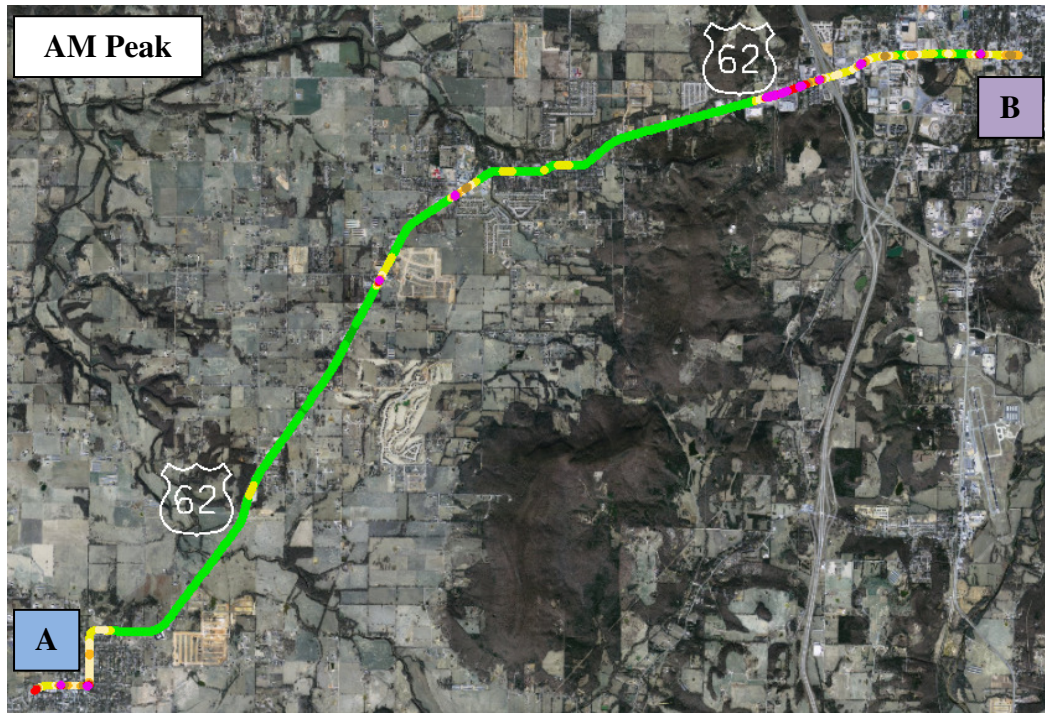


FIGURE 2.48: Route NW-6- Highways 62/180 Speed Map
(A @ Prairie Grove, B @Hwy. 71B)

2.2.7 Route NW-7 –I-540/Highway 71. Travel time data was collected during the morning peak period on 4/11/2008 and the noon and afternoon peak periods on 4/10/2008 for traveling on I-540/Highway 71 in both directions between Point A (Highways 62/180 in Fayetteville, AR) and Point B (Highway 71B/Joyce Blvd. in Fayetteville, AR). Figure 2.49 shows the 2008 ADT on the subject route and Figure 2.50 shows the worst AM and PM peak travel conditions.

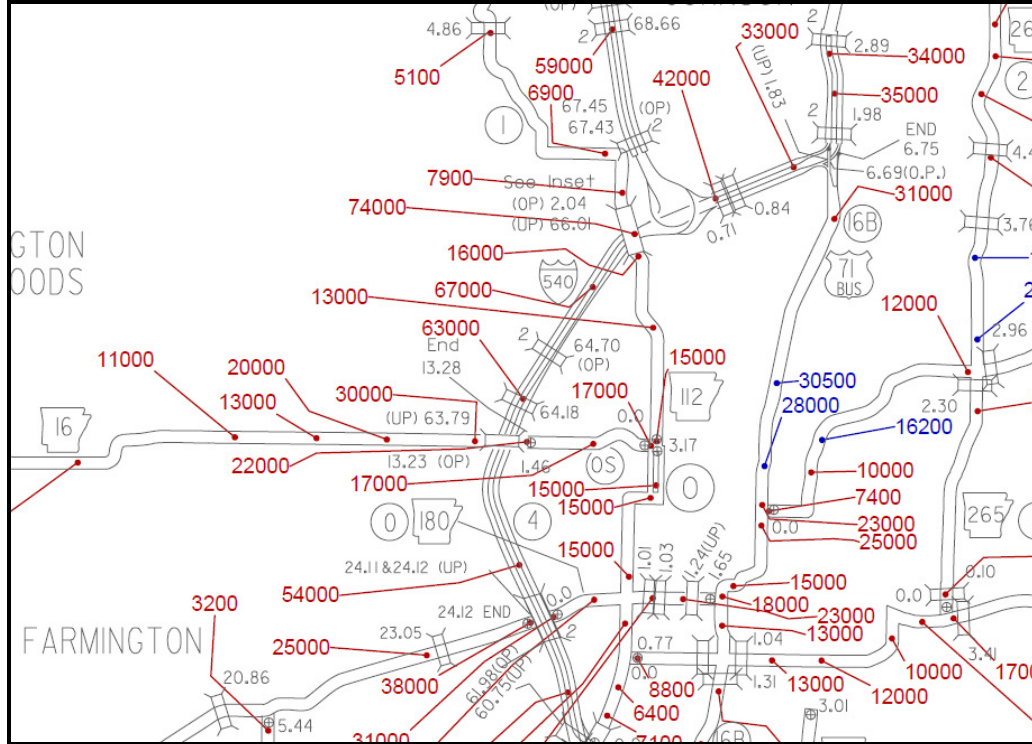


FIGURE 2.49: Route NW-7 - 2008 ADT (Washington County)

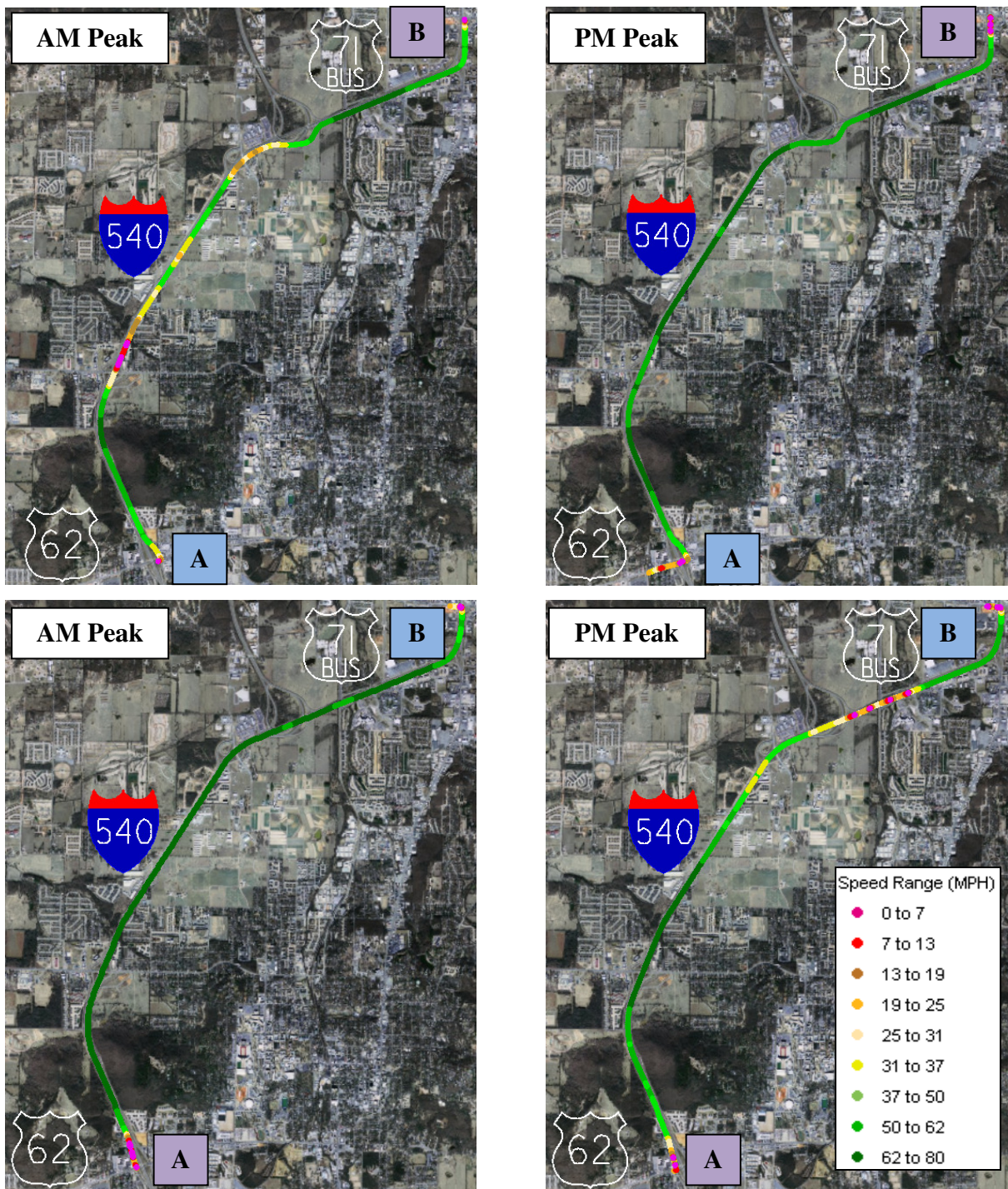
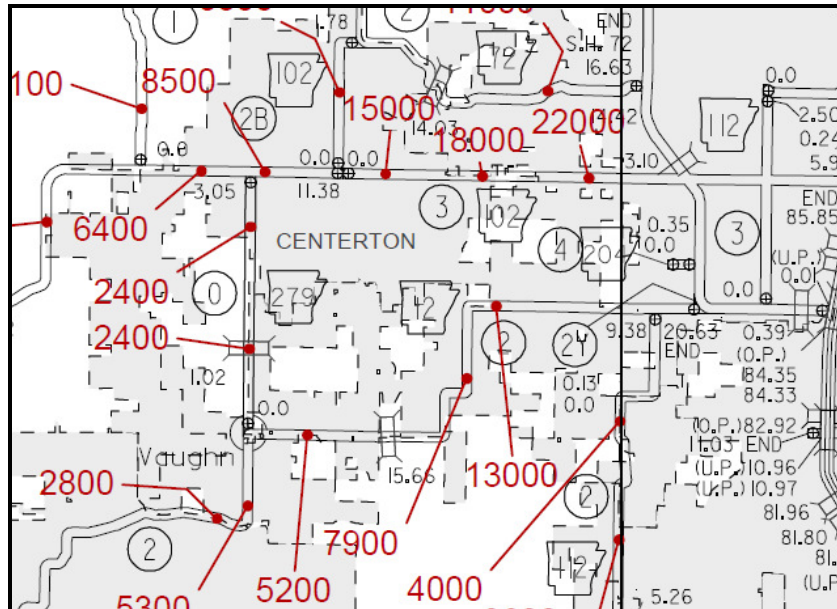


FIGURE 2.50: Route NW-7- I-540/Hwy. 71 Speed Map

(A @ Hwy. 62/180, B @Hwy. 71B/Joyce Blvd.)

2.2.8 Route NW-8 –Highways 12/112. Travel time data was collected during the morning peak period on 4/8/2008 and the noon and afternoon peak periods on 4/7/2008 for

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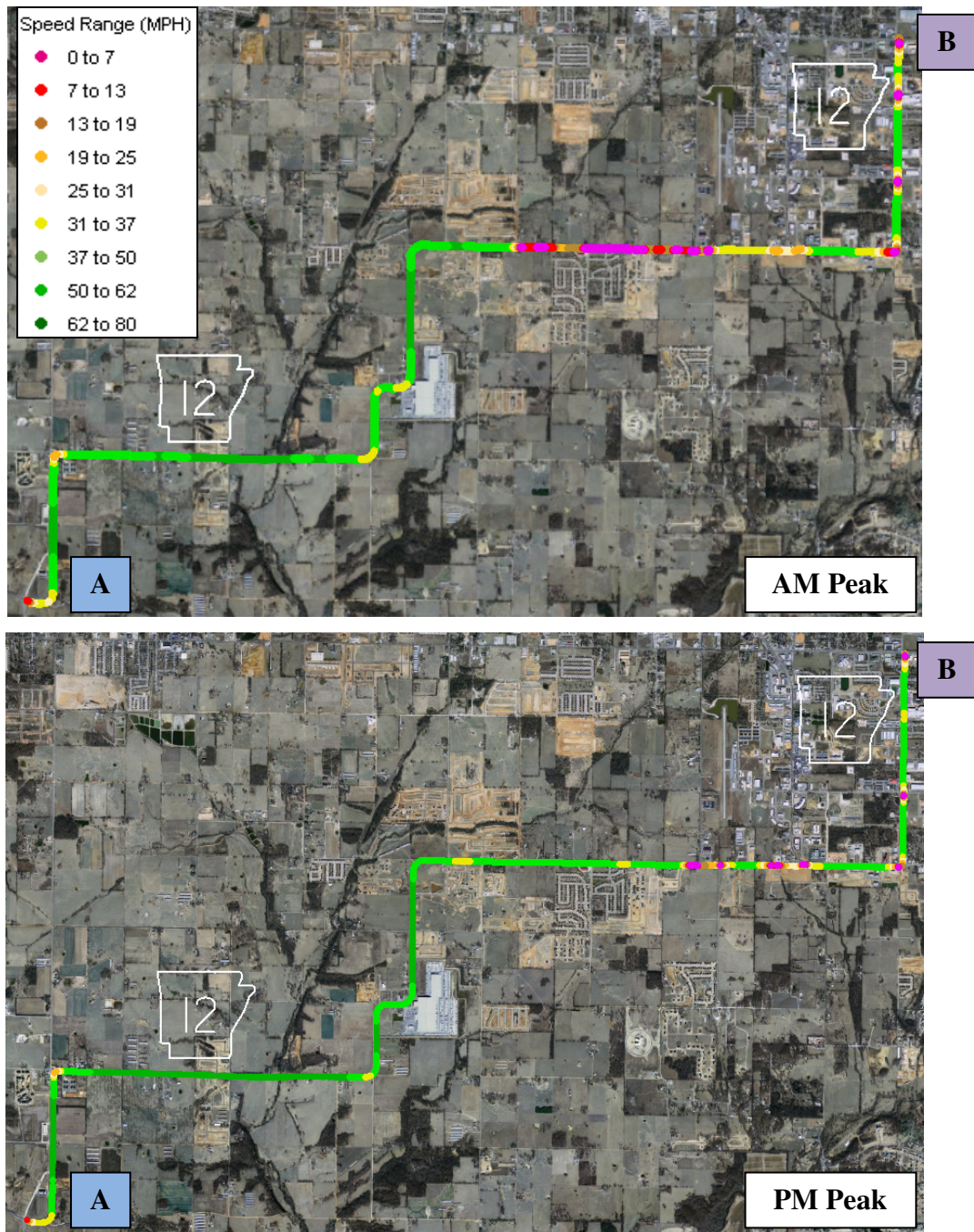


FIGURE 2.52: Route NW-8- Highways 12/112 Speed Map

(A @ XNA Airport Rd., B @Hwy. 102)

2.2.9 Route NW-9 – I-540. Travel time data was collected during the morning peak period on 4/29/2008 and the afternoon peak period on 4/28/2008 for traveling on I-540 in both directions between Point A (Highways 16/102 in Bentonville, AR) and Point B

(Highway 264 in Lowell, AR). Figure 2.53 shows the 2008 ADT on the subject route and Figure 2.54 shows the worst AM and PM peak travel conditions.

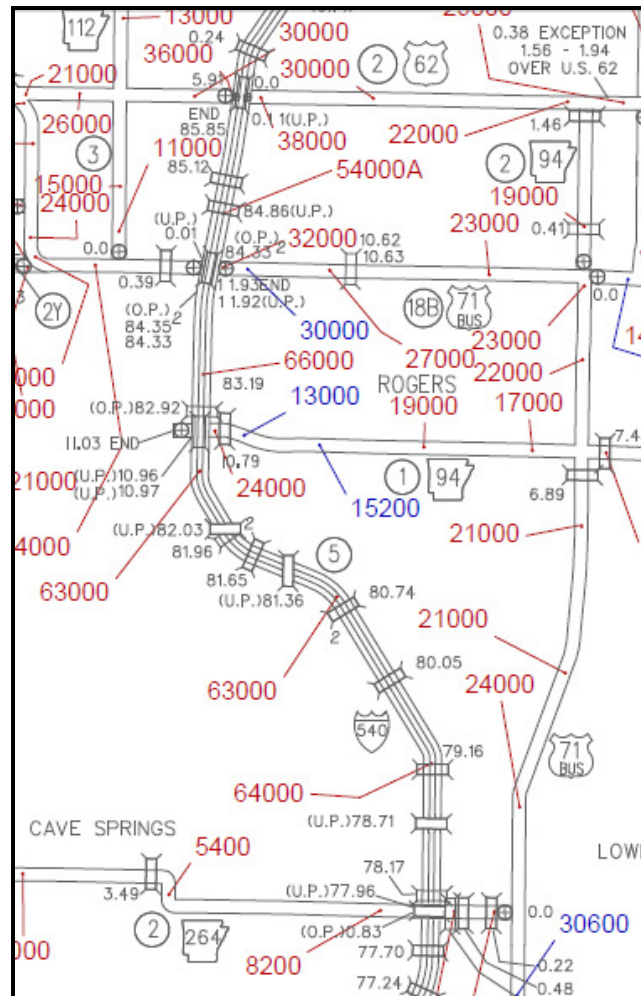


FIGURE 2.53: Route NW-9 - 2008 ADT (Benton County)

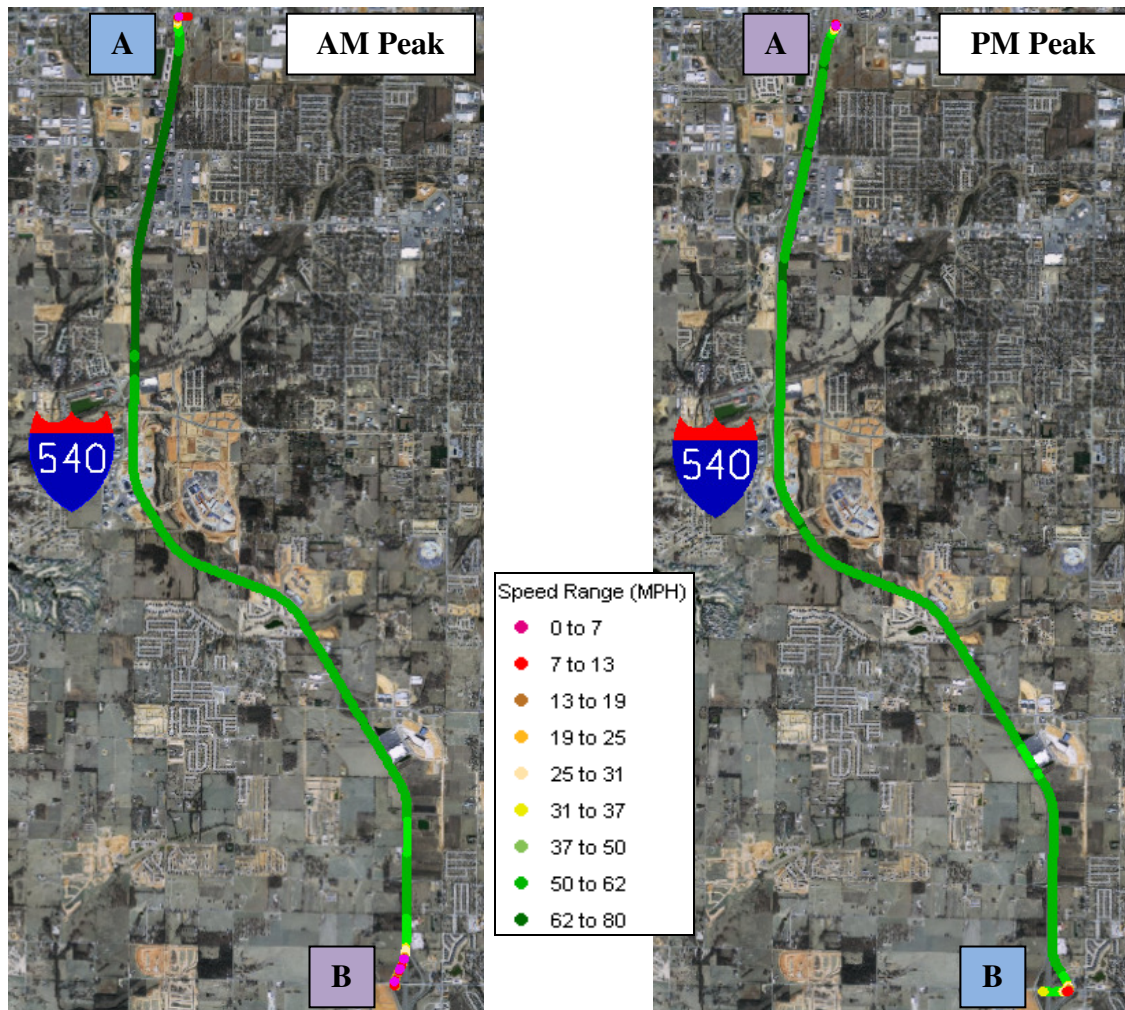


FIGURE 2.54: Route NW-9- I-540 Speed Map
(A @ Hwy. 16/102., B @Hwy. 264)

2.2.10 Route NW-10 – Highways 16/112. Travel time data was collected during the morning peak period on 4/30/2008 and the noon and afternoon peak periods on 4/29/2008 for traveling on Highways 16/112 in both directions between Point A (Double Springs Road in Fayetteville, AR) and Point B (Agri Park in Fayetteville, AR). Figure 2.55 shows the 2008 ADT on the subject route and Figure 2.56 shows the worst AM and PM peak travel conditions.

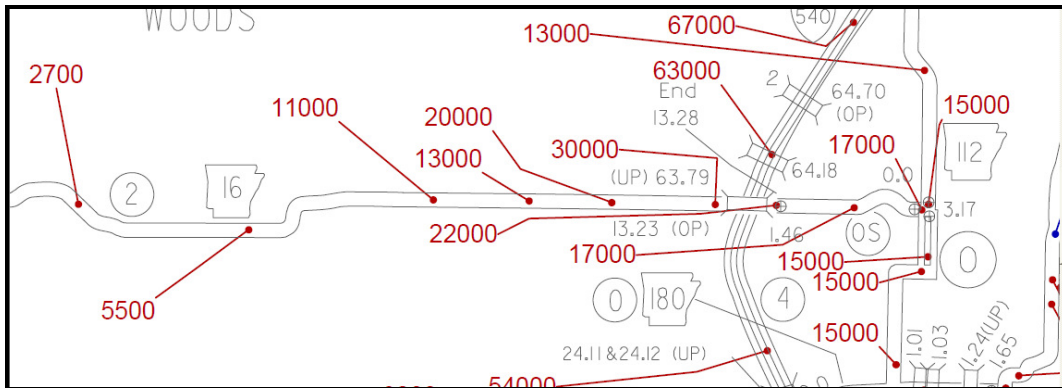


FIGURE 2.55: Route NW-10 - 2008 ADT (Washington County)

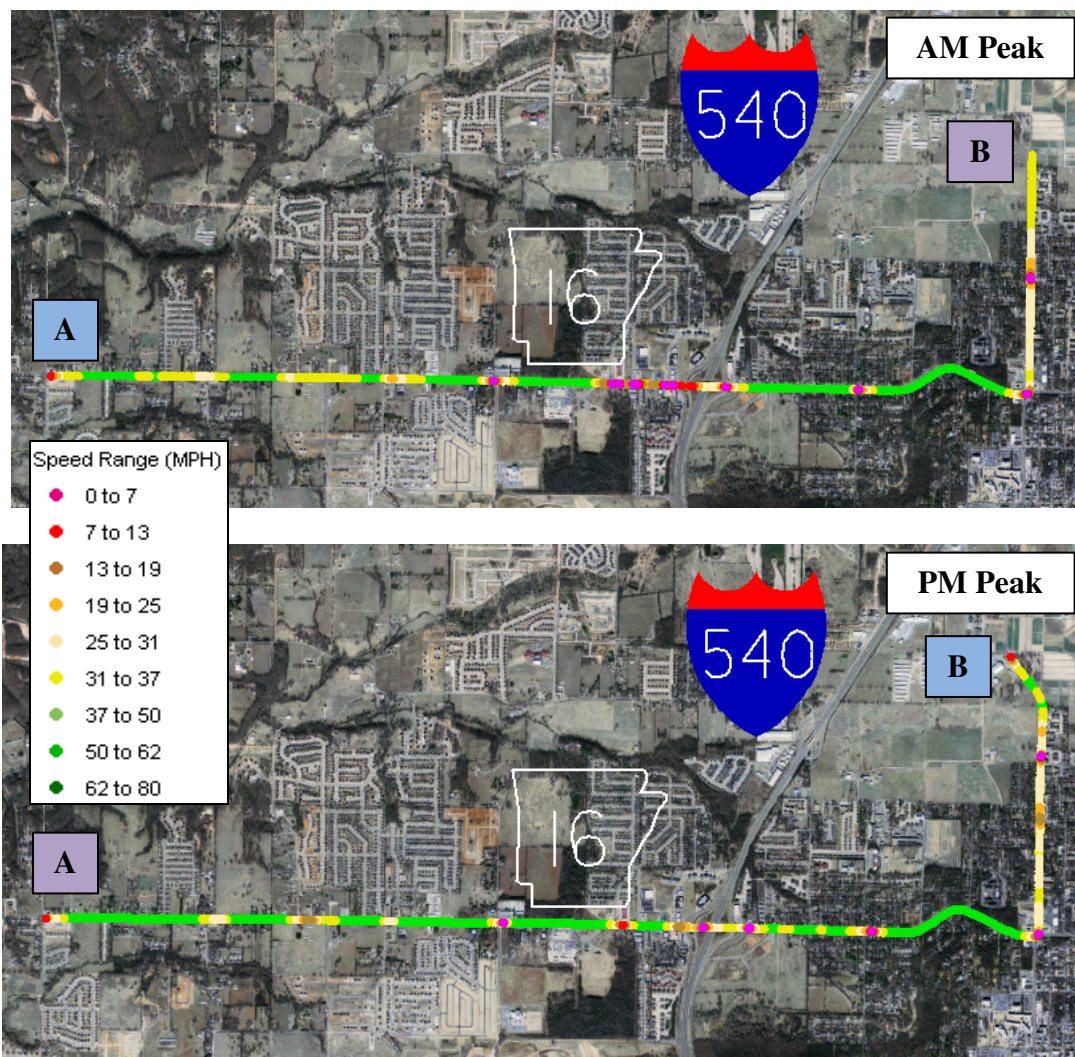


FIGURE 2.56: Route NW-10- Highway 16/112 Speed Map

(A @ Double Springs Rd., B @ Agri Park)

[illegible]

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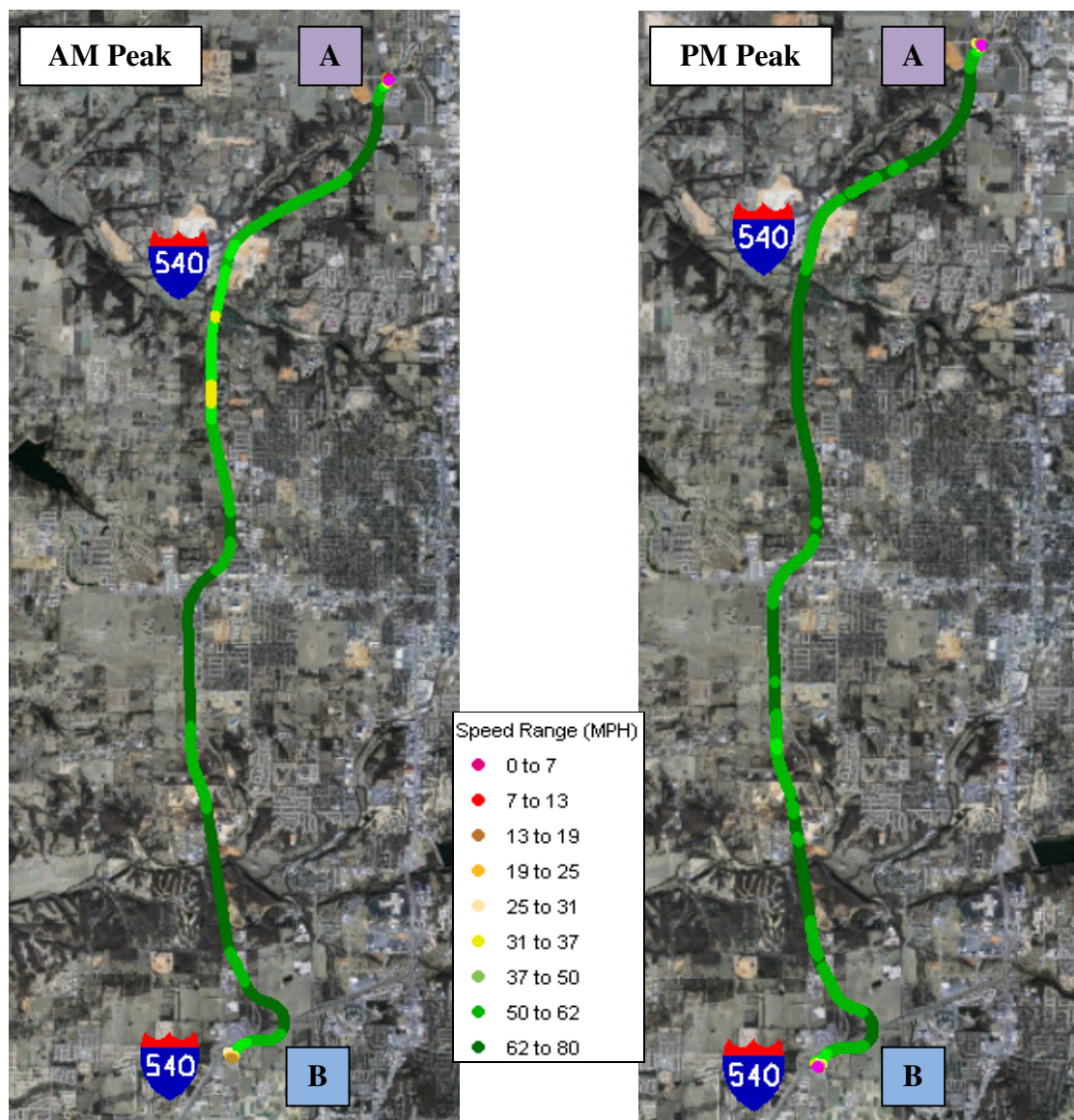


FIGURE 2.58: Route NW-11- I-540 Speed Map

(A @ Hwy. 264, B @Hwy. 112)

2.3 Hot Springs Area (HSATS)

The selected routes in the HSATS area are listed in Table.2.3.

Table 2.3. Selected Routes in HSATS Area

Route #	Route	From	To	Length (mile)
HS-1	Highways 7/88	Highway 7	Highway 290	6
HS-2	Highway 7 (Central Ave.)	Highway 88	Fountain Street	6
HS-3	Highways 7/5	Highway 7 S	Highway 128	8
HS-4	Highway 70B/270B	Phillips Street	Meadow Creek Ln.	11
HS-5	Highway 128	Highway 290	Highway 270B	4.5
HS-6	Highway 70/270	Highway 270B	Highway 70B	13

2.3.1 Route HS-1 – Highways 7/88. Travel time data was collected during the morning peak period on 6/11/2008, the noon peak period on 6/10/10, and the afternoon peak period on 6/9/2008 for traveling on Highways 7/88 in both directions between Point A (Highway 7) and Point B (Highway 290). Figure 2.59 shows the 2008 ADT on the subject route and Figure 2.60 shows the worst AM and PM peak travel conditions.

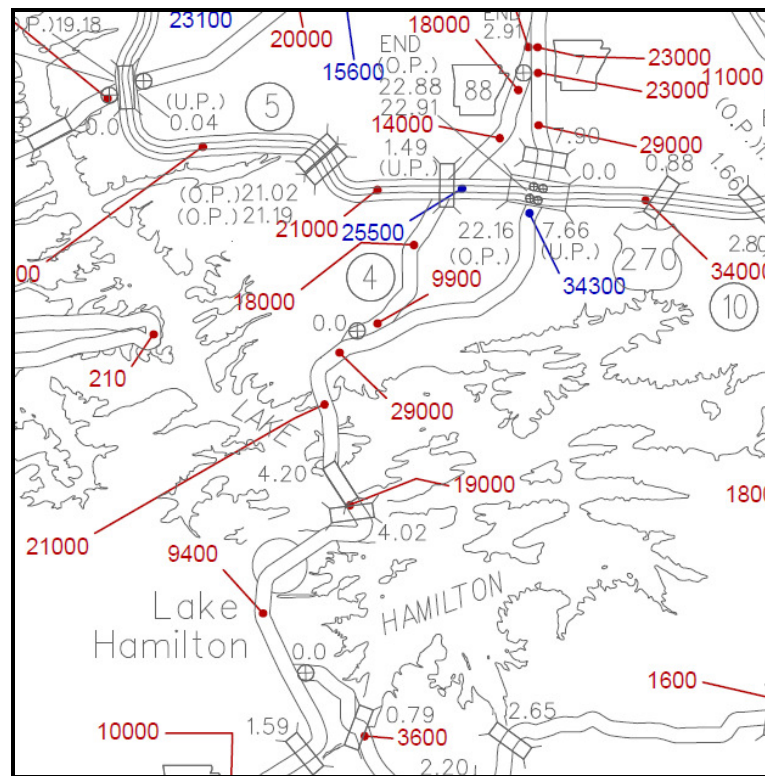


FIGURE 2.59: Route HS-1 - 2008 ADT (Garland County)

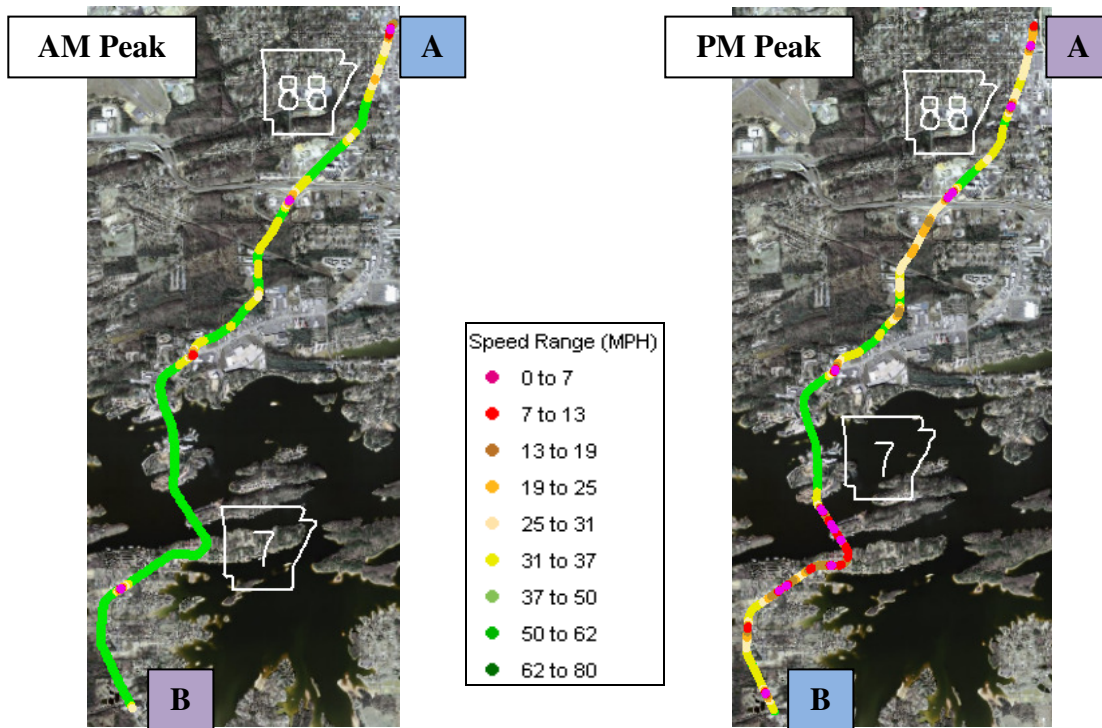


FIGURE 2.60: Route HS-1 - Highways 7/88 Speed Map
(A @ Hwy. 7, B @Hwy. 290)

2.3.2 Route HS-2 – Highway 7. Travel time data was collected during the morning peak period on 6/12/2008 and the noon and afternoon peak periods on 6/11/2008 for traveling on Highway 7 in both directions between Point A (Highway 88) and Point B (Fountain Street). Figure 2.61 shows the 2008 ADT on the subject route and Figure 2.62 shows the worst AM, Noon and PM peak travel conditions.

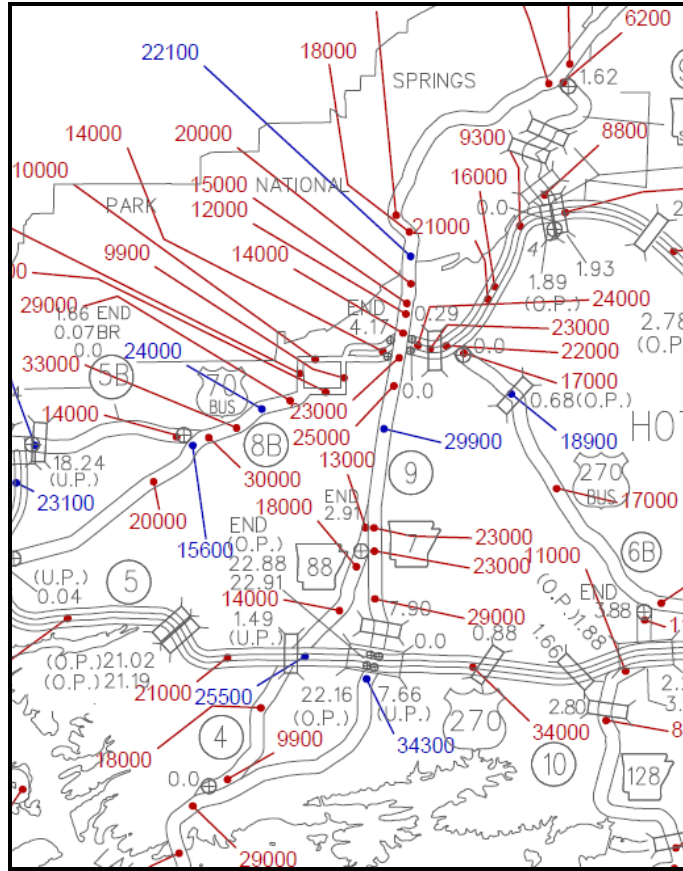


FIGURE 2.61: Route HS-2 - 2008 ADT (Garland County)

2.3.3 Route HS-3 – Highway 7. Travel time data was collected during the morning peak period on 6/13/2008 and the noon and afternoon peak periods on 6/12/2008 for traveling on Highway 7 in both directions between Point A (Highway 70) and Point B (Highway 5). Figure 2.63 shows the 2008 ADT on the subject route and Figure 2.64 shows the worst Noon peak travel conditions.

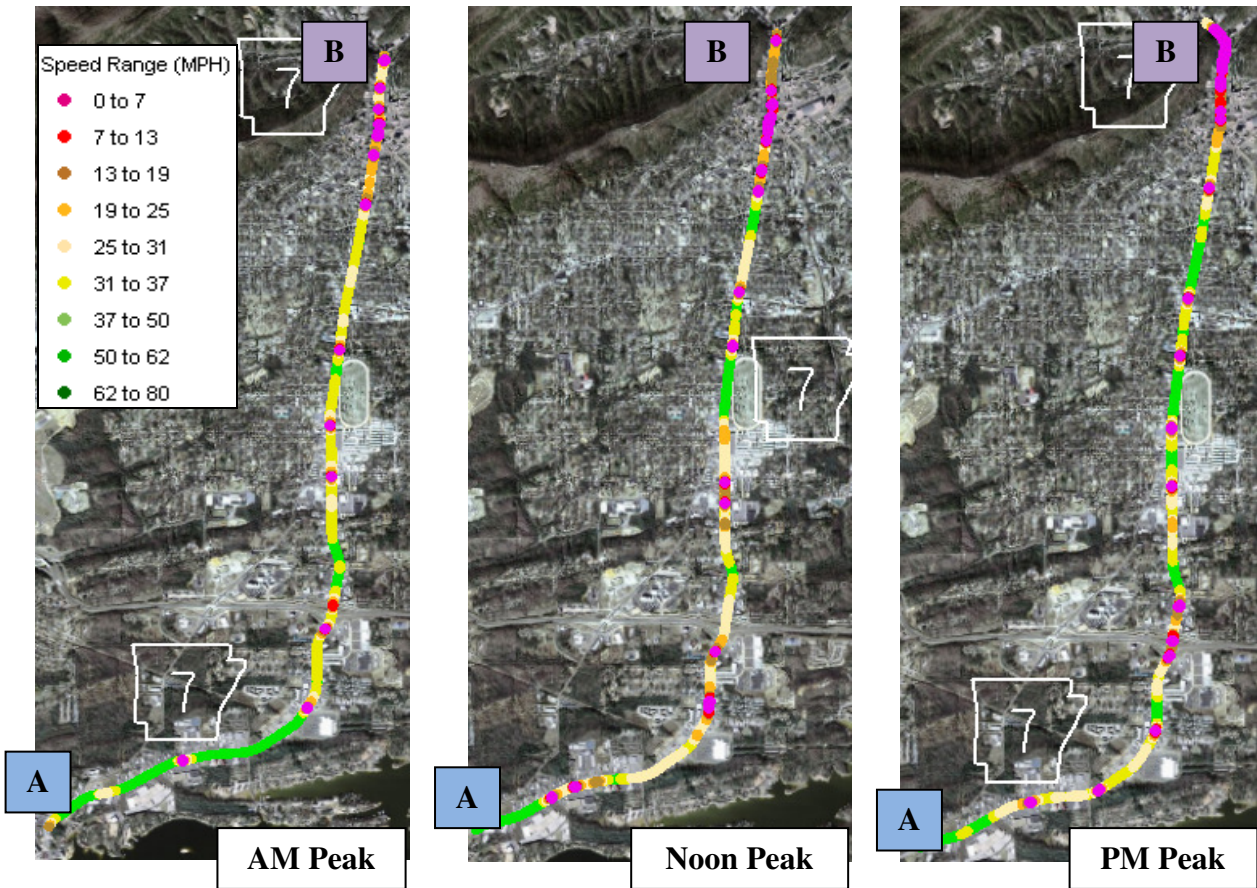
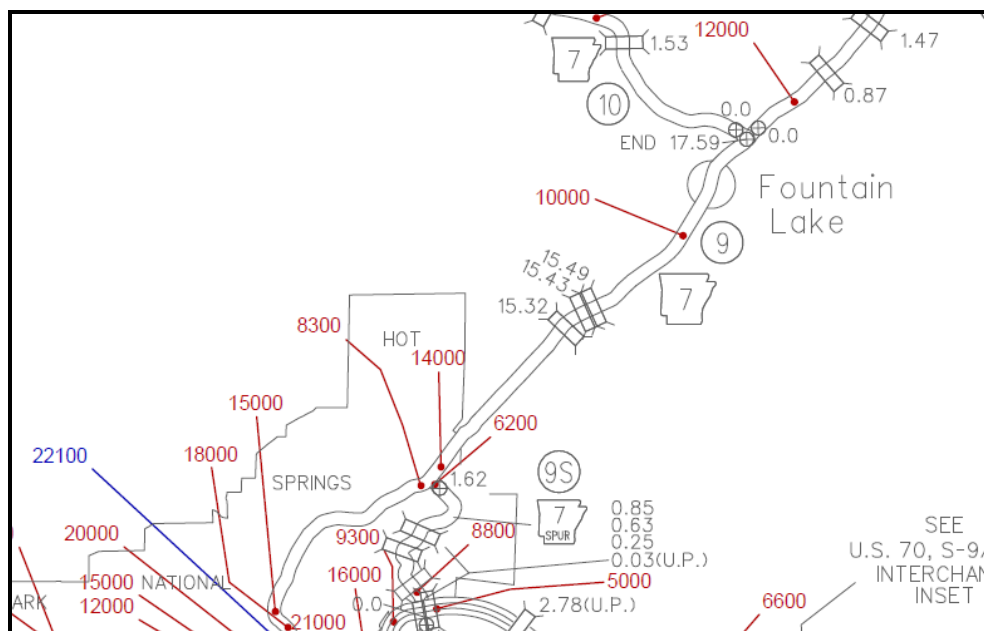


FIGURE 2.62: Route HS-2 - Highway 7 Speed Map
(A @ Hwy. 88, B @Fountain Street)



(A @ Hwy. 70, B @Hwy. 5)

[illegible]

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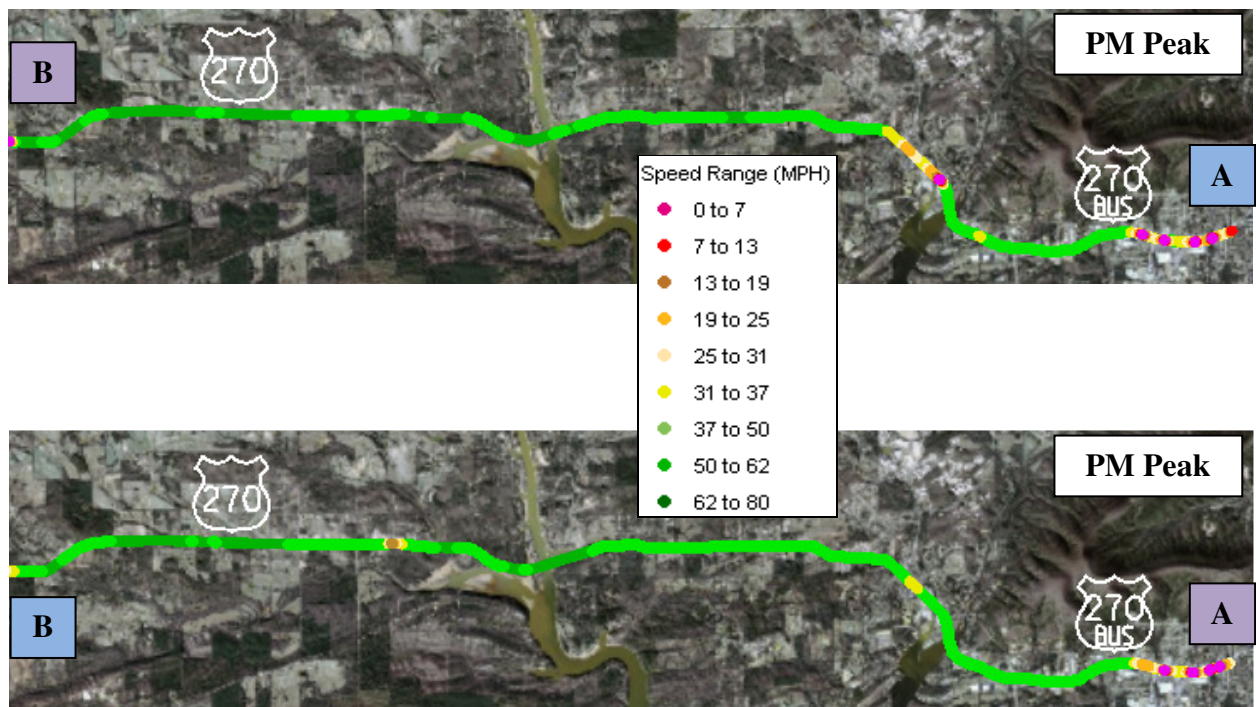


FIGURE 2.66: Route HS-4 - Highways 70B/270 Speed Map
(A @ Phillips St., B @Meadow Creek Ln.)

2.3.5 Route HS-5 – Highway 128. Travel time data was collected during the morning and noon peak periods on 6/25/2008 and the afternoon peak period on 6/24/2008 for traveling on Highway 128 in both directions between Point A (Highway 290) and Point B (Highway 270B). Figure 2.67 shows the 2008 ADT on the subject route and Figure 2.68 shows the worst AM and PM peak travel conditions.

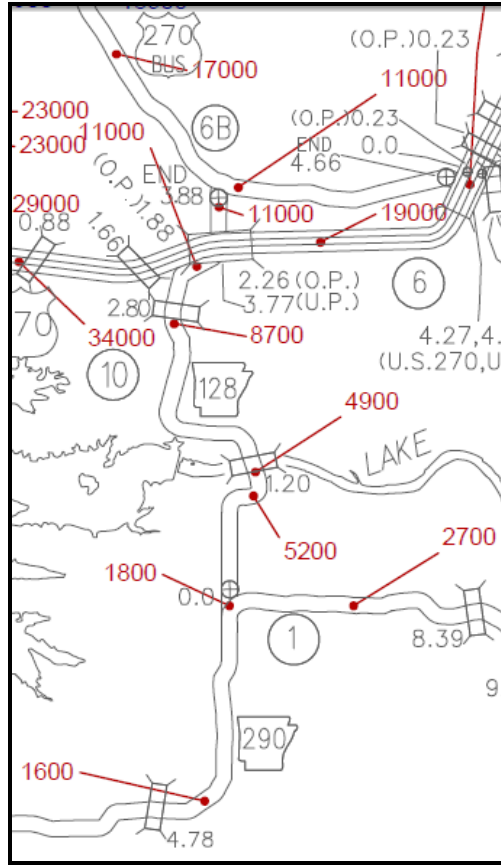


FIGURE 2.67: Route HS-5 - 2008 ADT (Garland County)

2.3.6 Route HS-6 – Highways 70/270. Travel time data was collected during the morning peak period on 6/26/2008 and the afternoon peak period on 6/25/2008 for traveling on Highways 70/270 in both directions between Point A (Highway 270B) and Point B (Highway 70B). Figure 2.69 shows the 2008 ADT on the subject route and Figure 2.70 shows the worst AM and PM peak travel conditions.

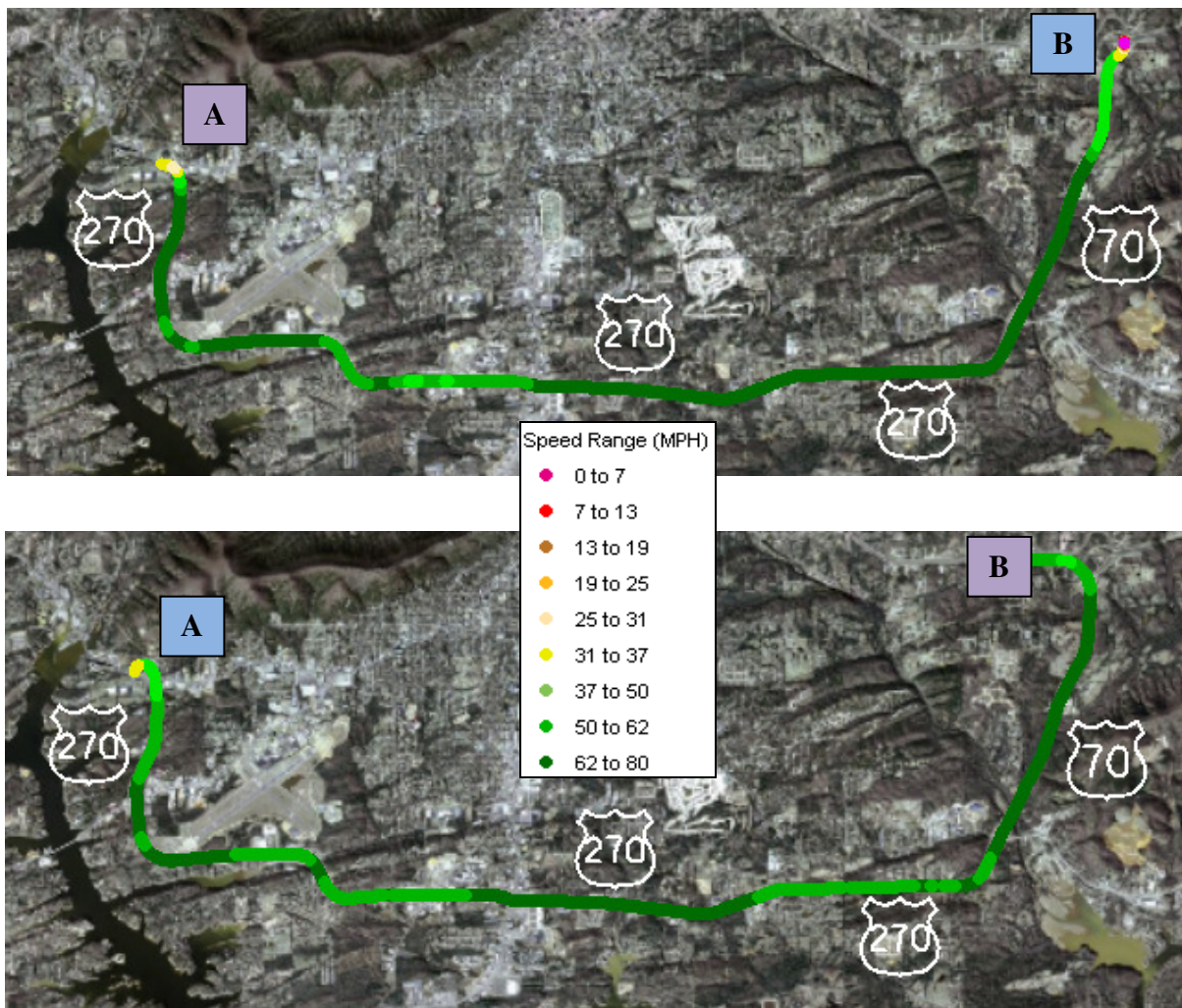


FIGURE 2.70: Route HS-6 - Highways 70/270 Speed Map
(A @ Highway 270B, B @ Highway 70B)

CHAPTER 3 DATA COLLECTION (PART II)

For Part II of the Data Collection Program, small commuter GPS devices containing a data storage unit were distributed to volunteers who commute from various communities to Little Rock. An example of the GPS device used is shown below.



FIGURE 3.1: Commuter GPS Device

Data were collected during the peak periods from/to the following communities:

- Maumelle
- Cabot
- Benton/Bryant
- Conway
- Pine Bluff/Sheridan
- Lonoke

3.1 Maumelle

Travel time data was collected from October 2007 through February 2008. The travel time data was recorded during the AM peak periods from Maumelle to Southwest Little Rock and the PM peak periods from Southwest Little Rock to Maumelle. The progression of congestion during the morning and afternoon peak periods are shown in Figures 3.2 and 3.3.

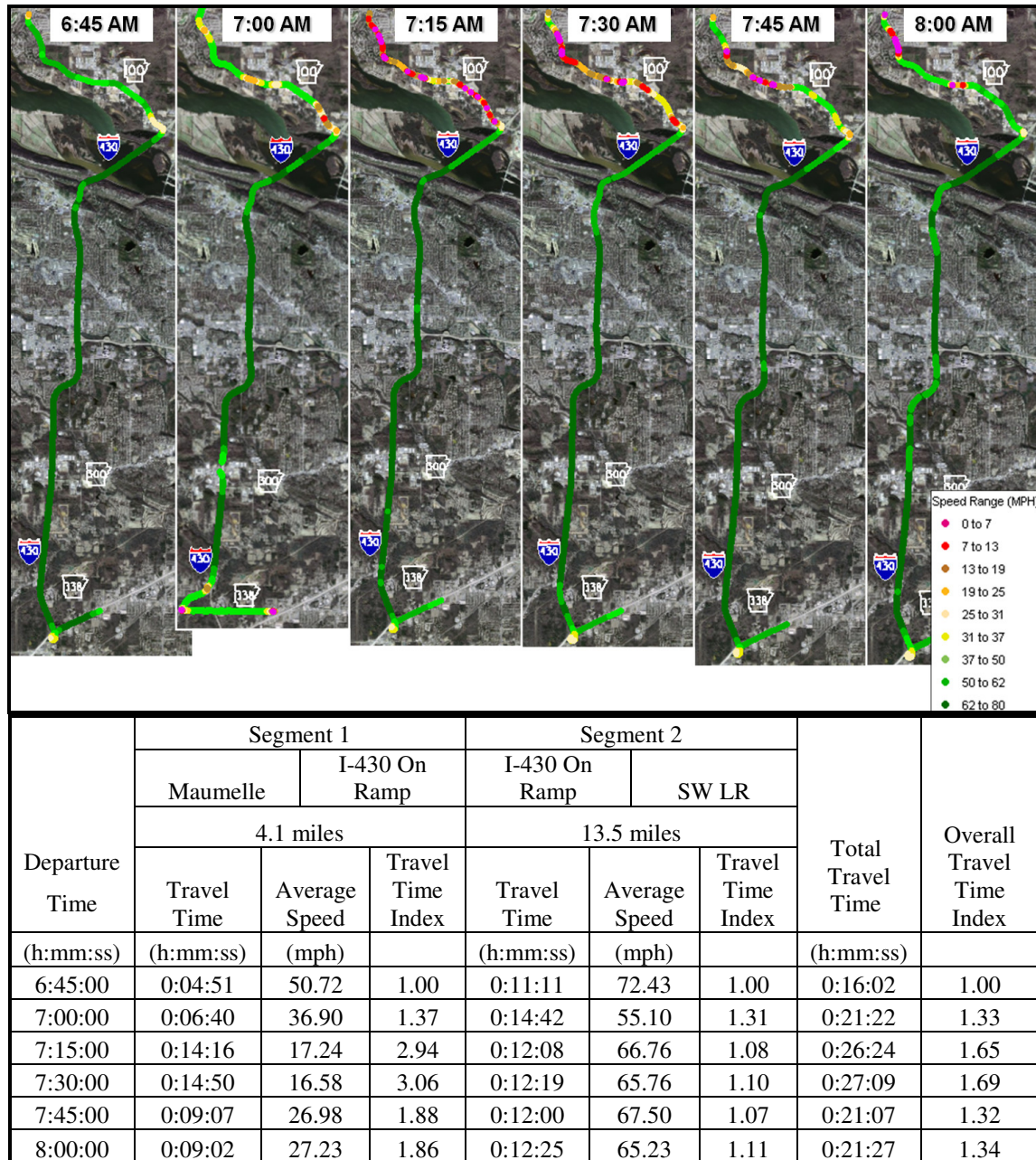


FIGURE 3.2: Maumelle-SW LR (AM Peak)

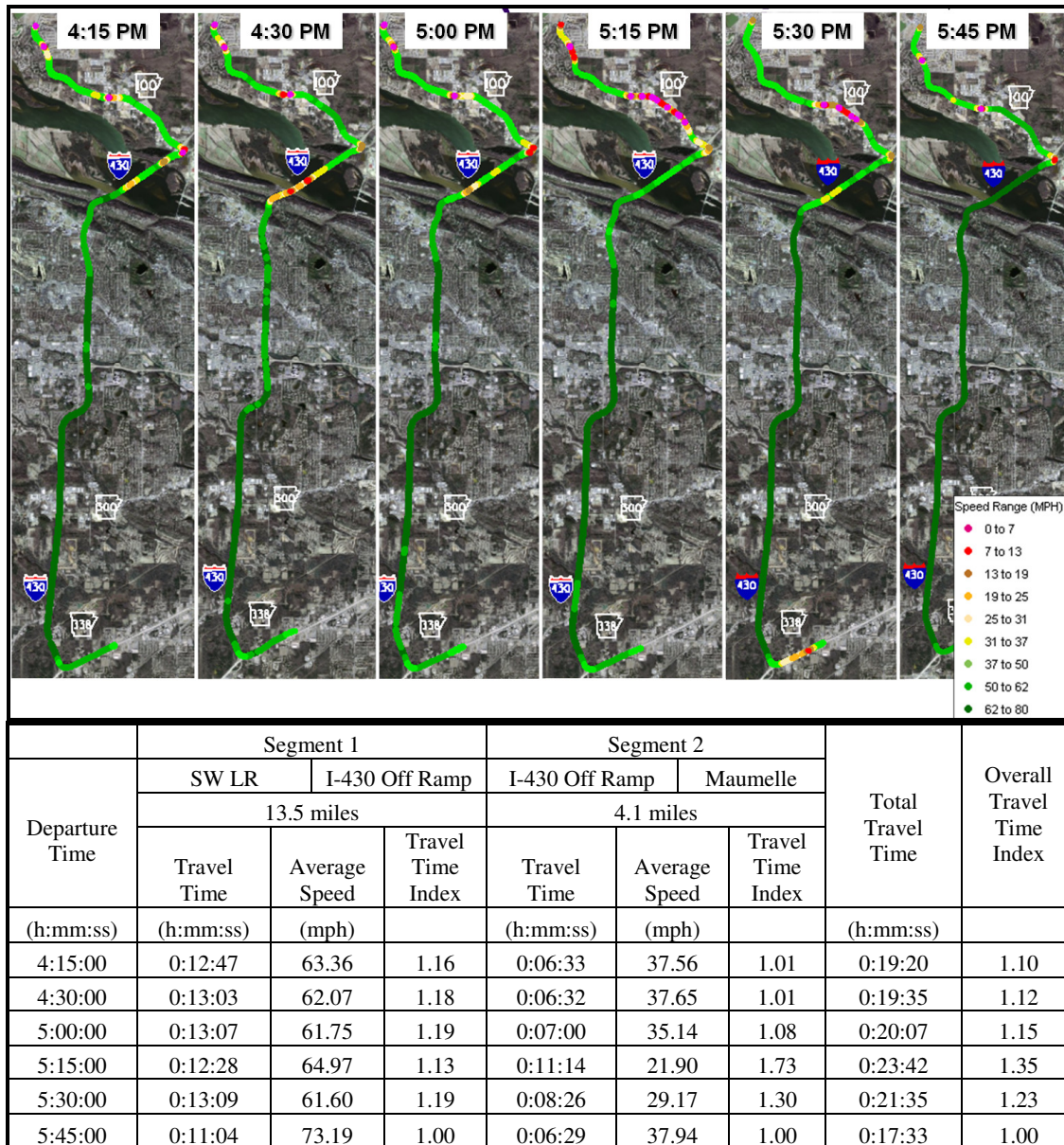
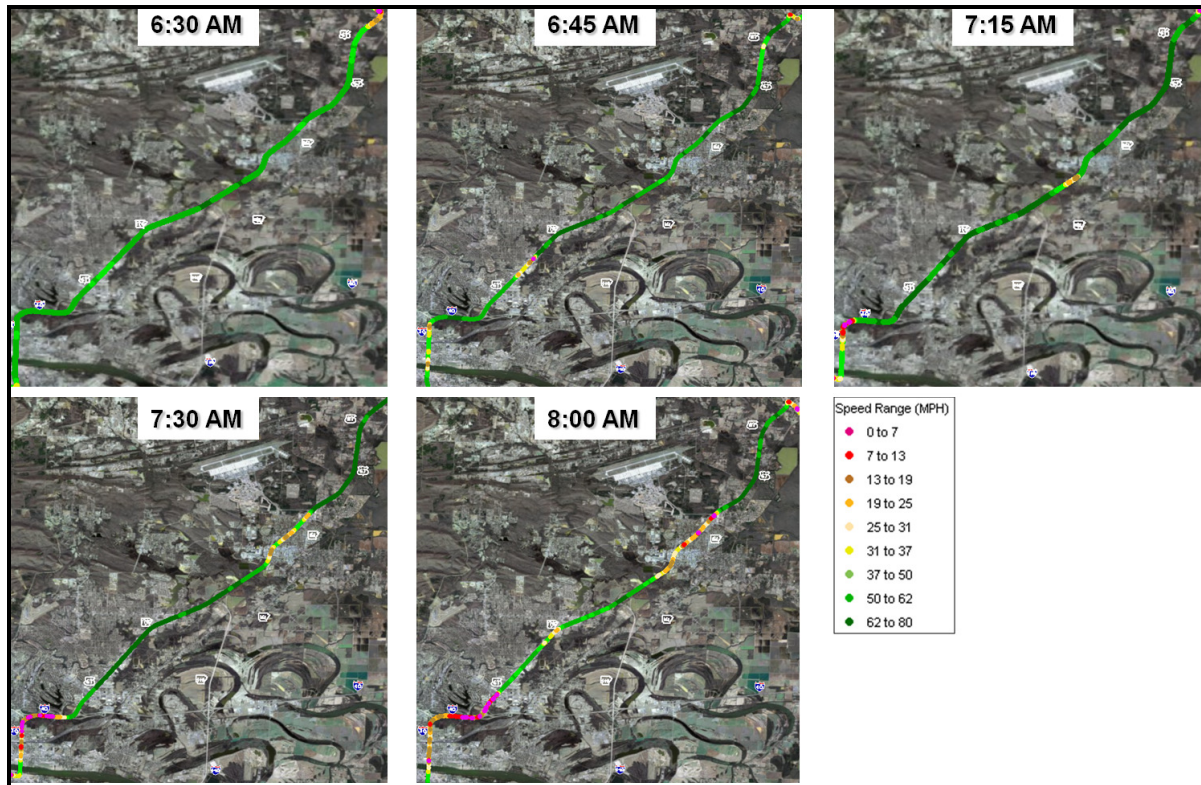


FIGURE 3.3: Maumelle-SW LR (PM Peak)

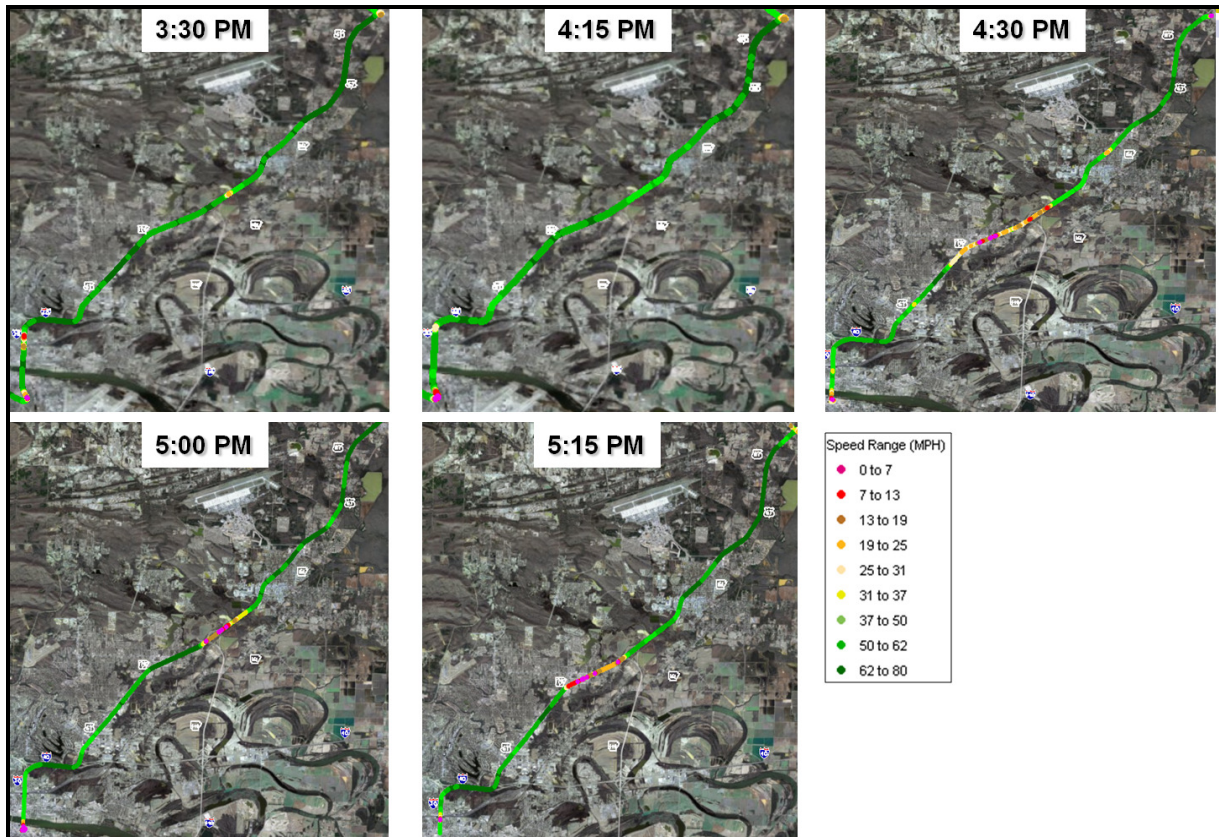
3.2 Cabot

Travel time data was collected from November 2007 through February 2008. The travel time data was recorded during the AM peak periods from Cabot to Downtown Little Rock and the PM peak periods from Downtown Little Rock to Cabot. The progression of congestion during the morning and afternoon peak periods are shown in Figures 3.4 and 3.5.



Departure Time	Segment 1			Segment 2			Segment 3			Total Travel Time	Overall Travel Time Index
	Cabot		I-440	I-440	I-40 @ Hwy. 67		I-40	I-30 @ Cantrell			
	9.3 miles			6.3 miles			3.7 miles				
	Travel Time	Average Speed	Travel Time Index	Travel Time	Average Speed	Travel Time Index	Travel Time	Average Speed	Travel Time Index		
(h:mm:ss)	(h:mm:ss)	(mph)		(h:mm:ss)	(mph)		(h:mm:ss)	(mph)		(h:mm:ss)	
6:15:00	0:08:21	66.83	1.00	0:06:22	59.37	1.09	0:03:04	72.39	1.00	0:17:47	1.00
6:45:00	0:09:09	60.98	1.10	0:07:28	50.63	1.28	0:04:40	47.57	1.52	0:21:17	1.20
7:00:00	0:10:18	54.17	1.23	0:06:37	57.13	1.13	0:04:29	49.52	1.46	0:21:24	1.20
7:15:00	0:12:06	46.12	1.45	0:06:41	56.56	1.14	0:08:20	26.64	2.72	0:27:07	1.52
7:30:00	0:10:04	55.43	1.21	0:05:51	64.62	1.00	0:10:49	20.52	3.53	0:26:44	1.50
8:00:00	0:12:59	42.98	1.55	0:13:04	28.93	2.23	0:11:22	19.53	3.71	0:37:25	2.10

FIGURE 3.4: Cabot-Downtown LR (AM Peak)

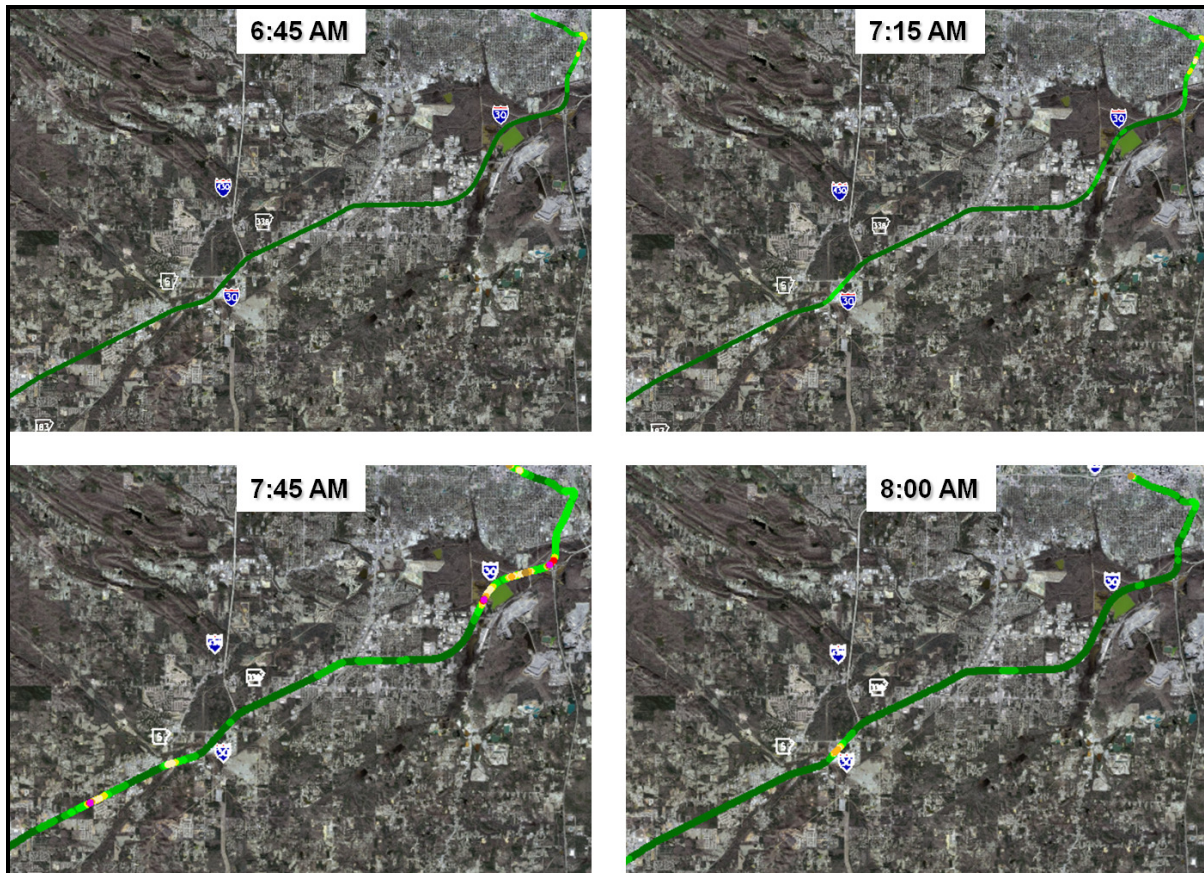


Departure Time	Segment 1			Segment 2			Segment 3			Total Travel Time	Overall Travel Time Index
	Downtown		I-30 @ I-40	I-30@ I-40		Hwy. 67 @ I-440	Hwy. 67@ I-440		Cabot		
	3.7 miles			6.3 miles			9.3 miles				
	Travel Time	Average Speed	Travel Time Index	Travel Time	Average Speed	Travel Time Index	Travel Time	Average Speed	Travel Time Index		
(h:mm:ss)	(h:mm:ss)	(mph)		(h:mm:ss)	(mph)		(h:mm:ss)	(mph)		(h:mm:ss)	
3:30:00	0:06:12	35.81	1.47	0:06:57	54.39	1.00	0:08:23	66.56	1.00	0:21:32	1.01
4:15:00	0:07:00	31.71	1.66	0:07:20	51.55	1.06	0:08:48	63.41	1.05	0:23:08	1.09
4:30:00	0:04:13	52.65	1.00	0:13:11	28.67	1.90	0:10:37	52.56	1.27	0:28:01	1.32
4:45:00	0:05:26	40.86	1.29	0:07:37	49.63	1.10	0:08:26	66.17	1.01	0:21:29	1.01
5:00:00	0:05:49	38.17	1.38	0:08:14	45.91	1.18	0:11:04	50.42	1.32	0:25:07	1.18
5:15:00	0:04:28	49.70	1.06	0:13:09	28.75	1.89	0:08:25	66.30	1.00	0:26:02	1.22
5:40:00	0:04:49	46.09	1.14	0:07:46	48.67	1.12	0:08:41	64.26	1.04	0:21:16	1.00

FIGURE 3.5: Cabot-Downtown LR (PM Peak)

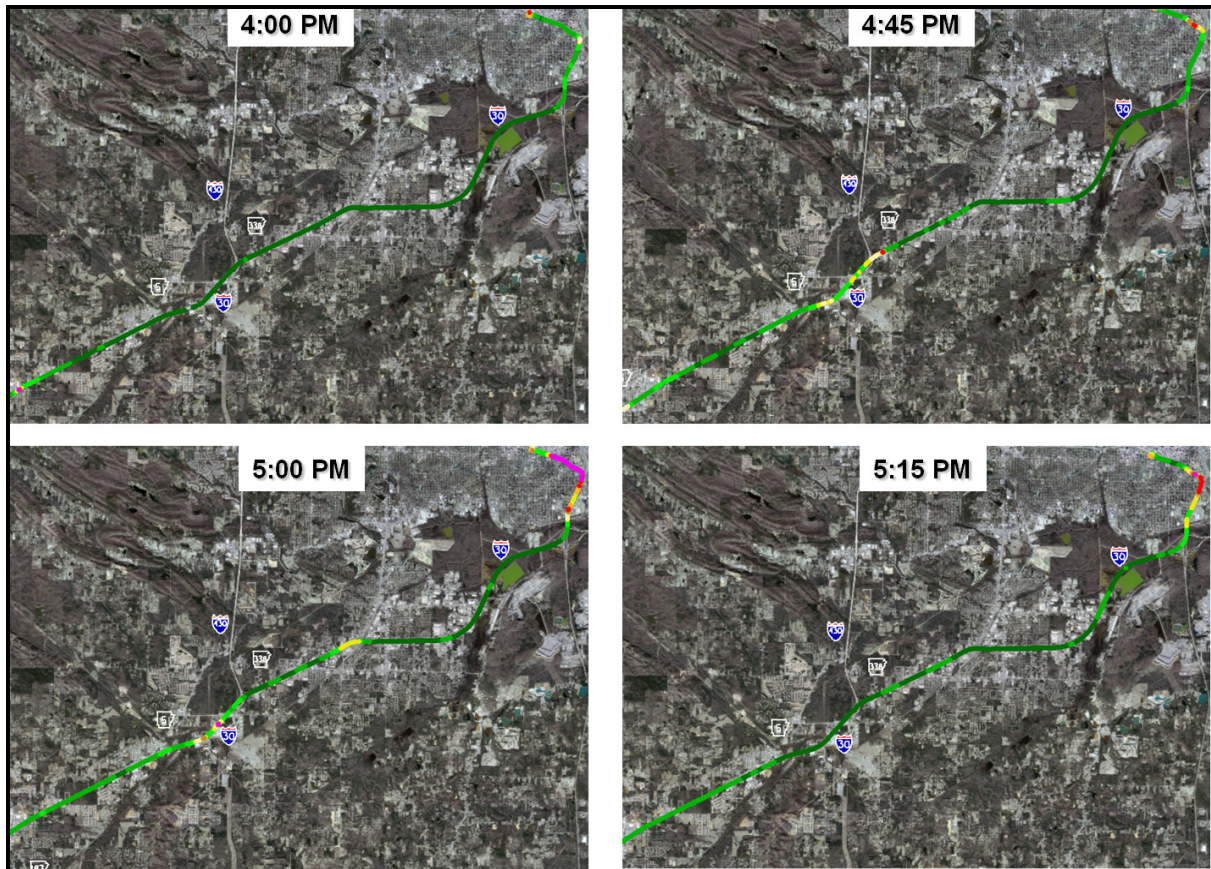
3.3 Benton/Bryant

Travel time data was collected in February 2008. The travel time data was recorded during the AM peak periods from Benton/Bryant to Downtown Little Rock and the PM peak periods from Downtown Little Rock to Benton/Bryant. The progression of congestion during the morning and afternoon peak periods are shown in Figures 3.6 and 3.7.



Departure Time	Segment 1			Segment 2			Segment 3			Total Travel Time	Overall Travel Time Index
	Sprillhill Rd.	I-430		I-430	I-630		I-630	Downtown			
	7.5 miles			10.5 miles			1.4 miles				
	Travel Time	Average Speed	Travel Time Index	Travel Time	Average Speed	Travel Time Index	Travel Time	Average Speed	Travel Time Index		
(h:mm:ss)	(h:mm:ss)	(mph)		(h:mm:ss)	(mph)		(h:mm:ss)	(mph)		(h:mm:ss)	
6:45:00	0:06:08	73.37	1.00	0:08:54	70.79	1.00	0:01:13	69.04	1.00	0:16:15	1.00
7:00:00	0:06:18	71.43	1.03	0:09:03	69.61	1.02	0:01:23	60.72	1.14	0:16:44	1.03
7:15:00	0:06:45	66.67	1.10	0:10:00	63.00	1.12	0:01:18	64.62	1.07	0:18:03	1.11
7:45:00	0:08:23	53.68	1.37	0:12:27	50.60	1.40	0:01:47	47.10	1.47	0:22:37	1.39
8:00:00	0:07:08	63.08	1.16	0:09:06	69.23	1.02	0:01:35	53.05	1.30	0:17:49	1.10

FIGURE 3.6: Benton/Bryant-Downtown LR (AM Peak)

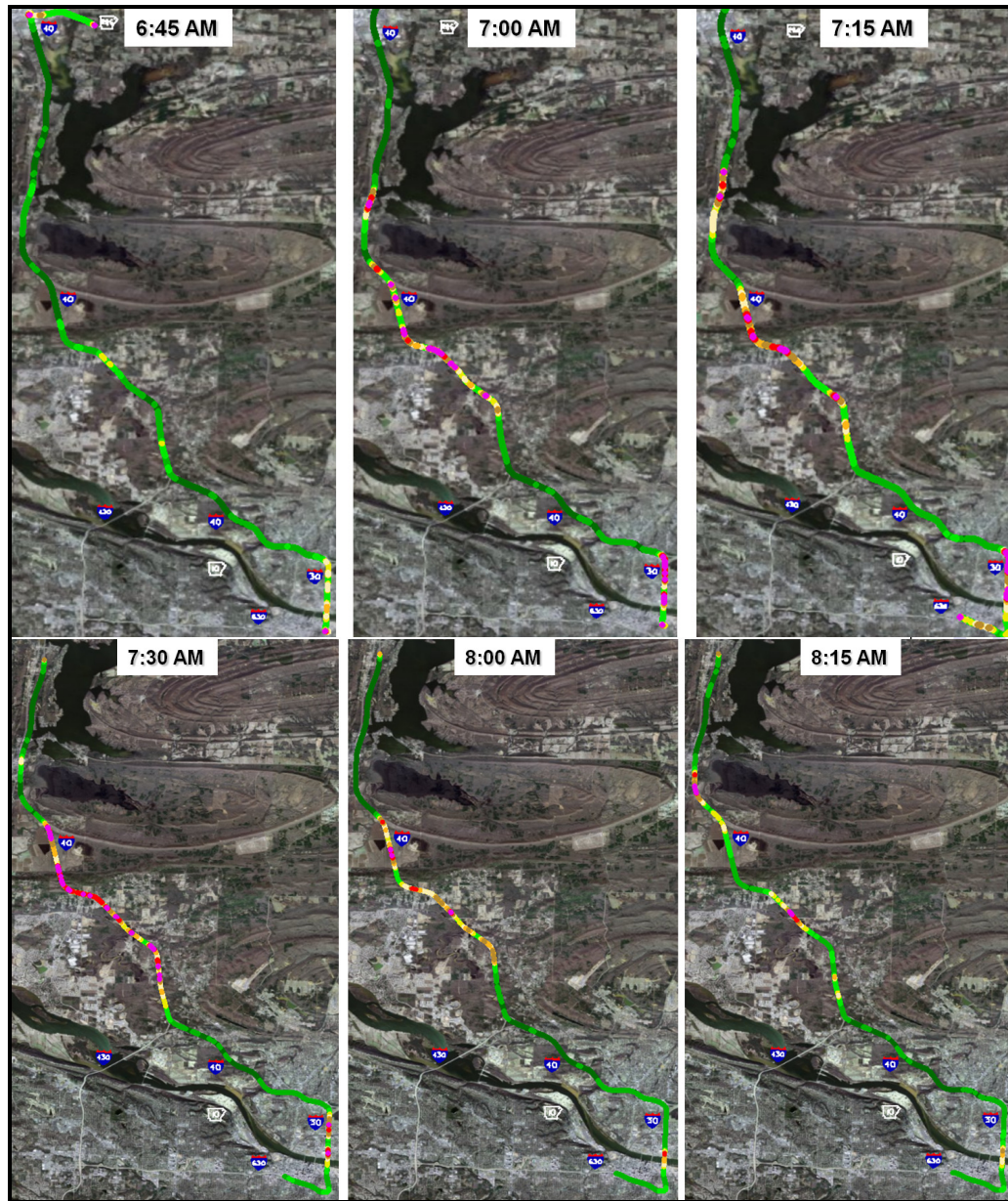


Departure Time	Segment 1			Segment 2			Segment 3			Total Travel Time	Overall Travel Time Index
	Downtown		I-30	I-30		I-430	I-430		Bryant		
	1.4 miles			10.5 miles			6 miles				
	Travel Time	Average Speed	Travel Time Index	Travel Time	Average Speed	Travel Time Index	Travel Time	Average Speed	Travel Time Index		
(h:mm:ss)	(h:mm:ss)	(mph)		(h:mm:ss)	(mph)		(h:mm:ss)	(mph)		(h:mm:ss)	
4:00:00	0:02:14	37.61	1.10	0:08:37	73.11	1.00	0:04:41	76.87	1.00	0:15:32	1.00
5:00:00	0:14:45	5.69	7.25	0:10:49	58.24	1.26	0:06:53	58.70	1.47	0:32:27	2.09
5:15:00	0:11:39	7.21	5.73	0:10:11	61.87	1.18	0:06:08	58.70	1.31	0:27:58	1.80
5:30:00	0:03:29	24.11	1.71	0:08:41	72.55	1.01	0:04:55	73.22	1.05	0:17:05	1.10
6:00:00	0:02:02	41.31	1.00	0:08:55	70.65	1.03	0:05:28	65.85	1.17	0:16:25	1.06

FIGURE 3.7: Benton/Bryant-Downtown LR (PM Peak)

3.4 Conway

Travel time data was collected in March 2008. The travel time data was recorded during the AM peak periods from Conway to Downtown Little Rock and the PM peak periods from Downtown Little Rock to Conway. The progression of congestion during the morning and afternoon peak periods are shown in Figures 3.8 and 3.9.



Departure Time	Segment 1			Segment 2			Segment 3			Total Travel Time	Overall Travel Time Index
	Conway	I-430 @ I-40		I-430 @ I-40		I-30 @ I-40	I-30@ I-40		Downtown LR		
	18 miles			6 miles			3 miles				
	Travel Time	Average Speed	Travel Time Index	Travel Time	Average Speed	Travel Time Index	Travel Time	Average Speed	Travel Time Index		
	(h:mm:ss)	(h:mm:ss)	(mph)		(h:mm:ss)	(mph)		(h:mm:ss)	(mph)		
6:45:00	0:17:51	60.50	1.00	0:06:31	55.24	1.08	0:04:16	42.19	1.00	0:28:38	1.00
7:00:00	0:31:04	34.76	1.74	0:07:48	46.15	1.30	0:08:18	21.69	1.95	0:47:10	1.65
7:15:00	0:33:41	32.06	1.89	0:10:46	33.44	1.79	0:10:58	16.41	2.57	0:55:25	1.94
7:30:00	0:38:40	27.93	2.17	0:06:25	56.10	1.07	0:06:58	25.84	1.63	0:52:03	1.82
8:00:00	0:23:14	46.48	1.30	0:06:01	59.83	1.00	0:05:10	34.84	1.21	0:34:25	1.20
8:15:00	0:17:59	60.06	1.01	0:06:02	59.67	1.00	0:05:07	35.18	1.20	0:29:08	1.02

FIGURE 3.8: Conway-Downtown LR (AM Peak)

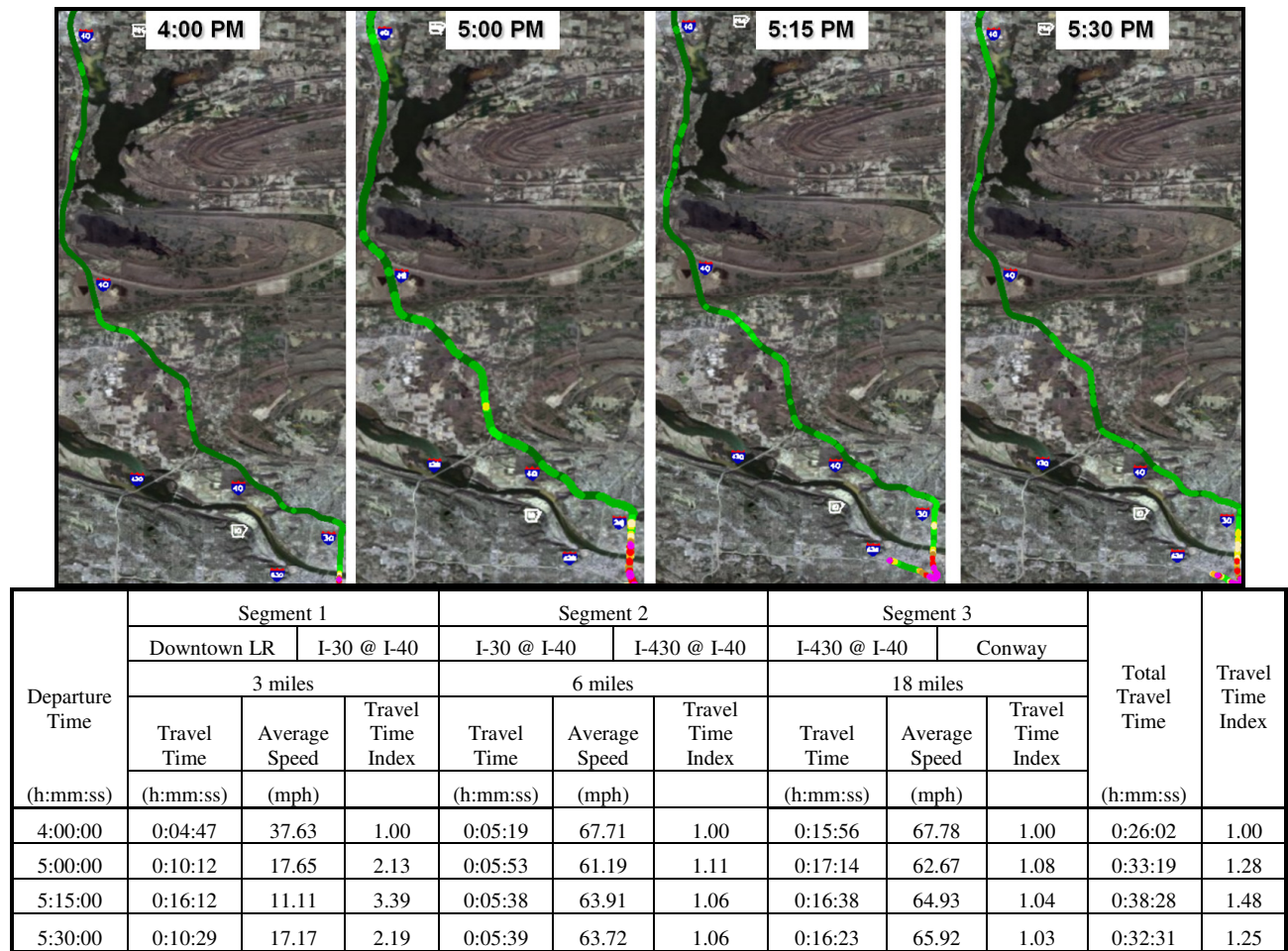


FIGURE 3.9: Conway-Downtown LR (PM Peak)

3.5 Pine Bluff/Sheridan

Travel time data was collected in April 2008. The travel time data was recorded during the AM peak periods from I-530 at Highway 167 to southwest Little Rock and the PM peak periods from southwest Little Rock to I-530 at Highway 167. The progression of congestion during the morning periods are shown in Figure 3.10.

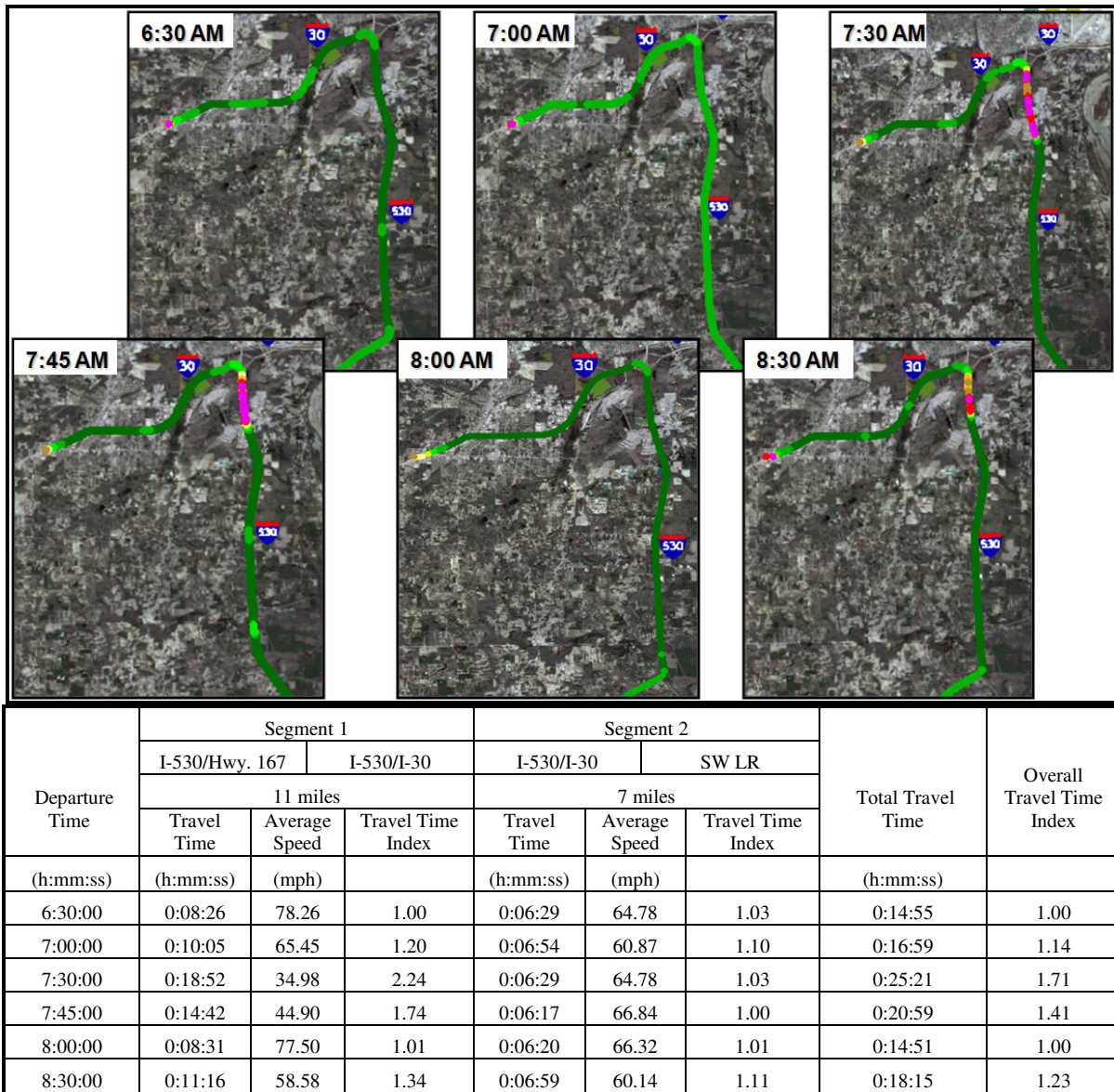
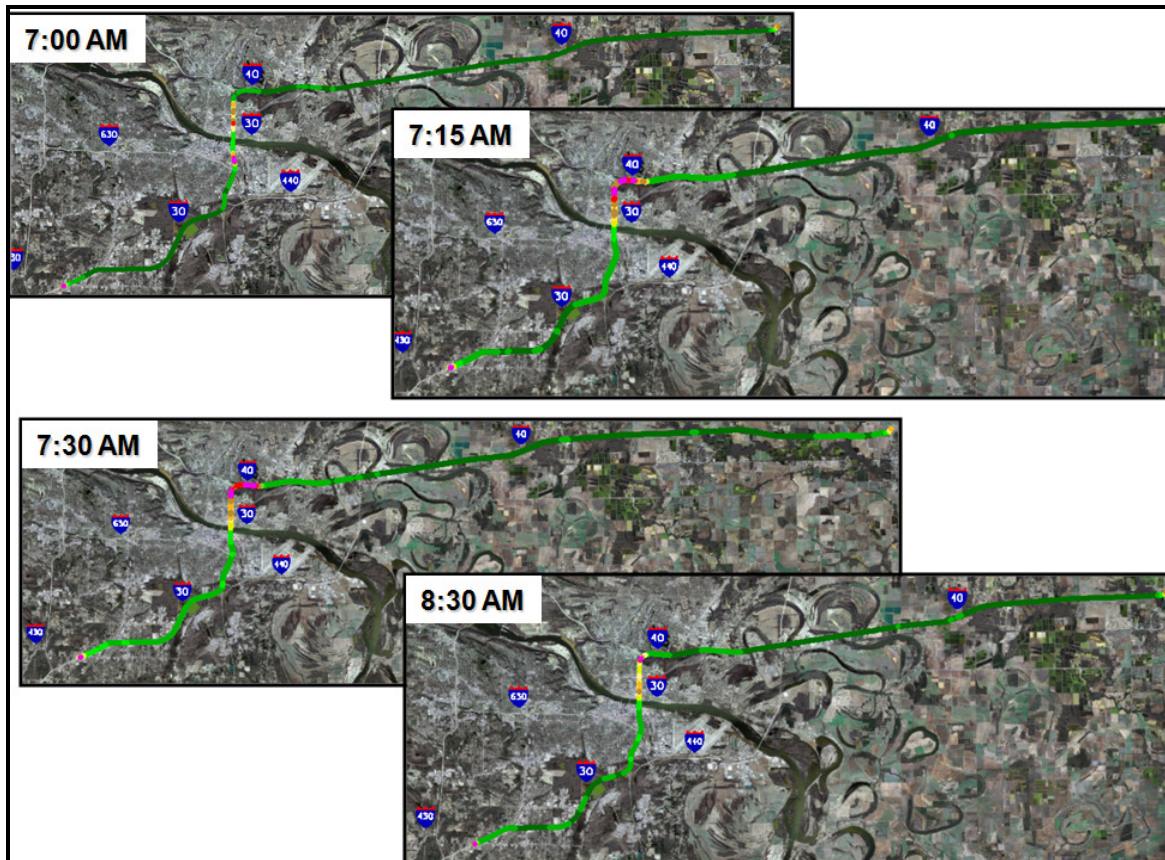


FIGURE 3.10: Pine Bluff/Sheridan-Southwest LR (AM Peak)

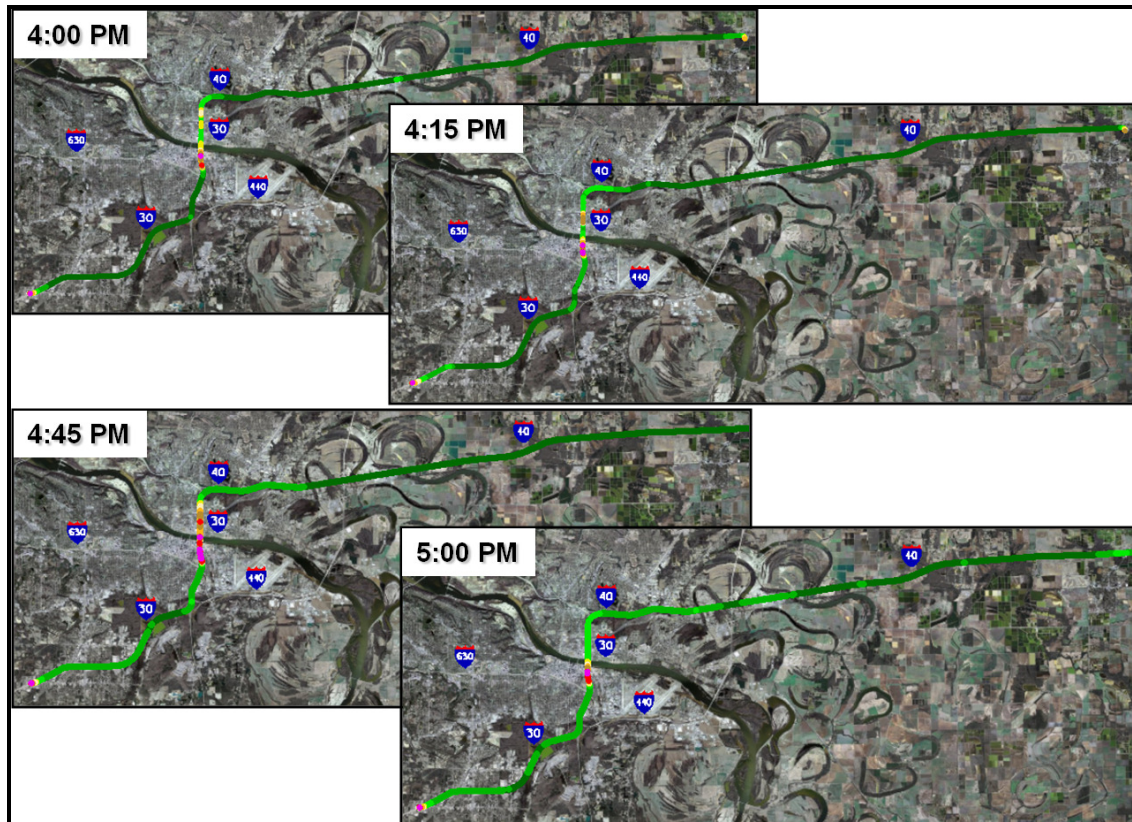
3.6 Lonoke

Travel time data was collected in April 2008. The travel time data was recorded during the AM peak periods from Lonoke to southwest Little Rock and the PM peak periods from southwest Little Rock to Lonoke. The progression of congestion during the morning and afternoon peak periods are shown in Figures 3.11 and 3.12.



Departure Time	Segment 1			Segment 2			Total Travel Time	Overall Travel Time Index
	Lonoke	I-40 @ I-440		I-40 @ I-440	SW LR			
	15.5 miles			17.5 miles via I-440				
	Travel Time	Average Speed	Travel Time Index	Travel Time	Average Speed	Travel Time Index		
(h:mm:ss)	(h:mm:ss)	(mph)		(h:mm:ss)	(mph)		(h:mm:ss)	
6:00:00	0:14:38	63.55	1.07	0:16:01	65.56	1.08	0:30:39	1.04
7:00:00	0:14:36	63.70	1.06	0:14:48	70.95	1.00	0:29:24	1.00
7:15:00	0:18:31	50.23	1.35	0:17:03	61.58	1.15	0:35:34	1.21
7:30:00	0:13:44	67.72	1.00	0:17:00	61.76	1.15	0:30:44	1.05
Departure Time	Segment 1			Segment 2			Total Travel Time	Overall Travel Time Index
	Lonoke	I-40 @ I-440		I-40 @ I-440		SW LR		
	15.5 miles			17.5 miles via I-30				
	Travel Time	Average Speed	Travel Time Index	Travel Time	Average Speed	Travel Time Index		
(h:mm:ss)	(h:mm:ss)	(mph)		(h:mm:ss)	(mph)		(h:mm:ss)	
7:00:00	0:12:20	75.41	1.00	0:18:46	55.95	1.00	0:31:06	1.00
7:15:00	0:13:47	67.47	1.12	0:24:33	42.77	1.31	0:38:20	1.23
7:30:00	0:13:57	66.67	1.13	0:26:48	39.18	1.43	0:40:45	1.31
8:30:00	0:13:26	69.23	1.09	0:19:53	52.81	1.06	0:33:19	1.07

FIGURE 3.11: Lonoke-Southwest LR (AM Peak)



Departure Time	Segment 1			Segment 2			Total Travel Time	Overall Travel Time Index
	SW LR	I-40 @ I-440		I-40 @ I-440		Lonoke		
	17.5 miles			15.5 miles via I-440				
	Travel Time	Average Speed	Travel Time Index	Travel Time	Average Speed	Travel Time Index		
(h:mm:ss)	(h:mm:ss)	(mph)		(h:mm:ss)	(mph)		(h:mm:ss)	
4:00:00	0:14:15	73.68	1.00	0:14:59	62.07	1.05	0:29:14	1.00
4:30:00	0:16:03	65.42	1.13	0:15:24	60.39	1.08	0:31:27	1.08
5:30:00	0:16:06	65.22	1.13	0:14:59	62.07	1.05	0:31:05	1.06
6:30:00	0:16:27	63.83	1.15	0:14:19	64.96	1.00	0:30:46	1.05
Departure Time	Segment 1			Segment 2			Total Travel Time	Overall Travel Time Index
	SW LR	I-40 @ I-440		I-40 @ I-440		Lonoke		
	17.5 miles			15.5 miles via I-30				
	Travel Time	Average Speed	Travel Time Index	Travel Time	Average Speed	Travel Time Index		
(h:mm:ss)	(h:mm:ss)	(mph)		(h:mm:ss)	(mph)		(h:mm:ss)	
4:00:00	0:17:58	58.44	1.00	0:12:47	72.75	1.00	0:30:45	1.00
4:15:00	0:19:07	54.93	1.06	0:12:48	72.66	1.00	0:31:55	1.04
4:45:00	0:28:57	36.27	1.61	0:19:12	48.44	1.50	0:48:09	1.57
5:00:00	0:23:26	44.81	1.30	0:13:54	66.91	1.09	0:37:20	1.21

FIGURE 3.12: Lonoke-Southwest LR (PM Peak)

CHAPTER 4 FINDINGS

During the course of this project, travel time and speed data were collected on approximately 175 miles (18 routes) of roadway in central Arkansas, 110 miles (11 routes) in northwest Arkansas and 39 miles (6 routes) in Hot Springs area. Over 70% of the mileage where data was collected is functionally classified as principal arterials or above.

4.1 Summary of Travel Time Indices

A summary of travel time indices and average speeds for the routes on which data was collected is shown in Table 4.1. The following segments of roadway are identified as congested and they are also highlighted in the table.

- Highway 10: Sam Peck – I-430
- Highway 89: Highway 67 – Highway 321
- Highway 100: Country Club Parkway – I-430
- Highway 107: I-40 – McCain Blvd.
- I-30: I-40 – I-630
- I-40: Pulaski/Faulkner County Line – I-430
- I-40: Highway 67 – I-30
- I-430: Highway 10 – I-40
- I-430: Rodney Parham – I-630
- I-530/I-30: Dixon Road – I-630
- I-630: Broadway – I-30
- Highways 12/112: Greenhouse Road – Highway 71B
- Highway 7 (Central Ave.): Fountain St. – Highway 70

During the peak periods, the travel time indices on these segments are ranging from 2.01 to 7.25.

Table 4.1 Summary of Travel Time Indices and Average Speeds

CENTRAL ARKANSAS AREA											
Route No.	Route	Point A	Point B	Length (miles)	2008 ADT (low)	2008 ADT (high)	Departure Time	Direction	Average Speed (mph)	Travel Time Index	Congested Segments
C-1	Highway 5	I-30	I-430	10.5	10,000	22,000	7:27:40	A-B	29.0	1.34	Reynolds Rd. - Salem Rd.
							17:13:42	B-A	24.8	1.57	Alexander Rd. - I-430
C-2	Highway 10	Highway 300	Reservoir Road	7.5	17,000	51,000	7:29:33	A-B	26.4	1.80	Sam Peck - I-430
							15:44:56	A-B	28.8	1.65	
C-3	Highway 10	San Peck Road	President Clinton Ave.	9.7	24,000	51,000	7:44:05	A-B	21.6	2.12	Sam Peck - I-430
							16:54:16	A-B	25.3	1.81	Reservoir Rd. - Markham St.
C-4	Hwy 60 (Conway)	I-40	Hogan Lane	4.3	30,000	32,000	7:57:23	B-A	24.0	1.60	Hwy. 65B - I-40
							17:43:54	A-B	20.5	1.88	
C-5	Highway 89 (Cabot)	Douglas Road	Highway 321	4.8	8,900	29,000	7:46:06	A-B	13.3	2.38	Hwy. 67 - Hwy. 321
							15:28:23	A-B	13.6	2.34	
C-6	Highway 365 & 70	Roosevelt Road	I-40	4.7	9,500	26,000	7:45:08	B-A	15.1	1.91	Hwy. 365 (Pike Ave.) - 9th St.
							17:13:39	A-B	17.6	1.64	
C-7	Highways 300/570	Bowman Road	Arch Street	8.1	9,400	36,000	7:43:56	A-B	24.8	1.37	I-430 - Shackleford
							16:04:34	A-B	26.4	1.29	
C-8	Highway 107 (JFK)	I-40	Highway 176	4.8	24,000	28,000	7:24:24	A-B	17.7	1.95	I-40 - McCain Blvd.
							17:20:55	A-B	17.1	2.02	
C-9	Hwy 70 (University)	I-30	Highway 5 (Asher)	2.5	25,000	40,000	7:43:49	A-B	20.9	1.88	
							16:31:17	A-B	24.5	1.61	
C-10	Interstate 30/430	Congo Road	Highway 300 (Colonel Glenn)	14	61,000	92,000	7:34:48	A-B	47.2	1.37	Hwy. 300 - I-30
							16:51:52	B-A	39.8	1.63	
C-11	I-30 Frontage Road/Hwy 5	Congo Road	Highway 338 (Baseline Rd)	12.4	----	----	8:09:23	A-B	43.4	1.26	
							17:43:53	B-A	45.7	1.20	
C-12	Highway 67/I-440	Highway 89	I-40	16.7	22,000	73,000	7:08:23	A-B	48.9	1.39	Gregory St. - I-440
							17:34:58	B-A	39.1	1.74	
C-13	Highway 67/I-40/I-30	Redmond Road	Roosevelt Road	13.4	47,000	122,000	7:15:57	A-B	40.3	1.65	I-40@Hwy. 67 - I-30@Hwy. 10
							17:06:45	B-A	40.3	1.65	
	I-40/I-30	I-40 @ Hwy. 67	I-30 @ Hwy. 10	3.7	104,000	122,000	AM Peak	A-B	19.5	3.71	I-40@Hwy. 67 - I-30@Hwy. 10
	I-30	I-40	Downtown LR	3	103,000	122,000	AM Peak	A-B	16.4	2.57	I-40 - Hwy. 10
C-14	I-40/I-430/I-630	Highway 365 (Morgan)	Lile Drive	12.2	66,000	99,000	7:38:41	A-B	31.0	2.03	Rodney Parham - I-630
							17:21:08	B-A	34.1	1.84	Hwy. 10 - I-40
C-15	I-40	Highway 65 (Conway)	Highway 365 (Morgan)	17	58,000	63,000	7:26:41	A-B	38.5	1.82	Pulaski Co. Line - Hwy. 365
							17:22:08	B-A	54.4	1.29	
	I-40	Highway 60 (Conway)	I-430	18	58,000	68,000	7:30:00	A-B	27.9	2.17	Pulaski Co. Line - I-430
C-16	I-630/I-30/I-530	Fair Park Blvd.	Highway 338 (Dixon Road)	8.5	42,000	113,000	7:53:46	B-A	28.9	2.49	Dixon Rd. - I-630
							16:45:49	A-B	34.1	2.11	Broadway - I-30
	I-630	Chester St.	I-30 @ I-630	1.4	100,000	113,000	17:00:00	A-B	5.7	7.25	Chester - I-30
C-17	I-430/I-630	Highway 300	Woodrow Street	7.5	73,000	113,000	7:48:16	A-B	39.0	1.59	Shackleford Rd. - Mississippi St.
							16:48:55	B-A	41.3	1.51	
C-18	Highway 100/I-430	Highway 10	Highway 365	9.7	16,000	33,000	7:12:58	B-A	30.5	1.55	Country Club Pkwy. - I-430
							17:25:45	A-B	29.3	1.62	
	Hwy. 100	Odom Blvd. South	I-430	4.1	22,000	33,000	7:30:00	A-B	16.6	3.09	Country Club Pkwy. - I-430

Table 4.1 Summary of Travel Time Indices and Average Speeds (cont.)

NORTHWEST ARKANSAS AREA											
Route No.	Route	Point A	Point B	Length (miles)	2008 ADT (low)	2008 ADT (high)	Departure Time	Direction	Average Speed (mph)	Travel Time Index	Congested Segments
NW-1	Highway 71B	Peach Orchard Rd./Co. Rd. 40	Hwy. 71B 8th Street/Walnut Street	12.5	17,000	32,000	7:45:23	B-A	24.3	1.47	North of Co. Rd. 40
NW-2	Highway 102/62	Highway 279	Rogers Airport on Hwy 62	11.5	8,500	38,000	16:51:04	B-A	20.0	1.79	J St. - 8th St.
							7:20:13	A-B	18.1	1.94	Main St. - I-540
							17:42:19	A-B	21.0	1.67	
NW-3	Highway 412/265	Highway 112	Highway 45	12	15,000	37,000	7:30:14	A-B	23.6	1.37	I-540 - Hwy. 265
NW-4	Highway 71B	Hwy. 71B 8th St./Walnut	Highway 412	11.5	21,000	30,600	16:38:17	A-B	17.4	1.86	Zion - Joyce Blvd. - Hwy. 45
							7:45:51	B-A	23.9	1.33	Hwy. 264 - Hwy. 412
							16:29:53	B-A	22.3	1.43	
NW-5	Highway 71B	Highway 412	Highway 16	8.5	13,000	35,000	12:32:08	A-B	23.0	1.57	Main Dr. - Hwy. 16
NW-6	Highway 62/180	Prairie Grove	Highway 71B	12	23,000	38,000	15:41:21	B-A	22.8	1.59	
							7:39:40	A-B	28.2	1.53	West of I-540 - Hwy. 71B
							15:40:04	B-A	33.0	1.31	
NW-7	I-540/Highway 71	Hwy. 62/180 (6th St.)	Hwy. 71/Joyce Blvd. (U-turn)	7	33,000	74,000	7:51:30	B-A	34.7	1.86	Hwy. 16 - Hwy. 71B
NW-8	Hwy. 12/112	XNA Airport Road	Hwy. 102	10	2,800	13,000	17:20:30	B-A	32.6	1.97	
							7:27:06	A-B	20.9	2.18	Greenhouse Rd. - Hwy. 71B
							17:13:36	A-B	30.5	1.50	
NW-9	I-540	Highway 62/102	Highway 264	7	54,000	66,000	7:48:05	A-B	43.2	1.63	
NW-10	Highway 16/112	Double Spring	Agri Park	6	2,700	30,000	16:20:54	B-A	46.9	1.50	
							7:29:57	A-B	24.5	1.67	Colorado Dr. - I-540
							15:34:14	B-A	27.1	1.51	Hwy. 16 - Agri Park
NW-11	I-540	Highway 264	Highway 112	12	59,000	74,000	7:21:46	B-A	53.0	1.30	
							16:42:12	B-A	54.7	1.26	
HOT SPRINGS AREA											
Route No.	Route	Point A	Point B	Length (miles)	2008 ADT (low)	2008 ADT (high)	Departure Time	Direction	Average Speed (mph)	Travel Time Index	Congested Segments
HS-1	Highways 7/88	Highway 7	Highway 290	6	9400	29,000	7:51:02	A-B	29.4	1.20	Amity Rd. - Hwy. 7
HS-2	Highway 7 (Central Ave.)	Highway 88	Fountain St.	6	12,000	29,000	17:08:51	B-A	20.3	1.74	
							7:44:20	A-B	20.6	1.57	Fountain St. - Hwy. 70
							12:42:55	A-B	16.1	2.01	
HS-3	Highways 7/5	Highway 7 S	Highway 128	8	10,000	14,000	16:50:35	A-B	16.9	1.92	
							11:58:05	A-B	39.8	1.26	
							12:10:37	B-A	40.9	1.23	
HS-4	Highway 70B/270B	Phillips Street	Meadow Creek Ln.	11	9400	35,200	16:04:47	A-B	37.6	1.26	Phillips St. - Masters Pl.
HS-5	Highway 128	Highway 290	Highway 270B	4.5	4900	11,000	16:22:56	B-A	37.1	1.28	Hwy. 270 near Hwy. 227
							7:50:10	A-B	37.4	1.32	Hwy. 270 - Hwy. 270B
							17:01:10	B-A	34.1	1.45	
HS-6	Highway 70/270	Highway 270B	Highway 70B	13	11,000	39,000	7:24:54	A-B	60.6	1.20	
							17:27:16	B-A	64.8	1.12	

4.2 Conclusions/Observations

- The methodology utilized for this project is an effective way to identify bottlenecks/chokepoints in the roadway and can be applied to other areas and routes.
- Because the data collected in this project was processed using a GIS, it can be easily shared and utilized in various studies. The digital video can substitute for field visits, saving time and money.
- The database can be used to establish baselines for performance measures of future transportation improvement projects.
- Some of the congested segments identified in this project are caused by bottlenecks. When a bottleneck is relieved, the downstream segment may become congested.
- Lower average speeds on some principal arterial routes are often caused by controlled delays, i.e. traffic signals.
- The duration of peak periods on most of the routes is less than one hour.
- There is not a distinct AM peak period on most of the routes in the Hot Springs area.
- The travel time data collection should envelop the bottlenecks on a selected route. It is advantageous to capture the end of the queue to accurately assess the congestion level.
- Comprehensive data collection at a congested interchange should be developed in order to correctly define the performance of an interchange.
- The floating-car technique should be applied consistently.

APPENDIX A

Summary of Travel Time and Average Speed

Table A.1. Route C-1 - Highway 5 Travel Time Summaries
(A @ I-30, B @ I-430)

A-B	Departure Time	Travel Time (min)	Additional Time	Travel Time Index	Avg. Speed
	6:49:05	18.50	0:02:21	1.15	34.1
	7:04:57	17.50	0:01:21	1.08	36.0
Poor	7:27:40	21.72	0:05:34	1.34	29.0
	7:43:29	19.22	0:03:04	1.19	32.8
	8:11:57	17.90	0:01:45	1.11	35.2
	8:22:30	16.97	0:00:49	1.05	37.1
	11:31:38	18.63	0:02:29	1.15	33.8
	11:48:22	17.78	0:01:38	1.10	35.4
	12:25:10	16.30	0:00:09	1.01	38.7
	13:00:29	16.98	0:00:50	1.05	37.1
	13:23:52	17.82	0:01:40	1.10	35.4
	15:50:33	23.45	0:07:18	1.45	26.9
	16:12:41	19.63	0:03:29	1.22	32.1
	16:34:33	17.83	0:01:41	1.10	35.3
	16:54:34	18.75	0:02:36	1.16	33.6
	17:18:08	19.12	0:02:58	1.18	33.0
	17:39:50	18.35	0:02:12	1.14	34.3
B-A	Departure Time	Travel Time (min)	Additional Time	Travel Time Index	Avg. Speed
	6:46:04	17.60	0:01:27	1.09	35.8
	7:08:04	18.45	0:02:18	1.14	34.1
	7:23:01	19.07	0:02:55	1.18	33.0
	7:50:04	20.90	0:04:45	1.29	30.1
	8:03:10	16.85	0:00:42	1.04	37.4
	8:30:14	18.28	0:02:08	1.13	34.5
	11:30:57	16.15	0:00:00	1.00	39.0
	11:50:34	16.92	0:00:46	1.05	37.2
	12:07:04	16.80	0:00:39	1.04	37.5
	12:26:25	17.88	0:01:44	1.11	35.2
	12:42:12	16.38	0:00:14	1.01	38.5
	13:04:36	17.37	0:01:13	1.08	36.3
	13:18:03	16.60	0:00:27	1.03	38.0
	15:29:36	19.67	0:03:31	1.22	32.0
	15:51:34	20.15	0:04:00	1.25	31.3
	16:14:32	18.60	0:02:27	1.15	33.9
	16:32:44	20.55	0:04:24	1.27	30.7
	16:53:14	23.23	0:07:05	1.44	27.1
Poor	17:13:42	25.40	0:09:15	1.57	24.8
	17:38:01	18.92	0:02:46	1.17	33.3

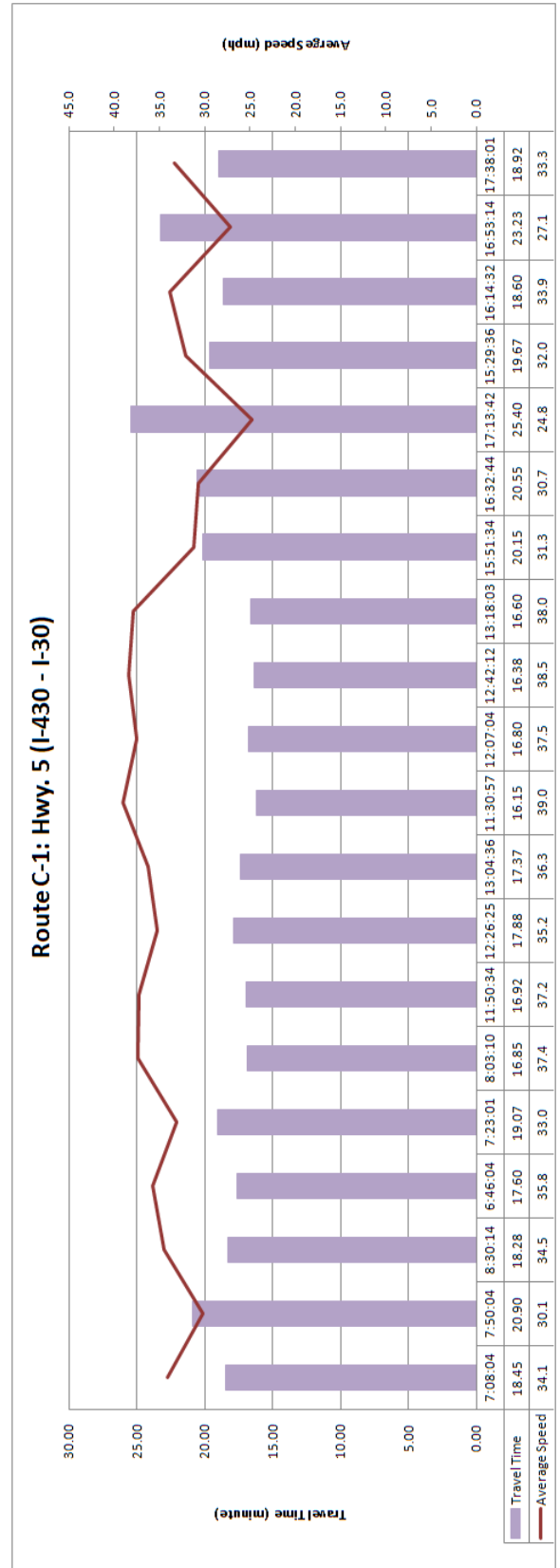
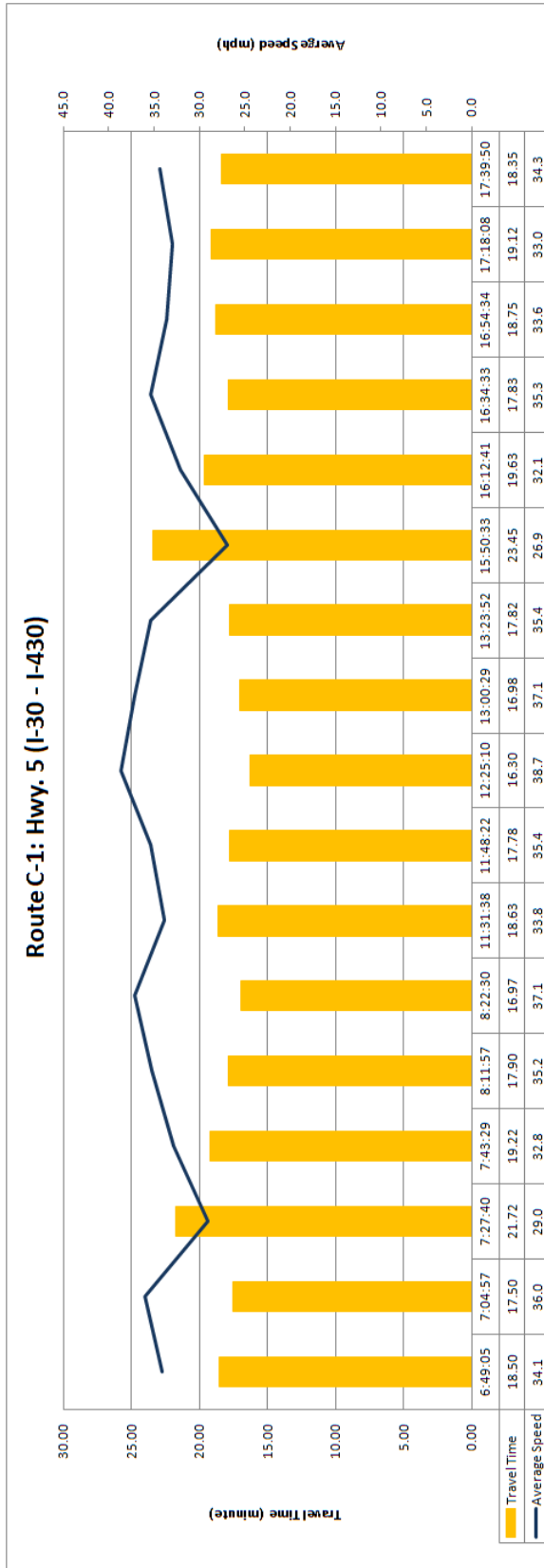


Table A-2. Route C-2 - Highway 10 Travel Time Summaries
(A @ Hwy. 300, B @ Reservoir Road)

A-B	Departure Time	Travel Time (min)	Additional Time	Travel Time Index	Avg. Speed
Poor	6:51:06	10.63	0:01:11	1.13	42.3
	6:59:12	10.73	0:01:17	1.14	41.9
	7:29:33	17.03	0:07:35	1.80	26.4
	7:48:10	13.95	0:04:30	1.48	32.3
	8:04:12	13.30	0:03:51	1.41	33.8
	8:18:29	11.80	0:02:21	1.25	38.1
	11:08:35	10.15	0:00:42	1.07	44.3
	11:18:07	12.17	0:02:43	1.29	37.0
	11:34:35	10.62	0:01:10	1.12	42.4
	11:46:52	12.05	0:02:36	1.28	37.3
	12:00:08	12.10	0:02:39	1.28	37.2
	12:14:18	11.27	0:01:49	1.19	39.9
	12:27:00	9.98	0:00:32	1.06	45.1
	12:56:13	11.03	0:01:35	1.17	40.8
	13:02:46	11.05	0:01:36	1.17	40.7
	13:22:29	13.18	0:03:44	1.40	34.1
	15:30:47	13.38	0:03:56	1.42	33.6
Poor	15:44:56	15.63	0:06:11	1.65	28.8
	16:00:30	13.05	0:03:36	1.38	34.5
	16:18:06	14.62	0:05:10	1.55	30.8
	16:30:55	11.78	0:02:20	1.25	38.2
	16:58:44	13.62	0:04:10	1.44	33.0
	17:29:21	12.17	0:02:43	1.29	37.0
	17:35:31	13.17	0:03:43	1.39	34.2
B-A	Departure Time	Travel Time (min)	Additional Time	Travel Time Index	Avg. Speed
	6:46:38	11.07	0:01:37	1.17	40.7
	7:03:47	10.97	0:01:31	1.16	41.0
	7:12:09	12.97	0:03:31	1.37	34.7
	7:33:01	11.50	0:02:03	1.22	39.1
	7:49:51	11.38	0:01:56	1.20	39.5
	8:04:15	10.88	0:01:26	1.15	41.3
	8:20:08	10.47	0:01:01	1.11	43.0
	10:59:47	10.87	0:01:25	1.15	41.4
	11:20:28	12.20	0:02:45	1.29	36.9
	11:33:07	11.58	0:02:08	1.23	38.8
	11:47:05	10.95	0:01:30	1.16	41.1
	12:01:26	10.82	0:01:22	1.14	41.6
	12:14:03	10.60	0:01:09	1.12	42.5
	12:42:32	11.53	0:02:05	1.22	39.0
	12:50:03	9.45	0:00:00	1.00	47.6
	13:09:37	10.85	0:01:24	1.15	41.5
	15:30:20	11.65	0:02:12	1.23	38.6
	15:47:15	10.63	0:01:11	1.13	42.3
	16:03:11	12.77	0:03:19	1.35	35.2
	16:16:44	11.88	0:02:26	1.26	37.9
	16:40:15	10.93	0:01:29	1.16	41.2
	16:44:51	11.68	0:02:14	1.24	38.5
	17:12:47	12.60	0:03:09	1.33	35.7
	17:15:39	11.58	0:02:08	1.23	38.8

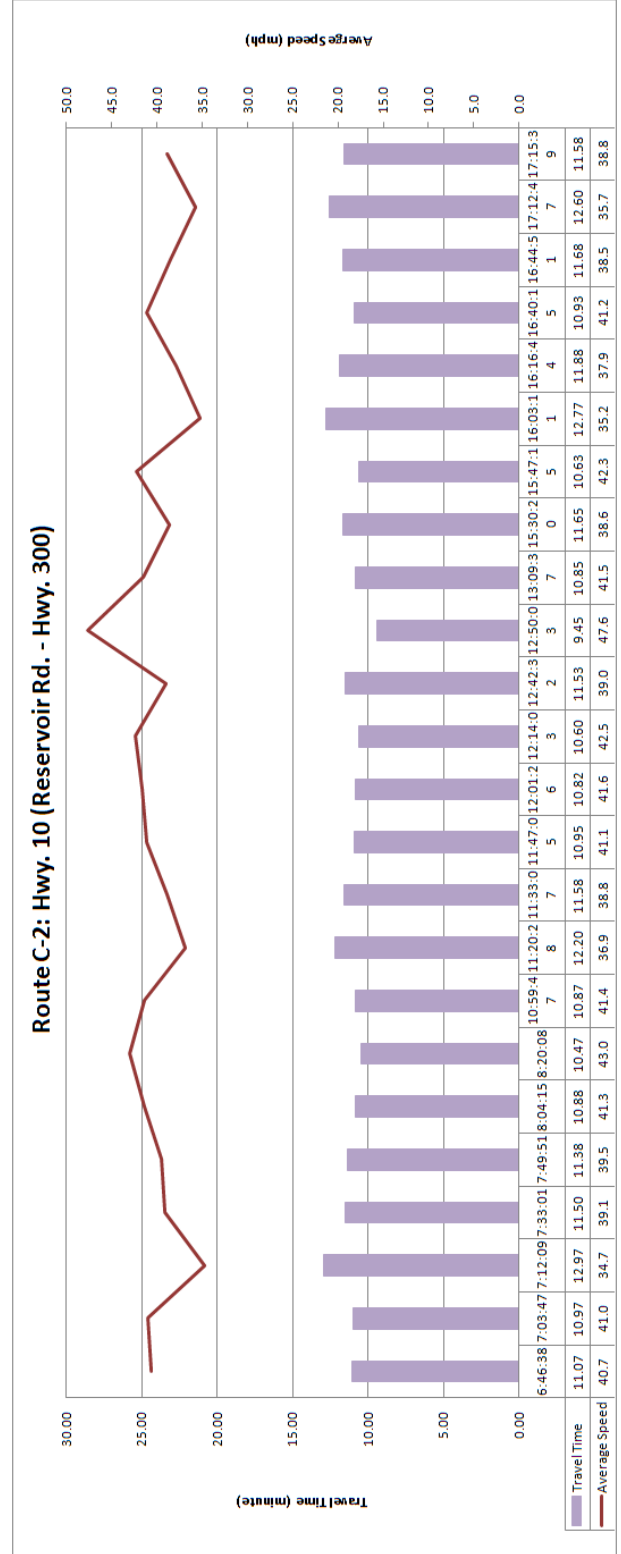
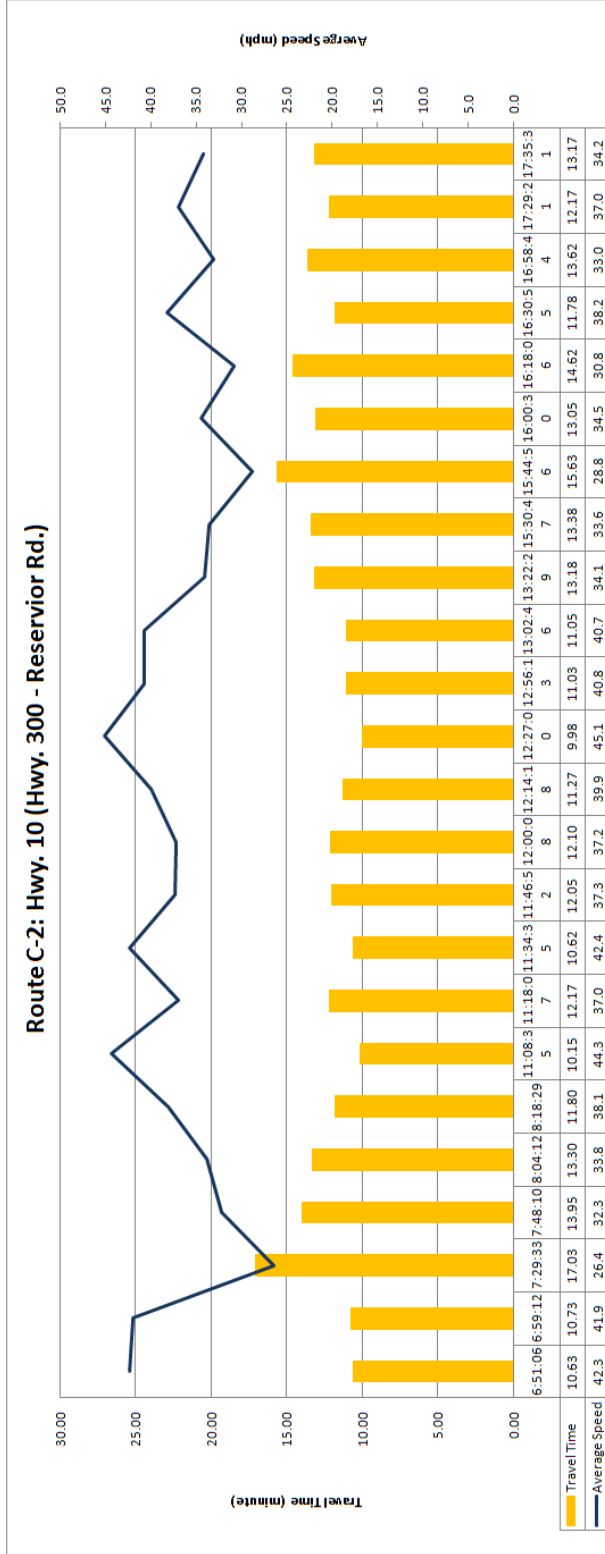


Table A.3. Route C-3 - Highway 10 Travel Time Summaries
(A @ Sam Peck, B @ Markham Street)

A-B	Departure Time	Travel Time (min)	Additional Time	Travel Time Index	Avg. Speed
	6:48:28	15.12	0:02:23	1.19	38.50
	7:04:43	18.45	0:05:43	1.45	31.54
	7:25:54	22.85	0:10:07	1.79	25.47
Poor	7:44:05	26.95	0:14:13	2.12	21.60
	8:13:09	17.63	0:04:54	1.38	33.01
	11:02:15	17.45	0:04:43	1.37	33.35
	11:41:03	17.15	0:04:25	1.35	33.94
	11:55:27	17.98	0:05:15	1.41	32.36
	12:24:57	17.60	0:04:52	1.38	33.07
	12:35:42	18.58	0:05:51	1.46	31.32
	13:02:48	17.07	0:04:20	1.34	34.10
	13:15:00	18.80	0:06:04	1.48	30.96
	15:32:09	18.47	0:05:44	1.45	31.52
	15:49:08	19.02	0:06:17	1.49	30.60
	16:12:17	19.10	0:06:22	1.50	30.47
	16:40:14	18.47	0:05:44	1.45	31.52
Poor	16:54:16	23.03	0:10:18	1.81	25.27
	17:28:57	20.83	0:08:06	1.64	27.94
B-A	Departure Time	Travel Time (min)	Additional Time	Travel Time Index	Avg. Speed
	6:45:51	17.67	0:04:56	1.39	32.94
	7:06:48	17.37	0:04:38	1.36	33.51
	7:25:32	17.43	0:04:42	1.37	33.38
	7:51:10	18.35	0:05:37	1.44	31.72
	8:13:25	18.60	0:05:52	1.46	31.29
	11:02:42	12.73	0:00:00	1.00	45.71
	11:22:14	16.62	0:03:53	1.30	35.03
	11:37:26	15.93	0:03:12	1.25	36.53
	12:01:51	16.68	0:03:57	1.31	34.89
	12:16:57	17.05	0:04:19	1.34	34.13
	12:46:14	15.52	0:02:47	1.22	37.51
	12:56:48	17.05	0:04:19	1.34	34.13
	15:29:29	17.97	0:05:14	1.41	32.39
	15:54:00	15.57	0:02:50	1.22	37.39
	16:10:27	17.52	0:04:47	1.38	33.23
	16:34:01	17.93	0:05:12	1.41	32.45
Poor	17:02:59	24.35	0:11:37	1.91	23.90
	17:22:50	20.58	0:07:51	1.62	28.28

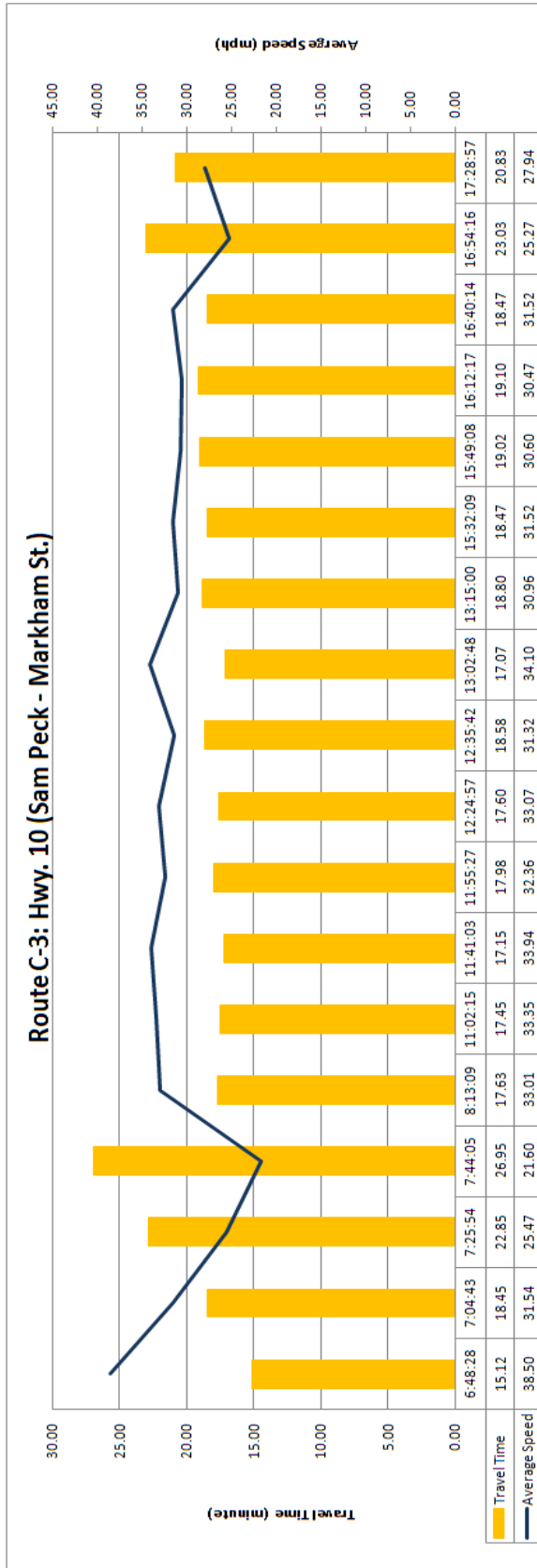


Table A.4. Route C-4 - Highway 60 Travel Time Summaries
(A @ I-40, B @ Hogan Lane)

A-B	Departure Time	Travel Time (min)	Additional Time	Travel Time Index	Avg. Speed
	6:43:06	9.40	0:02:41	1.40	27.45
	7:03:30	9.17	0:09:10	1.36	28.15
	7:25:27	9.03	0:09:02	1.34	28.56
	8:11:26	8.43	0:08:26	1.26	30.59
	10:59:24	8.87	0:08:52	1.32	29.10
	11:18:19	7.40	0:07:24	1.10	34.86
	11:36:32	8.33	0:08:20	1.24	30.96
	11:54:36	7.45	0:07:27	1.11	34.63
	12:12:13	10.63	0:10:38	1.58	24.26
	12:33:40	6.37	0:06:22	0.95	40.52
	15:27:48	9.63	0:09:38	1.43	26.78
	15:49:30	9.03	0:09:02	1.34	28.56
	16:10:51	12.12	0:12:07	1.80	21.29
	16:34:20	11.18	0:11:11	1.67	23.07
	16:56:12	10.68	0:10:41	1.59	24.15
	17:22:27	11.45	0:11:27	1.70	22.53
Poor	17:43:54	12.60	0:12:36	1.88	20.48
B-A	Departure Time	Travel Time (min)	Additional Time	Travel Time Index	Avg. Speed
	6:53:44	8.50	0:08:30	1.27	30.35
	7:13:44	9.93	0:09:56	1.48	25.97
	7:35:08	8.92	0:08:55	1.33	28.93
Poor	7:57:23	10.73	0:10:44	1.60	24.04
	8:20:34	9.70	0:09:42	1.44	26.60
	11:09:16	7.93	0:07:56	1.18	32.52
	11:26:27	8.92	0:08:55	1.33	28.93
	11:45:30	6.72	0:06:43	1.00	38.41
	12:02:40	8.90	0:08:54	1.33	28.99
	12:23:26	9.35	0:09:21	1.39	27.59
	12:40:37	9.70	0:09:42	1.44	26.60
	15:38:18	9.50	0:09:30	1.41	27.16
	15:59:16	8.42	0:08:25	1.25	30.65
	16:23:40	9.18	0:09:11	1.37	28.09
	16:46:08	8.72	0:08:43	1.30	29.60
	17:10:23	9.88	0:09:53	1.47	26.10
	17:34:32	8.17	0:08:10	1.22	31.59
	17:57:19	6.72	0:06:43	1.00	38.41

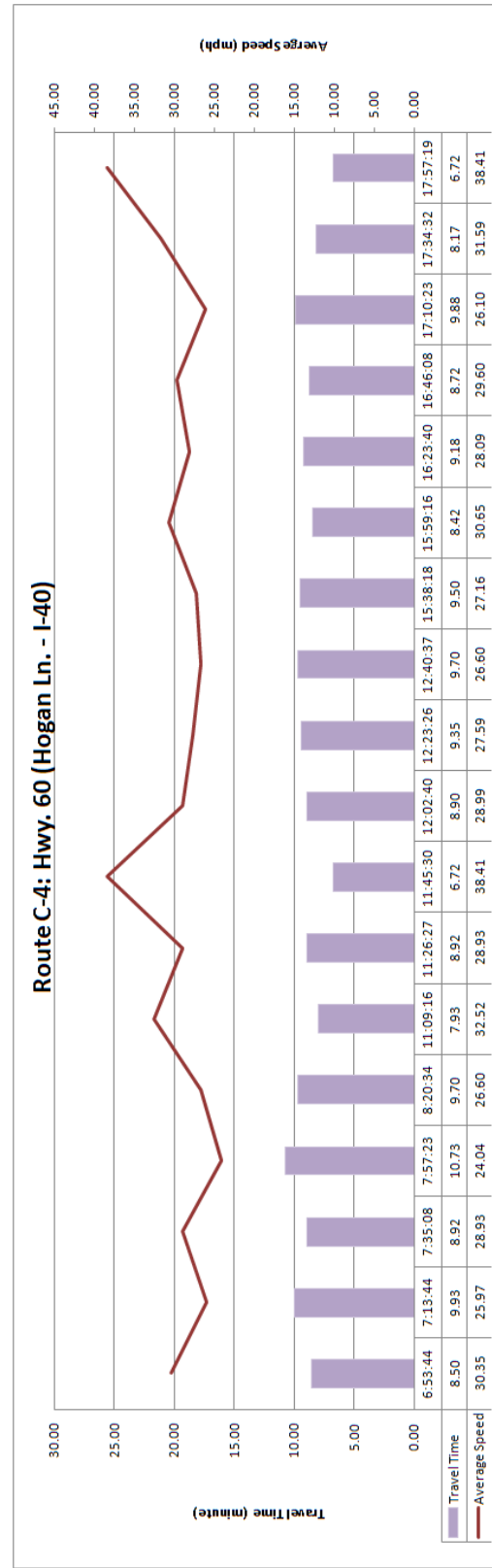
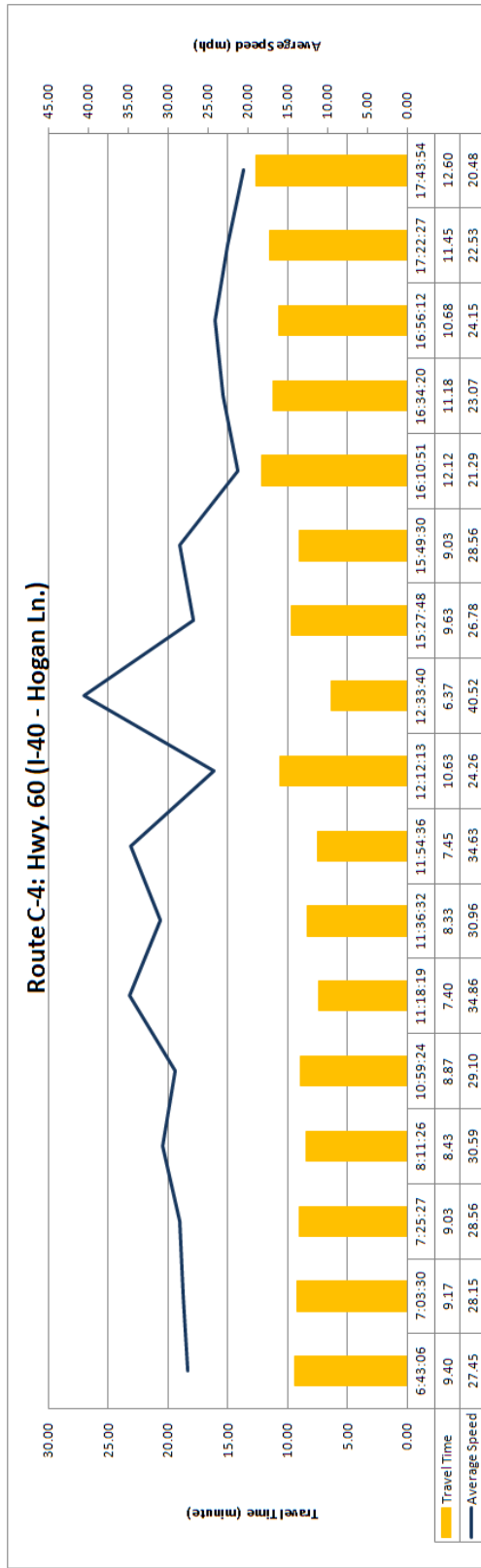


Table A.5. Route C-5 - Highway 89 Travel Time Summaries
(A @ Douglas Road, B @ Hwy. 321)

A-B	Departure Time	Travel Time (min)	Additional Time	Travel Time Index	Avg. Speed
	6:46:43	9.05	0:00:00	1.00	31.82
	7:12:50	11.25	0:02:12	1.24	25.60
Poor	7:46:06	21.58	0:12:32	2.38	13.34
	11:10:22	11.10	0:02:03	1.23	25.95
	11:36:51	12.05	0:03:00	1.33	23.90
	12:04:33	12.17	0:03:07	1.34	23.67
	15:01:35	12.02	0:02:58	1.33	23.97
Poor	15:28:23	21.18	0:12:08	2.34	13.60
	16:20:30	10.93	0:01:53	1.21	26.34
	16:48:19	13.02	0:03:58	1.44	22.13
	17:15:16	12.70	0:03:39	1.40	22.68
B-A	Departure Time	Travel Time (min)	Additional Time	Travel Time Index	Avg. Speed
	6:57:35	11.70	0:02:39	1.29	24.62
	7:24:54	13.88	0:04:50	1.53	20.74
	8:28:17	10.52	0:01:28	1.16	27.39
	11:22:45	12.58	0:03:32	1.39	22.89
	11:49:35	11.70	0:02:39	1.29	24.62
	12:17:24	10.02	0:00:58	1.11	28.75
	15:50:43	13.13	0:04:05	1.45	21.93
	16:31:56	15.52	0:06:28	1.71	18.56
	17:01:56	12.23	0:03:11	1.35	23.54
	17:32:09	12.48	0:03:26	1.38	23.07

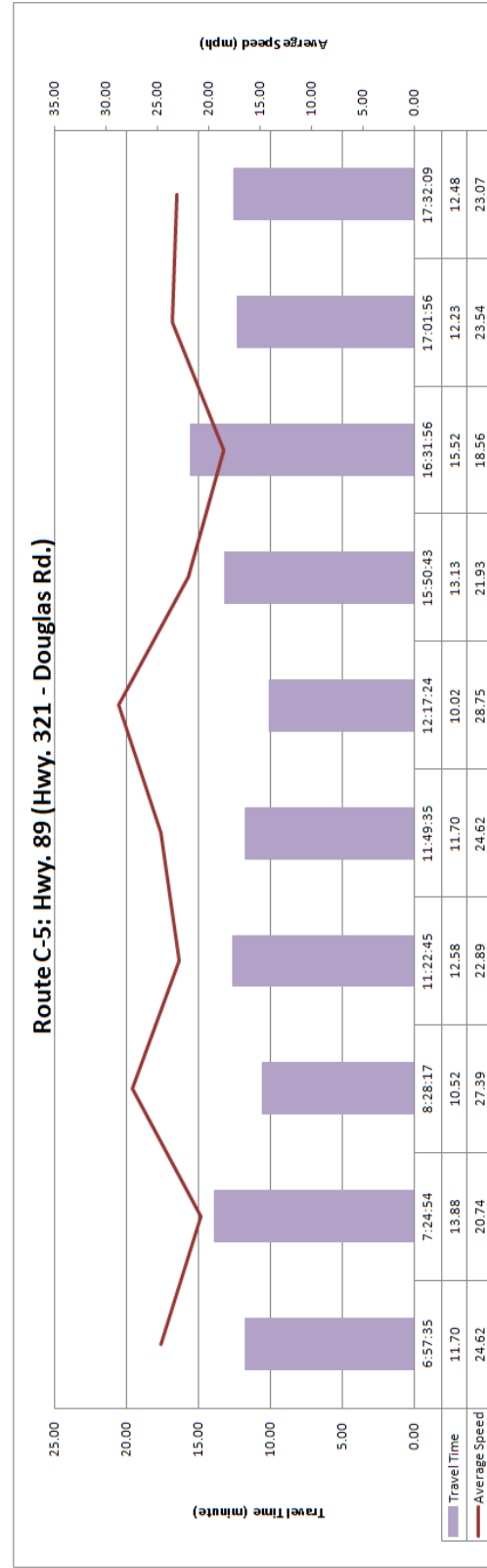
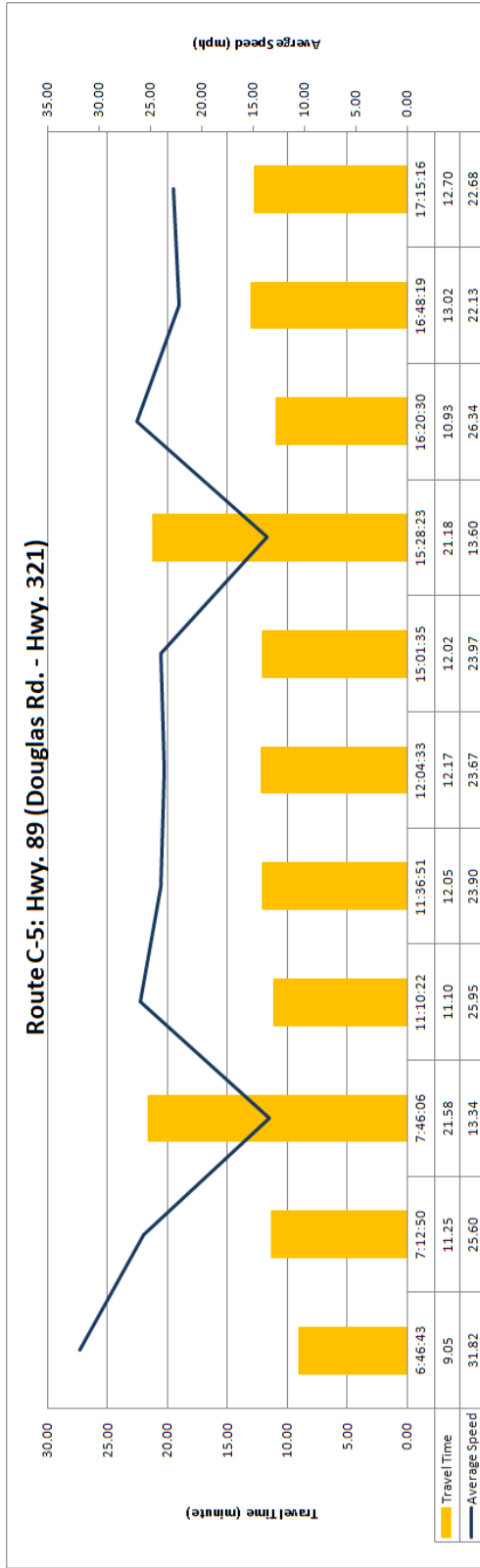


Table A.6. Route C-6 - Highways 365/70 Travel Time Summaries
(A @ Roosevelt Road, B @ I-40)

A-B	Departure Time	Travel Time (min)	Additional Time	Travel Time Index	Avg. Speed
	6:51:44	9.78	0:00:00	1.00	28.82
	7:09:14	11.40	0:01:37	1.17	24.74
	7:22:43	12.85	0:03:04	1.31	21.95
	7:47:12	13.28	0:03:30	1.36	21.23
	8:05:08	12.83	0:03:03	1.31	21.97
	11:00:50	11.72	0:01:56	1.20	24.07
	11:15:54	12.07	0:02:17	1.23	23.37
	11:31:33	11.37	0:01:35	1.16	24.81
	11:47:23	11.35	0:01:34	1.16	24.85
	12:05:39	10.68	0:00:54	1.09	26.40
	12:21:15	11.30	0:01:31	1.16	24.96
	12:36:11	10.68	0:00:54	1.09	26.40
	12:52:54	11.67	0:01:53	1.19	24.17
	13:06:37	11.45	0:01:40	1.17	24.63
	15:32:48	12.18	0:02:24	1.25	23.15
	15:58:53	13.58	0:03:48	1.39	20.76
	16:13:07	12.23	0:02:27	1.25	23.05
	16:34:16	14.48	0:04:42	1.48	19.47
	16:48:48	14.22	0:04:26	1.45	19.84
Poor	17:13:39	16.02	0:06:14	1.64	17.61
	17:32:03	11.92	0:02:08	1.22	23.66
B-A	Departure Time	Travel Time (min)	Additional Time	Travel Time Index	Avg. Speed
	6:54:54	11.82	0:02:02	1.21	23.86
	7:10:18	11.45	0:01:40	1.17	24.63
	7:30:22	15.52	0:05:44	1.59	18.17
Poor	7:45:08	18.70	0:08:55	1.91	15.08
	8:07:42	17.03	0:07:15	1.74	16.56
	11:03:53	10.65	0:00:52	1.09	26.48
	11:20:08	10.27	0:00:29	1.05	27.47
	11:35:01	10.95	0:01:10	1.12	25.75
	11:53:30	10.60	0:00:49	1.08	26.60
	12:08:31	11.43	0:01:39	1.17	24.66
	12:24:57	10.03	0:00:15	1.03	28.11
	12:39:38	11.62	0:01:50	1.19	24.28
	12:54:36	11.08	0:01:18	1.13	25.44
	13:17:19	10.70	0:00:55	1.09	26.36
	15:45:01	11.68	0:01:54	1.19	24.14
	15:58:55	10.67	0:00:53	1.09	26.44
	16:20:50	11.82	0:02:02	1.21	23.86
	16:34:15	13.42	0:03:38	1.37	21.02
	16:57:48	13.78	0:04:00	1.41	20.46
	17:18:25	11.58	0:01:48	1.18	24.35
	17:39:36	12.13	0:02:21	1.24	23.24

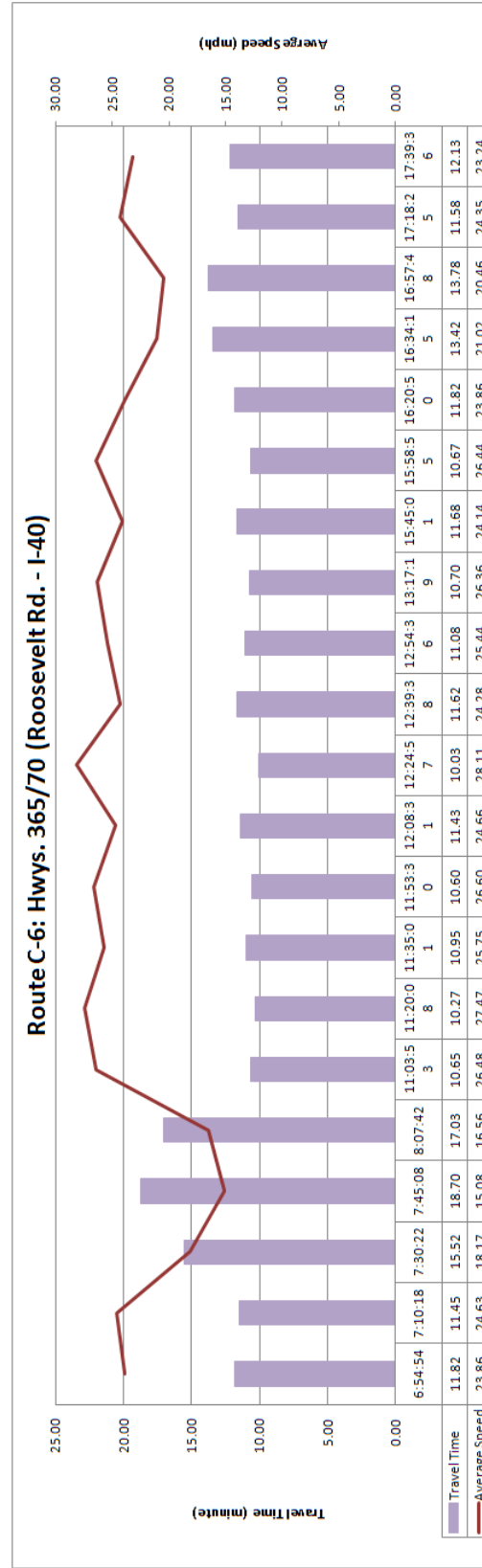
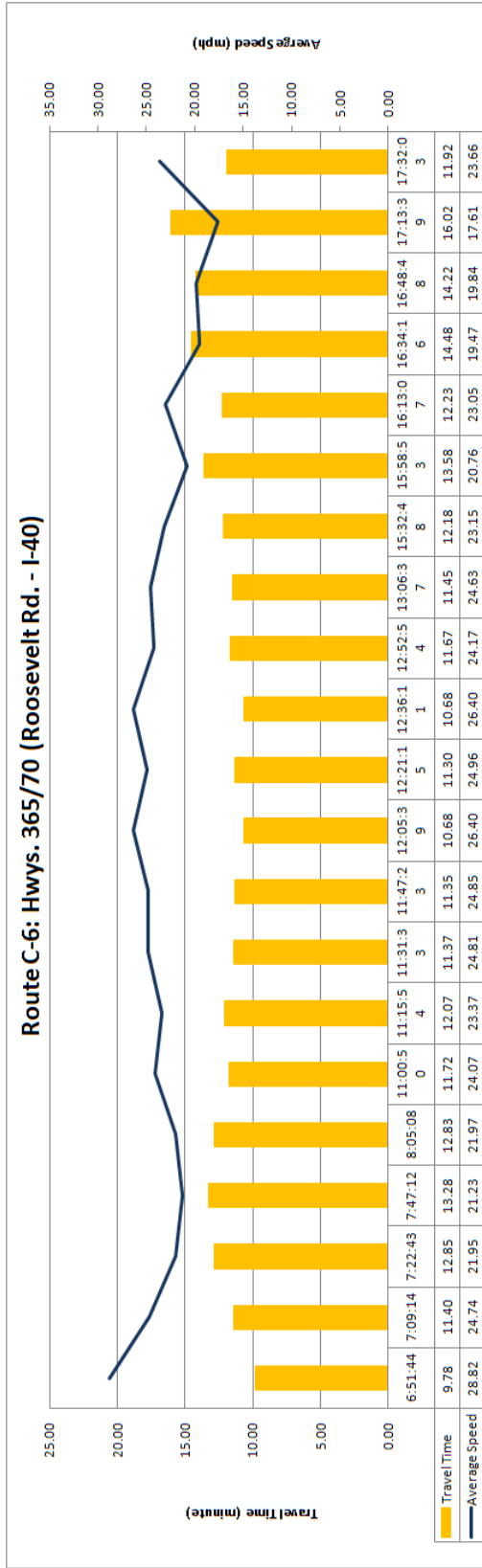


Table A.7. Route C-7 - Highways 300/5/70 Travel Time Summaries
(A @ Bowman Road, B @ Arch Street)

A-B	Departure Time	Travel Time (min)	Additional Time	Travel Time Index	Avg. Speed
	7:10:08	16.62	0:02:23	1.17	29.25
	7:28:02	18.08	0:03:51	1.27	26.88
Poor	7:43:56	19.57	0:05:20	1.37	24.84
	8:04:44	14.85	0:00:37	1.04	32.73
	8:22:26	15.20	0:00:58	1.07	31.97
	11:31:17	15.20	0:00:58	1.07	31.97
	15:31:54	17.03	0:02:48	1.20	28.53
Poor	16:04:34	18.40	0:04:10	1.29	26.41
B-A	Departure Time	Travel Time (min)	Additional Time	Travel Time Index	Avg. Speed
	7:08:45	17.08	0:02:51	1.20	28.45
	7:27:34	15.05	0:00:49	1.06	32.29
	7:47:08	16.33	0:02:06	1.15	29.76
	8:04:23	17.17	0:02:56	1.21	28.31
	8:20:34	17.30	0:03:04	1.22	28.09
	11:14:40	14.23	0:00:00	1.00	34.15
	15:35:06	15.87	0:01:38	1.11	30.63
	15:50:05	15.68	0:01:27	1.10	30.99

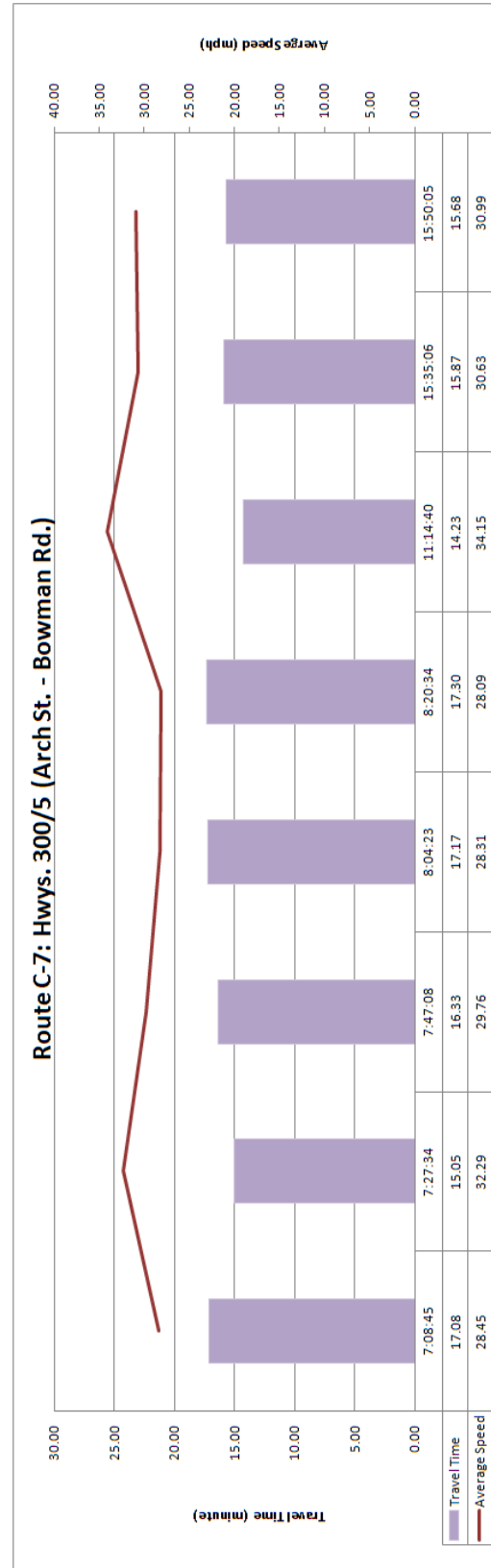
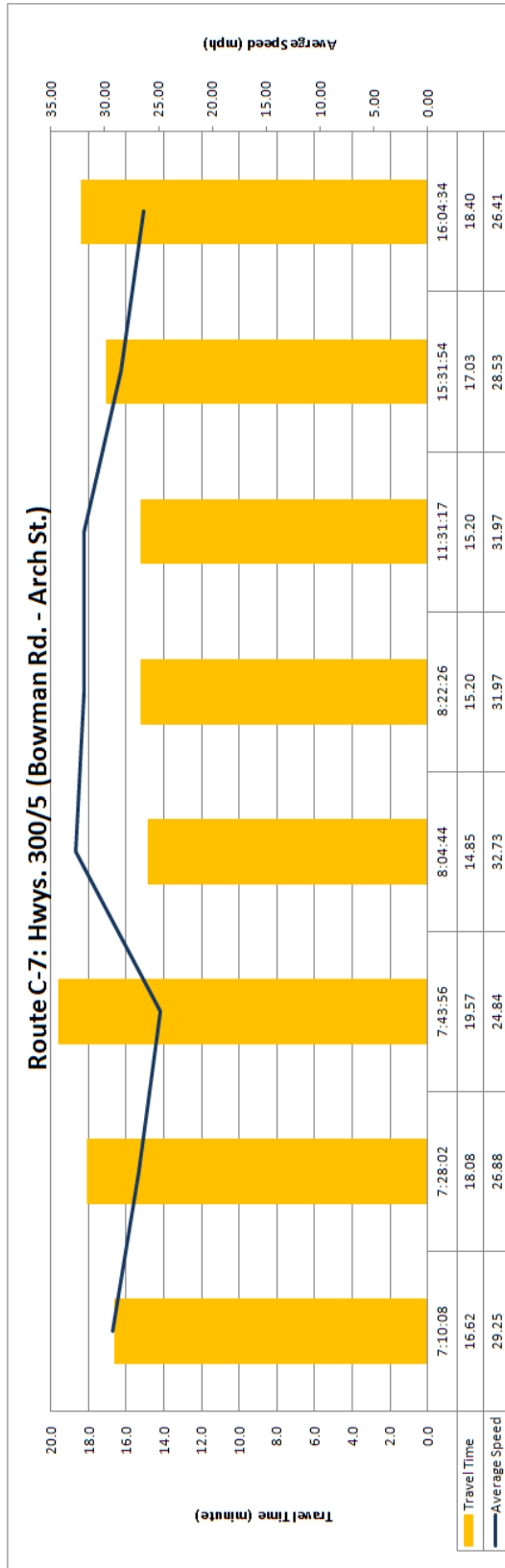


Table A.8. Route C-8 - Highway 107 Travel Time Summaries
(A @ I-40, B @ Hwy. 176)

A-B	Departure Time	Travel Time (min)	Additional Time	Travel Time Index	Avg. Speed
	6:55:23	12.83	0:04:30	1.54	22.44
Poor	7:24:24	16.28	0:07:57	1.95	17.69
	7:59:17	14.23	0:05:54	1.71	20.23
	15:29:30	10.00	0:01:40	1.20	28.80
	15:52:37	14.08	0:05:45	1.69	20.45
	16:23:05	14.42	0:06:05	1.73	19.98
	16:52:01	14.77	0:06:26	1.77	19.50
Poor	17:20:55	16.80	0:08:28	2.02	17.14
B-A	Departure Time	Travel Time (min)	Additional Time	Travel Time Index	Avg. Speed
	7:08:54	14.33	0:06:00	1.72	20.09
	7:42:40	15.02	0:06:41	1.80	19.18
	8:15:00	13.02	0:04:41	1.56	22.13
	15:41:19	8.33	0:00:00	1.00	34.56
	16:08:47	12.68	0:04:21	1.52	22.71
	16:38:08	11.80	0:03:28	1.42	24.41
	17:07:27	10.90	0:02:34	1.31	26.42
	17:38:28	10.93	0:02:36	1.31	26.34

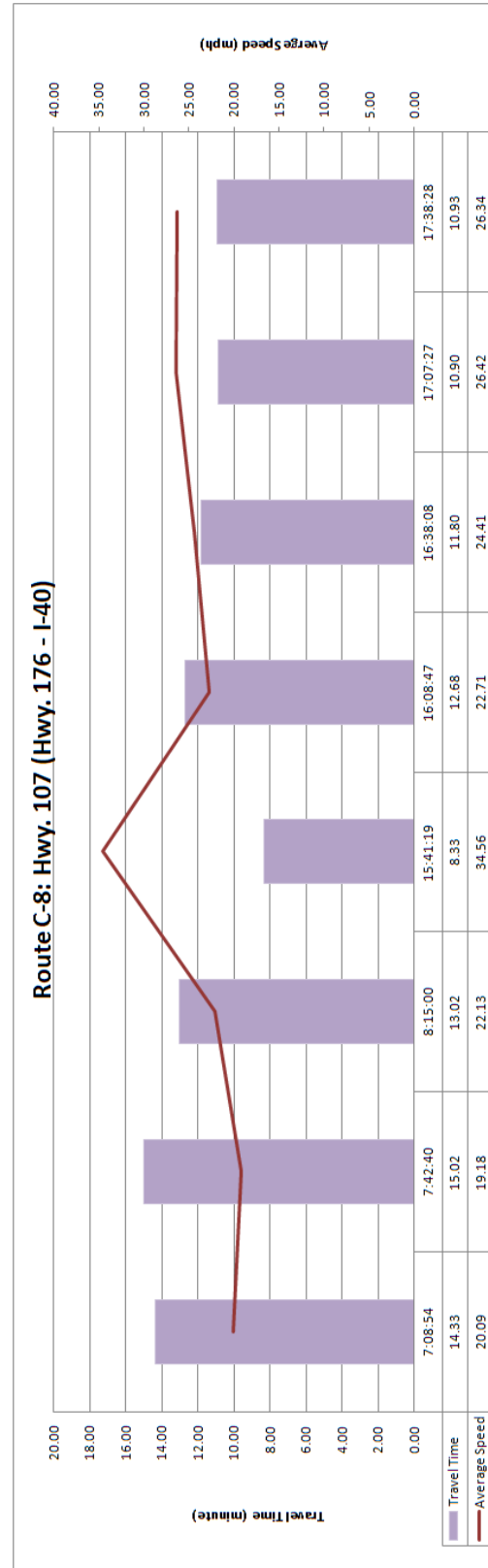
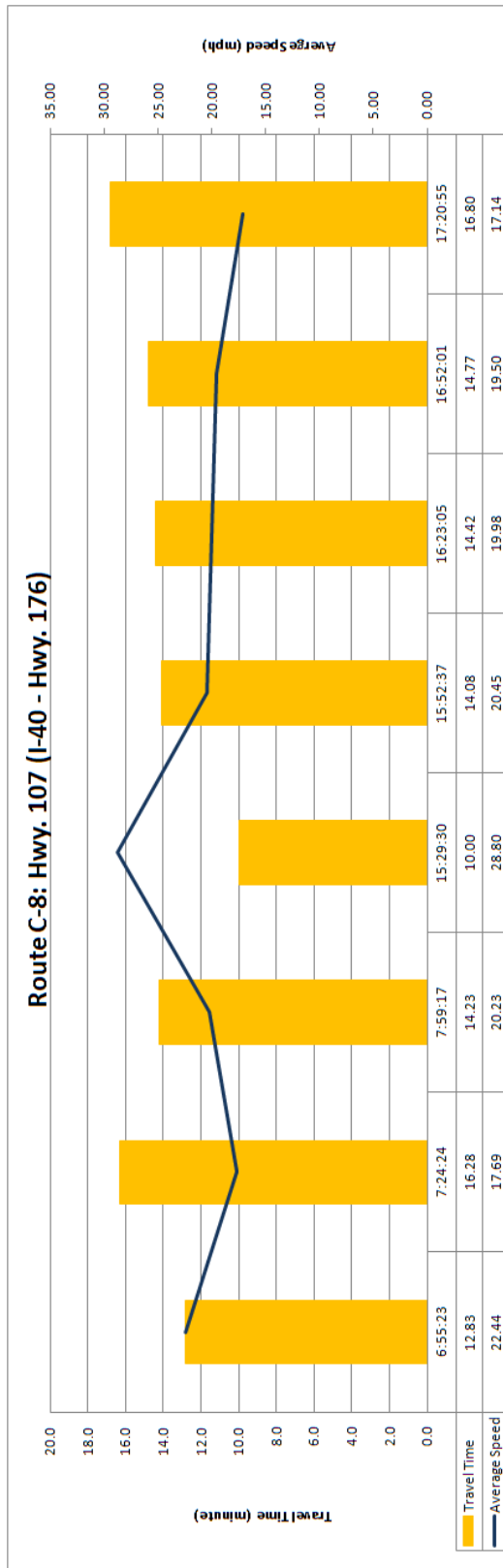


Table A.9. Route C-9 - Highway 70 Travel Time Summaries
(A @ I-30, B @ Hwy. 5)

A-B	Departure Time	Travel Time (min)	Additional Time	Travel Time Index	Avg. Speed
	6:46:43	5.60	0:01:47	1.47	26.79
	7:00:10	4.20	0:00:23	1.10	35.71
	7:14:06	5.00	0:01:11	1.31	30.00
	7:27:27	6.50	0:02:41	1.70	23.08
Poor	7:43:49	7.17	0:03:21	1.88	20.93
	8:00:16	5.63	0:01:49	1.48	26.63
	8:15:21	4.22	0:00:24	1.10	35.57
	15:29:30	4.88	0:01:04	1.28	30.72
	15:42:46	4.90	0:01:05	1.28	30.61
	15:56:02	4.92	0:01:06	1.29	30.51
	16:09:25	4.90	0:01:05	1.28	30.61
Poor	16:31:17	6.13	0:02:19	1.61	24.46
	16:49:15	5.03	0:01:13	1.32	29.80
	17:04:33	4.73	0:00:55	1.24	31.69
	17:20:25	5.50	0:01:41	1.44	27.27
B-A	Departure Time	Travel Time (min)	Additional Time	Travel Time Index	Avg. Speed
	6:54:01	3.82	0:00:00	1.00	39.30
	7:20:36	4.02	0:00:12	1.05	37.34
	7:35:39	4.70	0:00:53	1.23	31.91
	7:54:02	4.60	0:00:47	1.21	32.61
	8:10:21	4.13	0:00:19	1.08	36.29
	8:23:42	4.10	0:00:17	1.07	36.59
	15:37:14	4.12	0:00:18	1.08	36.44
	15:50:47	4.27	0:00:27	1.12	35.16
	16:02:29	4.93	0:01:07	1.29	30.41
	16:20:42	4.75	0:00:56	1.24	31.58
	16:58:50	4.63	0:00:49	1.21	32.37
	17:13:52	4.80	0:00:59	1.26	31.25
	17:28:50	4.68	0:00:52	1.23	32.03
	17:44:10	3.82	0:00:00	1.00	39.30

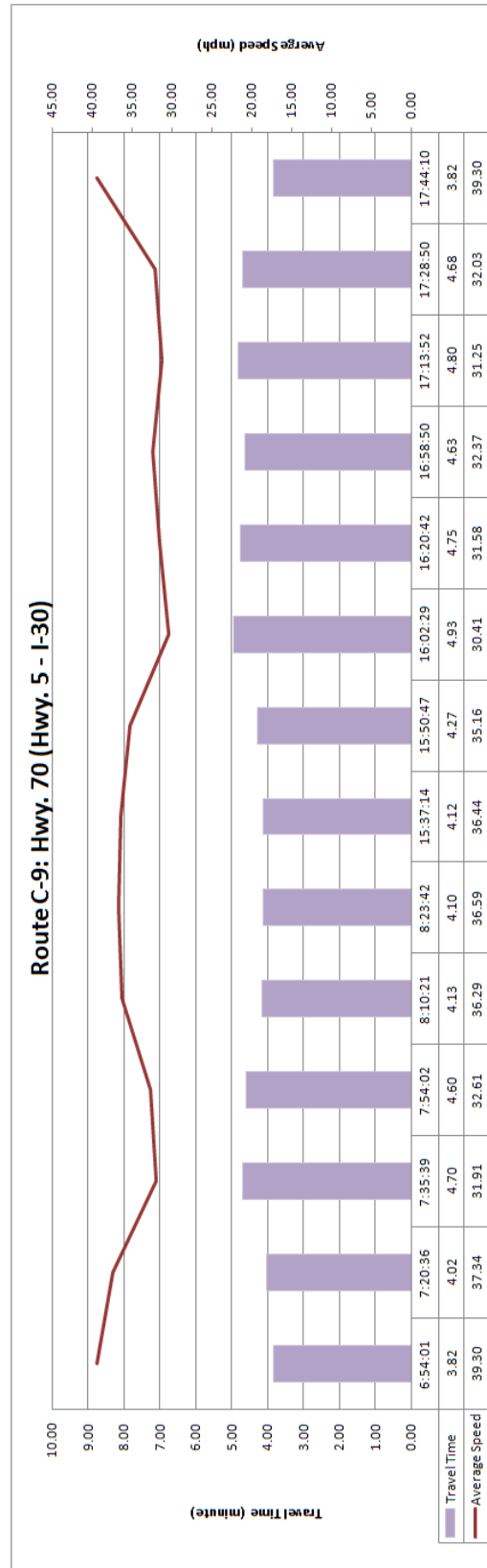
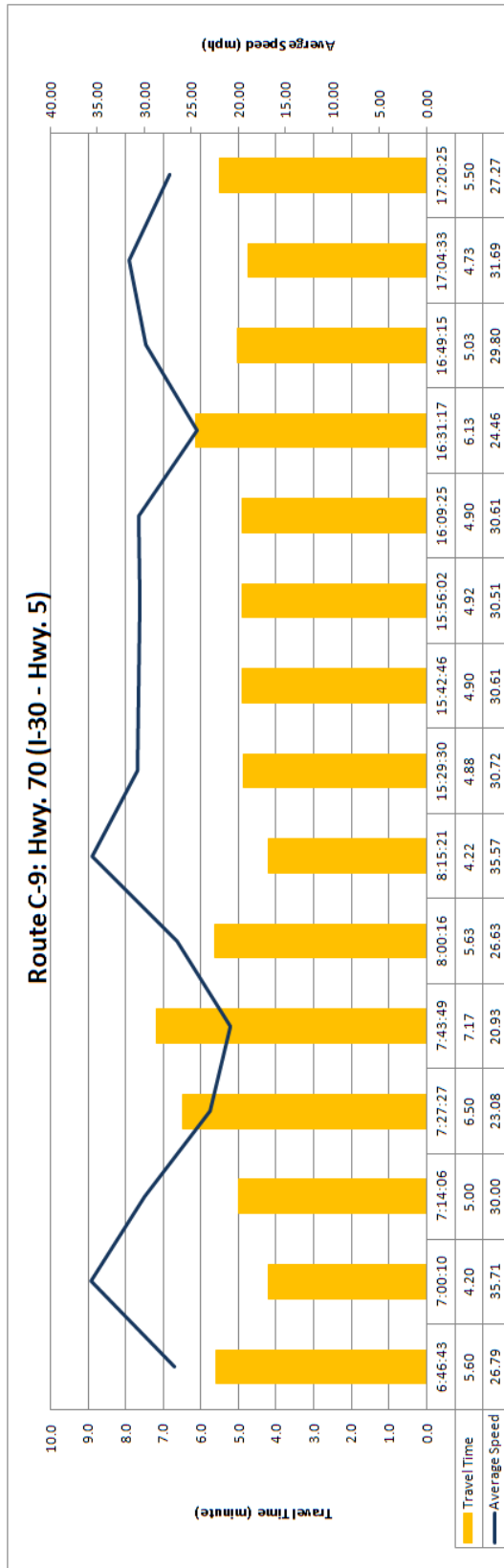


Table A.10. Route C-10 - I-30/I-430 Travel Time Summaries
(A @ Congo Road, B @ Hwy. 300)

A-B	Departure Time	Travel Time (min)	Additional Time	Travel Time Index	Avg. Speed
	6:53:29	14.92	0:01:58	1.15	56.31
	7:17:20	17.40	0:04:27	1.34	48.28
Poor	7:34:48	17.78	0:04:50	1.37	47.24
	7:55:03	15.47	0:02:31	1.19	54.31
	8:15:07	15.07	0:02:07	1.16	55.75
	8:31:47	14.80	0:01:51	1.14	56.76
	15:36:44	15.25	0:02:18	1.18	55.08
	15:56:17	14.95	0:02:00	1.15	56.19
	16:13:37	14.27	0:01:19	1.10	58.88
	16:37:11	12.95	0:00:00	1.00	64.86
	16:54:27	13.93	0:00:59	1.08	60.29
	17:18:54	14.03	0:01:05	1.08	59.86
	17:34:18	15.12	0:02:10	1.17	55.57
B-A	Departure Time	Travel Time (min)	Additional Time	Travel Time Index	Avg. Speed
	6:56:11	15.12	0:02:10	1.17	55.57
	7:16:02	13.75	0:00:48	1.06	61.09
	7:35:10	14.87	0:01:55	1.15	56.50
	7:54:27	13.80	0:00:51	1.07	60.87
	8:12:48	14.28	0:01:20	1.10	58.81
	15:35:08	14.23	0:01:17	1.10	59.02
	15:53:03	15.45	0:02:30	1.19	54.37
	16:13:39	16.23	0:03:17	1.25	51.75
	16:28:21	15.70	0:02:45	1.21	53.50
Poor	16:51:52	21.10	0:08:09	1.63	39.81
	17:09:28	19.03	0:06:05	1.47	44.13
	17:33:10	19.20	0:06:15	1.48	43.75

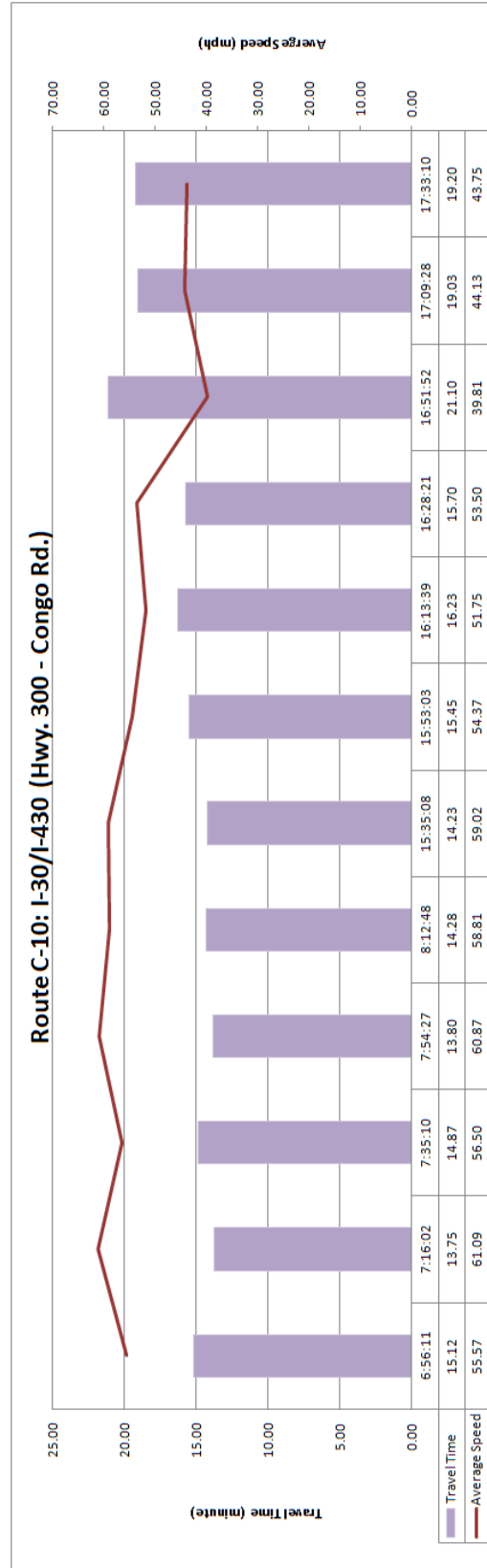
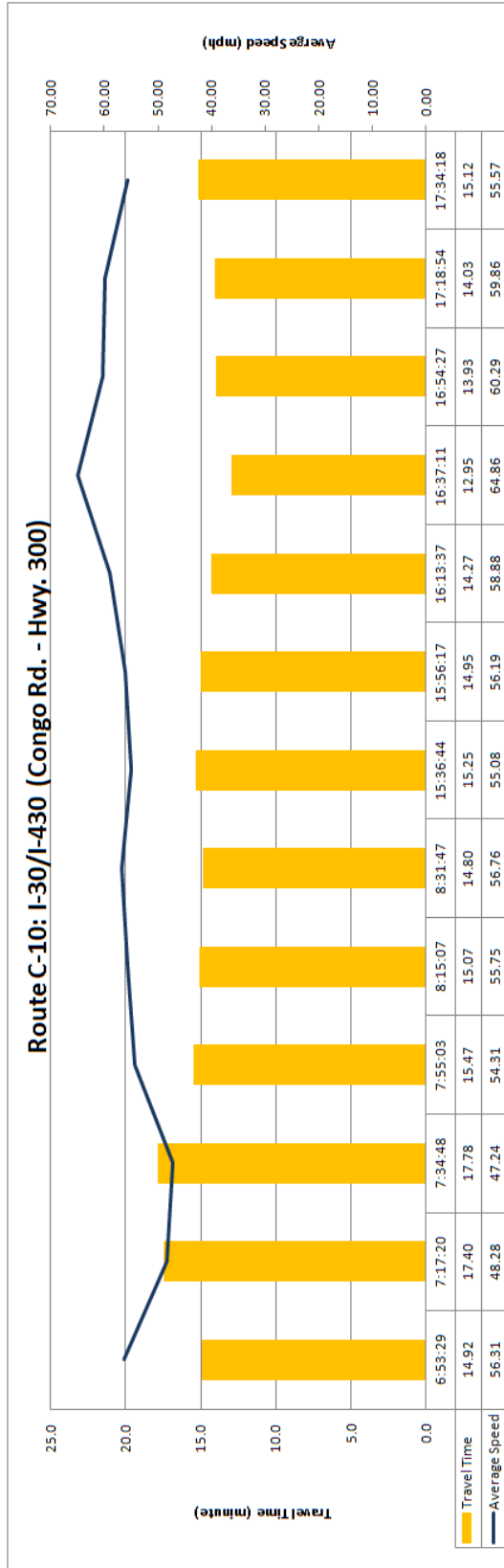


Table A.11. Route C-11 - I-30 Frontage Road/Highway 5 Travel Time Summaries
(A @ Congo Road, B @ Hwy. 338)

A-B	Departure Time	Travel Time (min)	Additional Time	Travel Time Index	Avg. Speed
	7:01:52	15.23	0:01:39	1.12	48.84
	7:25:36	14.93	0:01:21	1.10	49.82
	7:50:38	15.20	0:01:37	1.12	48.95
Poor	8:09:23	17.15	0:03:34	1.26	43.38
	15:36:02	14.82	0:01:14	1.09	50.21
	16:00:09	14.72	0:01:08	1.08	50.55
	16:17:23	14.32	0:00:44	1.05	51.97
	16:43:43	14.68	0:01:06	1.08	50.67
	17:01:12	14.07	0:00:29	1.04	52.89
	17:28:49	14.93	0:01:21	1.10	49.82
	17:45:11	13.58	0:00:00	1.00	54.77
	18:10:57	14.22	0:00:38	1.05	52.33
B-A	Departure Time	Travel Time (min)	Additional Time	Travel Time Index	Avg. Speed
	6:57:37	16.00	0:02:25	1.18	46.50
	7:19:45	16.05	0:02:28	1.18	46.36
	7:42:00	15.23	0:01:39	1.12	48.84
	8:07:01	15.23	0:01:39	1.12	48.84
	15:51:15	14.62	0:01:02	1.08	50.90
	16:36:37	14.10	0:00:31	1.04	52.77
	17:02:04	15.57	0:01:59	1.15	47.79
	17:15:45	14.77	0:01:11	1.09	50.38
Poor	17:43:53	16.28	0:02:42	1.20	45.69

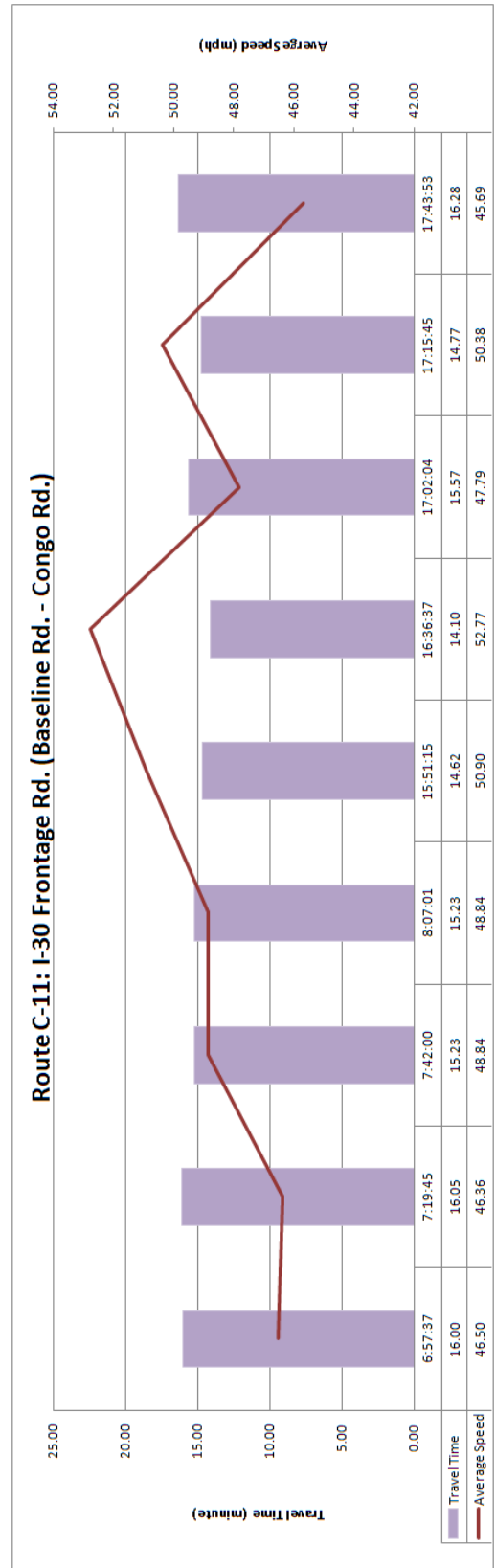
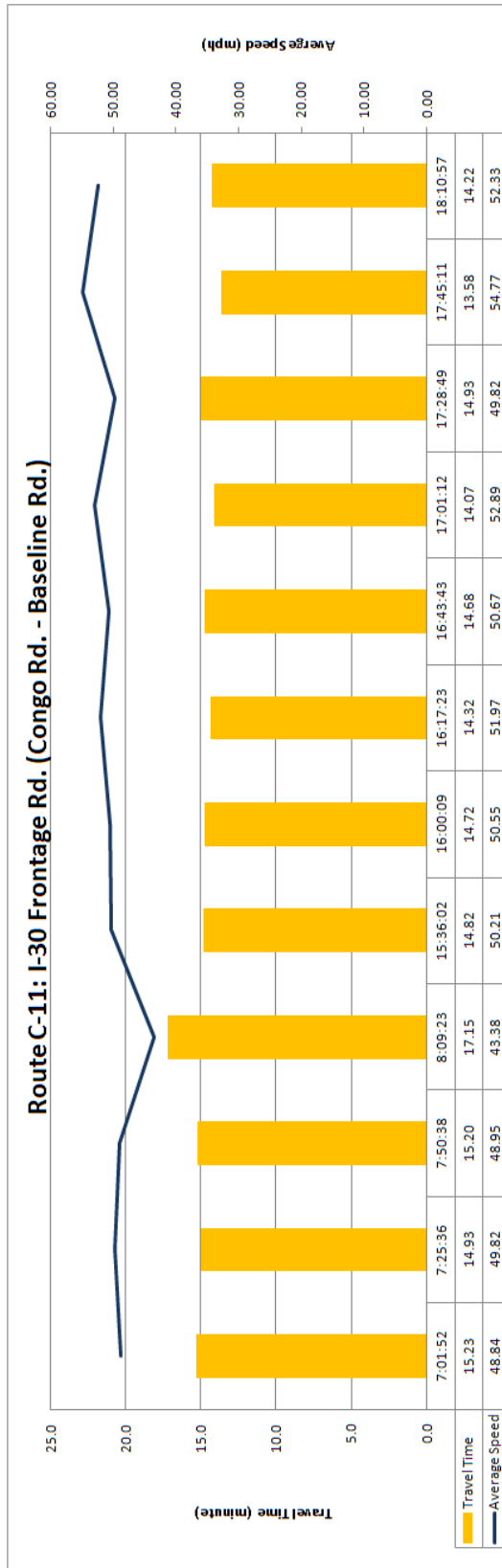


Table A.12. Route C-12 - Highway 67/I-440 Travel Time Summaries
(A @ Hwy. 89, B @ I-40)

A-B	Departure Time	Travel Time (min)	Additional Time	Travel Time Index	Avg. Speed
	6:49:16	15.95	0:01:13	1.08	62.82
Poor	7:08:23	20.48	0:05:45	1.39	48.92
	7:29:52	18.30	0:03:34	1.24	54.75
	7:48:18	17.93	0:03:12	1.22	55.87
	8:09:18	15.95	0:01:13	1.08	62.82
	8:27:20	16.63	0:01:54	1.13	60.24
	15:32:58	14.80	0:00:04	1.00	67.70
	16:07:20	15.02	0:00:17	1.02	66.73
	16:32:24	18.10	0:03:22	1.23	55.36
	16:49:57	14.73	0:00:00	1.00	68.01
	17:13:27	18.73	0:04:00	1.27	53.49
	17:39:42	15.10	0:00:22	1.02	66.36
B-A	Departure Time	Travel Time (min)	Additional Time	Travel Time Index	Avg. Speed
	6:50:43	16.67	0:01:56	1.13	60.12
	7:10:00	16.23	0:01:30	1.10	61.72
	7:32:07	16.05	0:01:19	1.09	62.43
	7:51:46	14.85	0:00:07	1.01	67.47
	8:09:50	16.02	0:01:17	1.09	62.56
	15:34:34	16.28	0:01:33	1.11	61.54
	15:50:46	15.42	0:00:41	1.05	64.99
	16:11:20	18.72	0:03:59	1.27	53.54
	16:25:21	18.38	0:03:39	1.25	54.51
	16:53:32	19.75	0:05:01	1.34	50.73
	17:13:04	22.90	0:08:10	1.55	43.76
Poor	17:34:58	25.65	0:10:55	1.74	39.06

Table A.13. Route C-13 - Highway 67/I-40/I-30 Travel Time Summaries
(A @ Redmond Road, B @ Roosevelt Road)

A-B	Departure Time	Travel Time (min)	Additional Time	Travel Time Index	Avg. Speed
	6:28:17	12.47	0:00:21	1.03	64.49
	6:45:40	15.02	0:02:54	1.24	53.54
	6:55:47	13.40	0:01:17	1.11	60.00
Poor	7:15:57	19.97	0:07:51	1.65	40.27
	7:26:54	18.97	0:06:51	1.57	42.39
	7:52:42	18.68	0:06:34	1.54	43.03
	8:01:16	15.47	0:03:21	1.28	51.98
	15:34:11	15.07	0:02:57	1.24	53.36
	15:50:34	12.75	0:00:38	1.05	63.06
	16:10:54	15.65	0:03:32	1.29	51.37
	16:20:14	13.27	0:01:09	1.09	60.60
	16:51:51	14.78	0:02:40	1.22	54.39
	17:14:10	12.12	0:00:00	1.00	66.35
	17:26:48	14.02	0:01:54	1.16	57.36
	17:49:45	12.72	0:00:36	1.05	63.22
B-A	Departure Time	Travel Time (min)	Additional Time	Travel Time Index	Avg. Speed
	6:29:39	15.13	0:03:01	1.25	53.13
	6:42:28	12.17	0:00:03	1.00	66.08
	7:01:13	14.18	0:02:04	1.17	56.69
	7:10:45	12.72	0:00:36	1.05	63.22
	7:37:05	15.07	0:02:57	1.24	53.36
	7:46:06	13.93	0:01:49	1.15	57.70
	8:12:30	15.43	0:03:19	1.27	52.10
	15:16:06	17.98	0:05:52	1.48	44.71
	15:52:17	18.48	0:06:22	1.53	43.50
	16:04:12	15.50	0:03:23	1.28	51.87
	16:32:07	19.57	0:07:27	1.61	41.09
	16:47:25	17.68	0:05:34	1.46	45.47
Poor	17:06:45	19.95	0:07:50	1.65	40.30
	17:28:06	16.33	0:04:13	1.35	49.22
	17:49:26	14.40	0:02:17	1.19	55.83

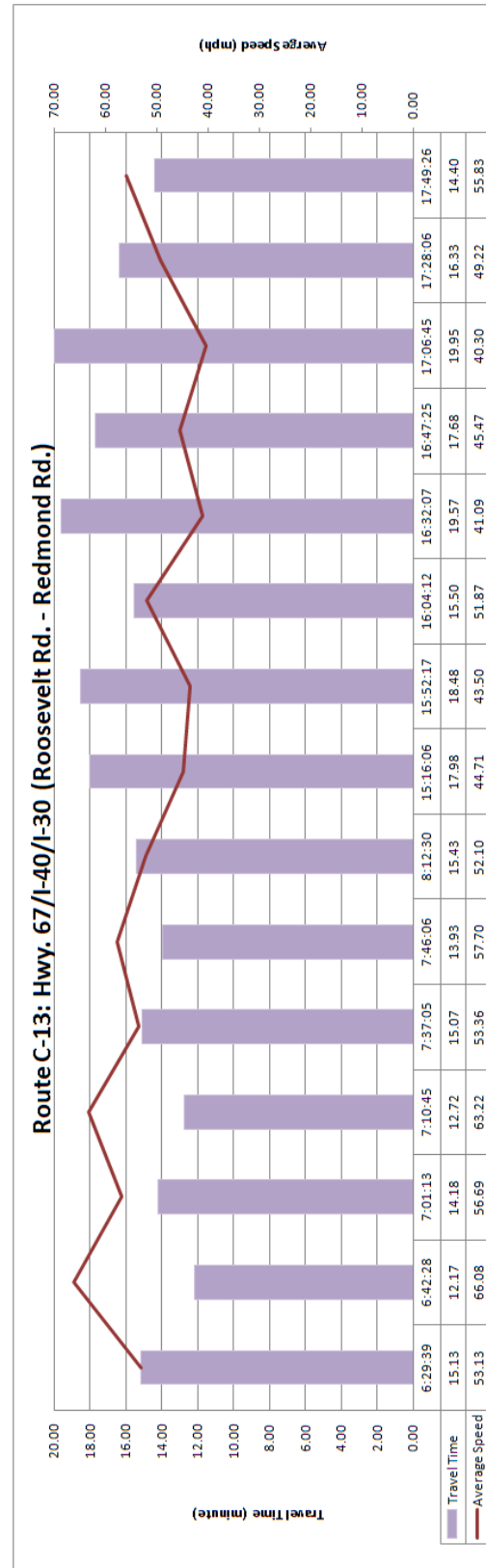
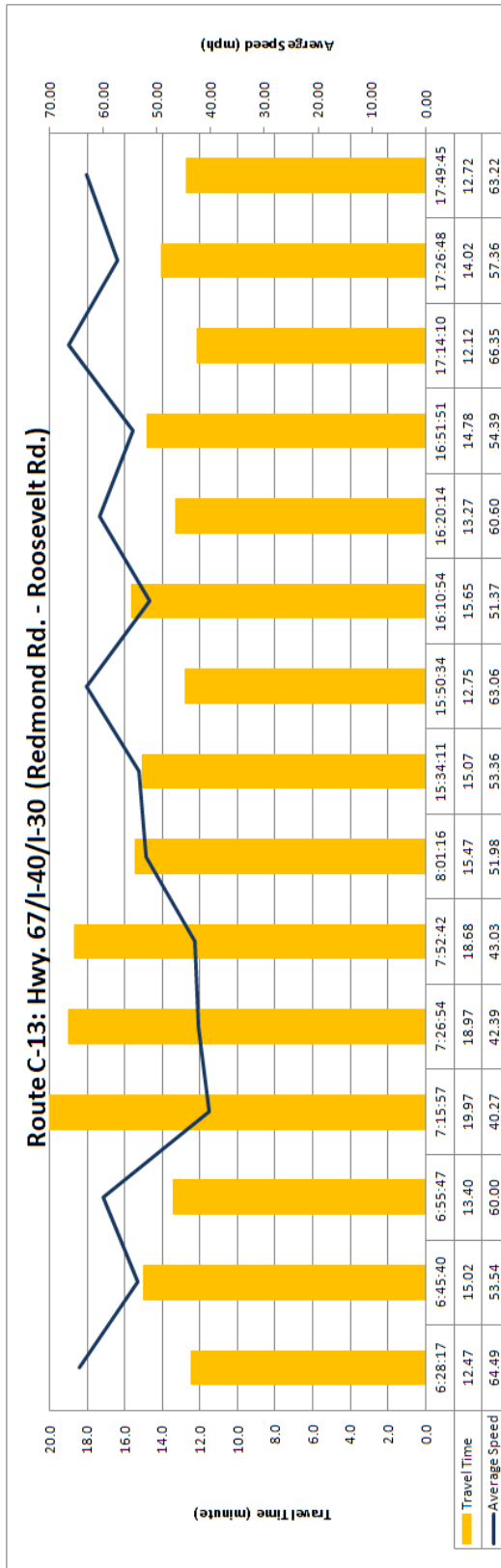


Table A.14. Route C-14 - I-40/I-430/I-630 Travel Time Summaries
(A @ Hwy. 365, B @ Lile Dr.)

A-B	Departure Time	Travel Time (min)	Additional Time	Travel Time Index	Avg. Speed
	6:49:26	12.55	0:00:54	1.08	58.33
	7:07:10	16.97	0:05:19	1.46	43.14
	7:16:58	21.65	0:10:00	1.86	33.81
Poor	7:38:41	23.63	0:11:59	2.03	30.97
	7:52:21	20.65	0:09:00	1.77	35.45
	8:19:45	13.00	0:01:21	1.12	56.31
	15:42:19	12.55	0:00:54	1.08	58.33
	16:03:07	12.08	0:00:26	1.04	60.58
	16:13:42	12.00	0:00:21	1.03	61.00
	16:31:34	12.82	0:01:10	1.10	57.11
	16:41:34	11.65	0:00:00	1.00	62.83
	17:04:46	15.57	0:03:55	1.34	47.02
	17:17:35	12.32	0:00:40	1.06	59.43
	17:43:33	12.13	0:00:29	1.04	60.33
B-A	Departure Time	Travel Time (min)	Additional Time	Travel Time Index	Avg. Speed
	7:02:12	13.28	0:01:38	1.14	55.11
	7:24:50	13.85	0:02:12	1.19	52.85
	7:38:44	13.52	0:01:52	1.16	54.16
	8:06:50	12.32	0:00:40	1.06	59.43
	8:13:06	13.72	0:02:04	1.18	53.37
	15:42:33	12.90	0:01:15	1.11	56.74
	15:55:30	12.25	0:00:36	1.05	59.76
	16:16:16	15.18	0:03:32	1.30	48.21
	16:28:12	12.10	0:00:27	1.04	60.50
	16:45:28	14.53	0:02:53	1.25	50.37
	17:02:39	13.87	0:02:13	1.19	52.79
Poor	17:21:08	21.47	0:09:49	1.84	34.10
	17:30:26	17.48	0:05:50	1.50	41.87

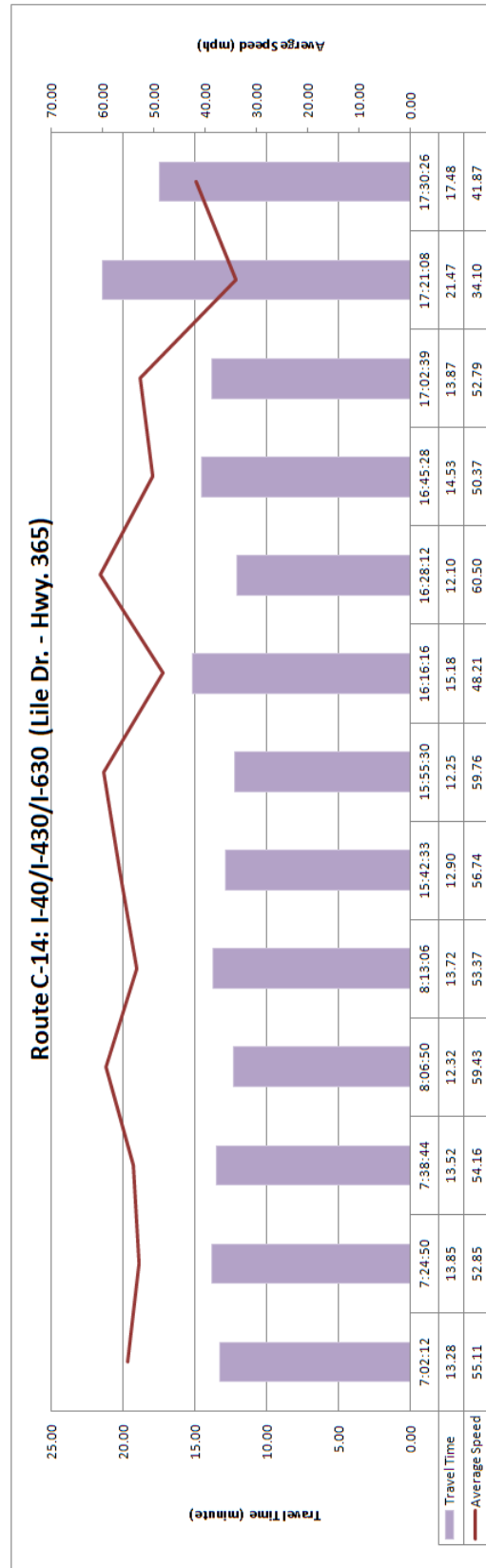
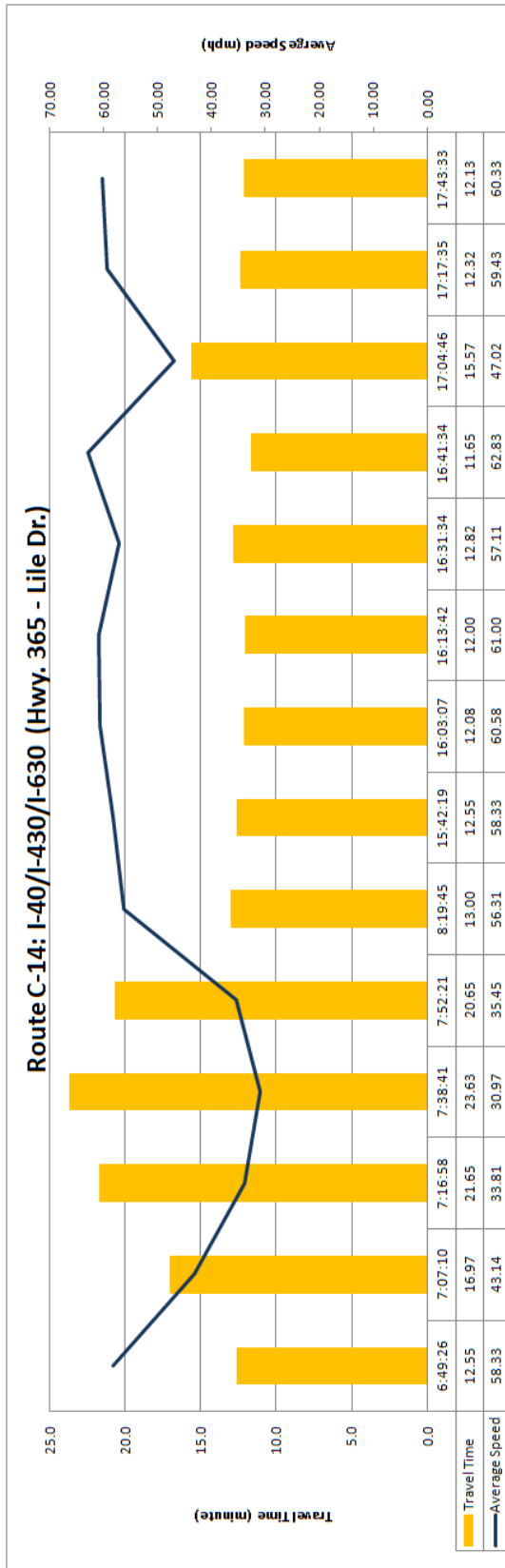


Table A.15. Route C-15 - I-40 Travel Time Summaries
(A @ Hwy. 65, B @Hwy. 365)

A-B	Departure Time	Travel Time (min)	Additional Time	Travel Time Index	Avg. Speed
	7:06:19	21.83	0:07:14	1.50	46.72
Poor	7:26:41	26.52	0:11:55	1.82	38.47
	7:46:34	22.53	0:07:56	1.54	45.27
	8:12:25	18.65	0:04:03	1.28	54.69
	8:26:26	16.22	0:01:37	1.11	62.90
	15:33:20	14.60	0:00:00	1.00	69.86
	15:51:31	17.20	0:02:36	1.18	59.30
	16:06:55	15.73	0:01:08	1.08	64.83
	16:27:57	17.03	0:02:26	1.17	59.88
	16:41:16	15.05	0:00:27	1.03	67.77
	17:02:55	16.57	0:01:58	1.13	61.57
	17:16:01	14.77	0:00:10	1.01	69.07
	17:41:12	17.17	0:02:34	1.18	59.42
B-A	Departure Time	Travel Time (min)	Additional Time	Travel Time Index	Avg. Speed
	7:08:55	17.18	0:02:35	1.18	59.36
	7:29:17	15.85	0:01:15	1.09	64.35
	7:54:23	16.98	0:02:23	1.16	60.06
	8:10:19	15.93	0:01:20	1.09	64.02
	15:32:30	17.67	0:03:04	1.21	57.74
	16:09:41	16.35	0:01:45	1.12	62.39
	16:23:52	16.42	0:01:49	1.12	62.13
	16:45:34	15.98	0:01:23	1.09	63.82
	16:57:16	15.40	0:00:48	1.05	66.23
Poor	17:22:08	18.77	0:04:10	1.29	54.35
	17:31:35	17.90	0:03:18	1.23	56.98

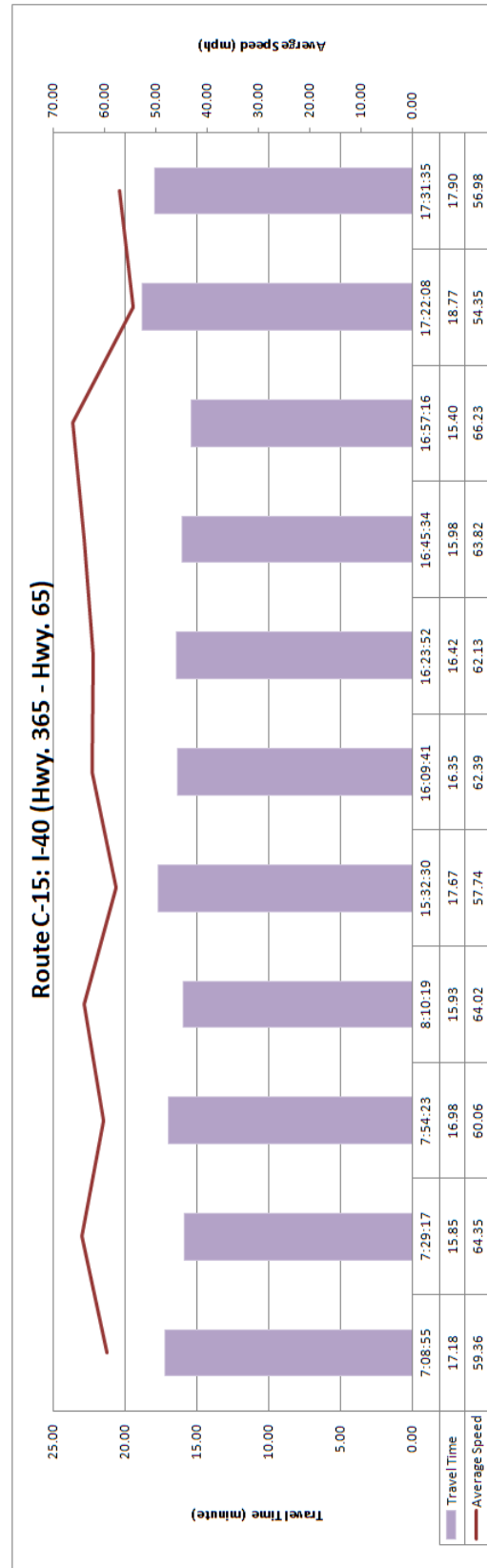
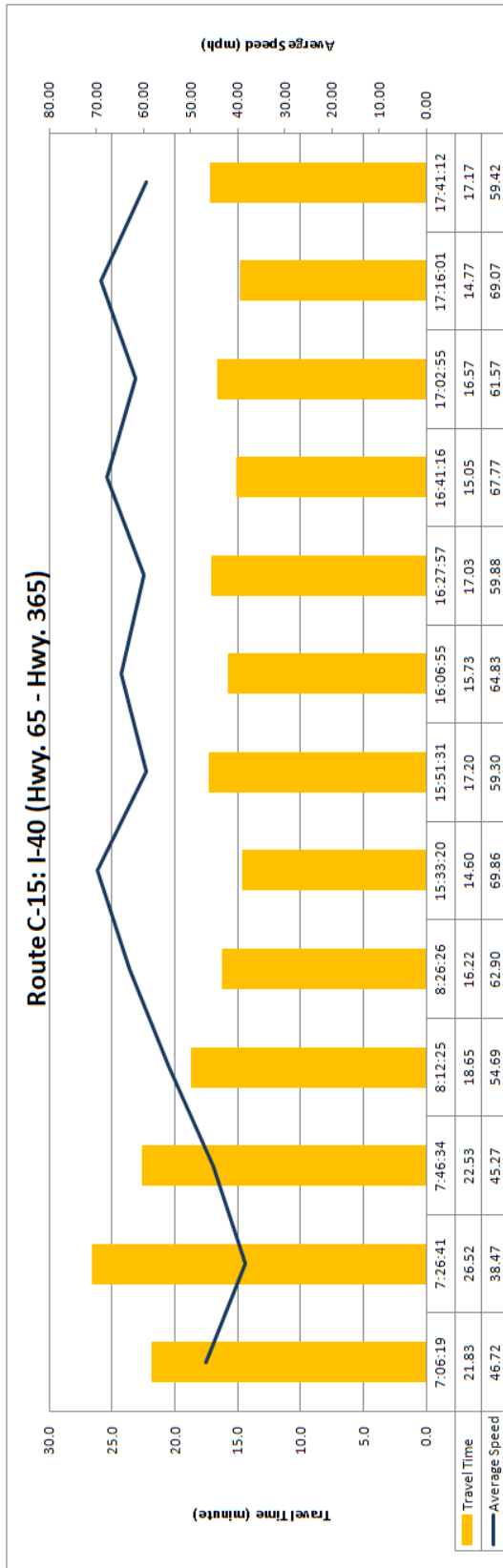


Table A.16. Route C-16 - I-630/I-30/I-530 Travel Time Summaries
(A @ Fair Park Blvd., B @Hwy. 338)

A-B	Departure Time	Travel Time (min)	Additional Time	Travel Time Index	Avg. Speed
	6:57:46	8.67	0:01:35	1.22	58.85
	7:08:42	8.28	0:01:12	1.17	61.57
	7:17:14	9.97	0:02:53	1.41	51.17
	7:28:43	8.85	0:01:46	1.25	57.63
	7:39:56	9.30	0:02:13	1.31	54.84
	7:57:41	9.73	0:02:39	1.37	52.40
	8:11:56	10.75	0:03:40	1.52	47.44
	8:21:08	8.55	0:01:28	1.21	59.65
	15:29:32	8.63	0:01:33	1.22	59.07
	15:44:39	7.08	0:00:00	1.00	72.00
	15:47:53	8.25	0:01:10	1.16	61.82
	16:03:08	9.15	0:02:04	1.29	55.74
	16:14:00	7.45	0:00:22	1.05	68.46
	16:23:56	8.77	0:01:41	1.24	58.17
	16:31:50	9.37	0:02:17	1.32	54.45
Poor	16:45:49	14.95	0:07:52	2.11	34.11
	16:53:55	9.92	0:02:50	1.40	51.43
	17:14:13	12.62	0:05:32	1.78	40.42
	17:28:38	9.58	0:02:30	1.35	53.22
	17:39:48	9.38	0:02:18	1.32	54.35
	17:50:57	8.47	0:01:23	1.20	60.24
B-A	Departure Time	Travel Time (min)	Additional Time	Travel Time Index	Avg. Speed
	6:58:55	9.08	0:02:00	1.28	56.15
	7:06:54	9.87	0:02:47	1.39	51.69
	7:17:52	10.15	0:03:04	1.43	50.25
	7:27:49	11.08	0:04:00	1.56	46.02
	7:38:23	17.15	0:10:04	2.42	29.74
Poor	7:53:46	17.65	0:10:34	2.49	28.90
	8:23:06	11.98	0:04:54	1.69	42.56
	15:30:06	9.07	0:01:59	1.28	56.25
	15:39:01	8.17	0:01:05	1.15	62.45
	15:52:59	9.05	0:01:58	1.28	56.35
	16:03:11	8.78	0:01:42	1.24	58.06
	16:13:33	8.80	0:01:43	1.24	57.95
	16:22:28	8.35	0:01:16	1.18	61.08
	16:34:00	11.30	0:04:13	1.60	45.13
	16:42:00	11.18	0:04:06	1.58	45.60
	17:01:46	11.07	0:03:59	1.56	46.08
	17:15:14	12.57	0:05:29	1.77	40.58
	17:28:11	10.57	0:03:29	1.49	48.26
	17:38:53	9.95	0:02:52	1.40	51.26
	17:50:47	8.02	0:00:56	1.13	63.62

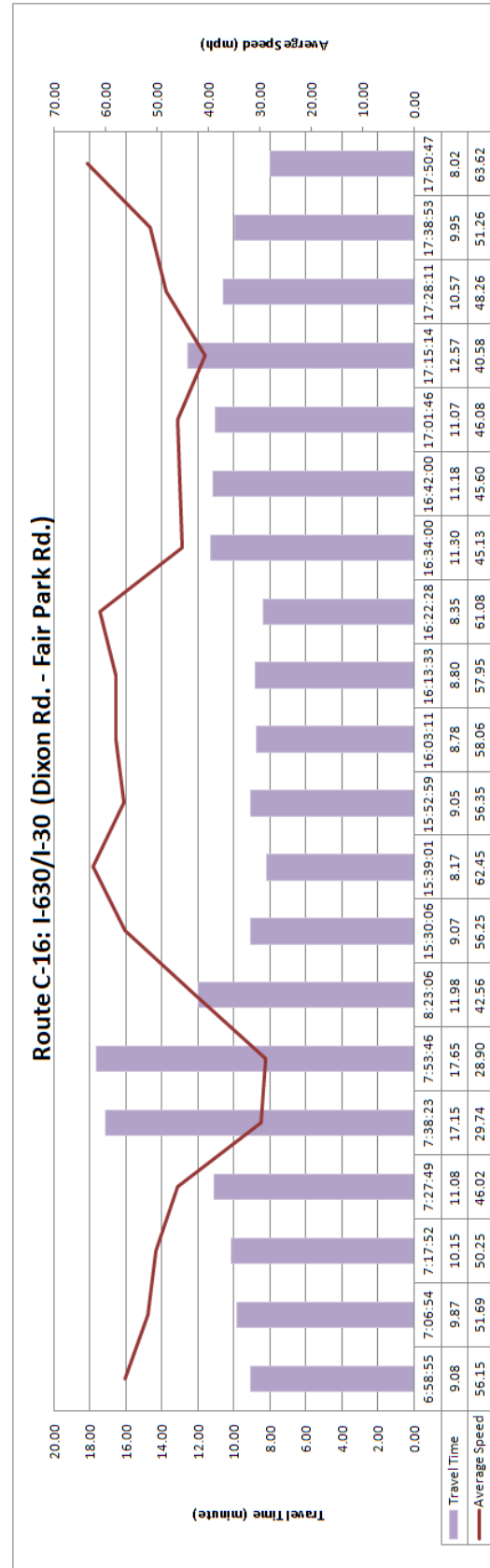
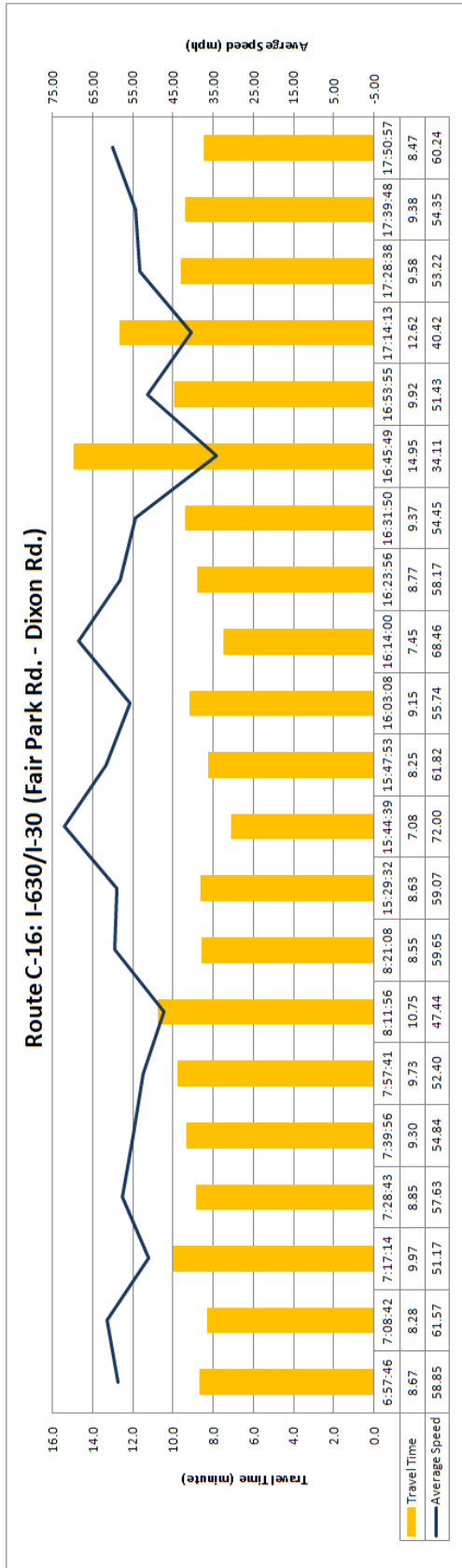


Table A.17. Route C-17 - I-430/I-630 Travel Time Summaries
(A @ Hwy. 300, B @ Woodrow St.)

A-B	Departure Time	Travel Time (min)	Additional Time	Travel Time Index	Avg. Speed
	6:44:32	9.60	0:02:22	1.33	46.88
	6:56:16	7.97	0:00:44	1.10	56.49
	7:03:49	9.17	0:01:56	1.27	49.09
	7:13:57	8.75	0:01:31	1.21	51.43
	7:23:57	10.62	0:03:23	1.47	42.39
	7:36:45	10.92	0:03:41	1.51	41.22
Poor	7:48:16	11.53	0:04:18	1.59	39.02
	8:11:00	8.93	0:01:42	1.24	50.37
	8:28:17	7.80	0:00:34	1.08	57.69
	15:41:11	7.73	0:00:30	1.07	58.19
	15:53:07	7.87	0:00:38	1.09	57.20
	16:01:57	7.97	0:00:44	1.10	56.49
	16:12:28	7.73	0:00:30	1.07	58.19
	16:22:10	7.75	0:00:31	1.07	58.06
	16:30:28	8.53	0:01:18	1.18	52.73
	16:58:41	8.07	0:00:50	1.12	55.79
	17:08:15	7.23	0:00:00	1.00	62.21
	17:18:18	8.00	0:00:46	1.11	56.25
	17:28:11	8.28	0:01:03	1.15	54.33
	17:37:35	8.70	0:01:28	1.20	51.72
	17:47:18	7.78	0:00:33	1.08	57.82
B-A	Departure Time	Travel Time (min)	Additional Time	Travel Time Index	Avg. Speed
	6:45:57	8.20	0:00:58	1.13	54.88
	6:54:44	8.33	0:01:06	1.15	54.00
	7:04:20	8.75	0:01:31	1.21	51.43
	7:13:27	9.67	0:02:26	1.34	46.55
	7:26:03	10.62	0:03:23	1.47	42.39
	7:37:01	9.48	0:02:15	1.31	47.45
	7:49:23	8.88	0:01:39	1.23	50.66
	8:00:14	9.35	0:02:07	1.29	48.13
	8:08:52	8.52	0:01:17	1.18	52.84
	8:20:35	7.98	0:00:45	1.10	56.37
	15:51:18	8.57	0:01:20	1.18	52.53
	16:01:36	9.98	0:02:45	1.38	45.08
	16:11:16	9.73	0:02:30	1.35	46.23
	16:30:29	9.48	0:02:15	1.31	47.45
Poor	16:48:55	10.90	0:03:40	1.51	41.28
	17:07:21	10.12	0:02:53	1.40	44.48
	17:15:59	10.55	0:03:19	1.46	42.65
	17:26:53	9.98	0:02:45	1.38	45.08
	17:37:40	8.92	0:01:41	1.23	50.47

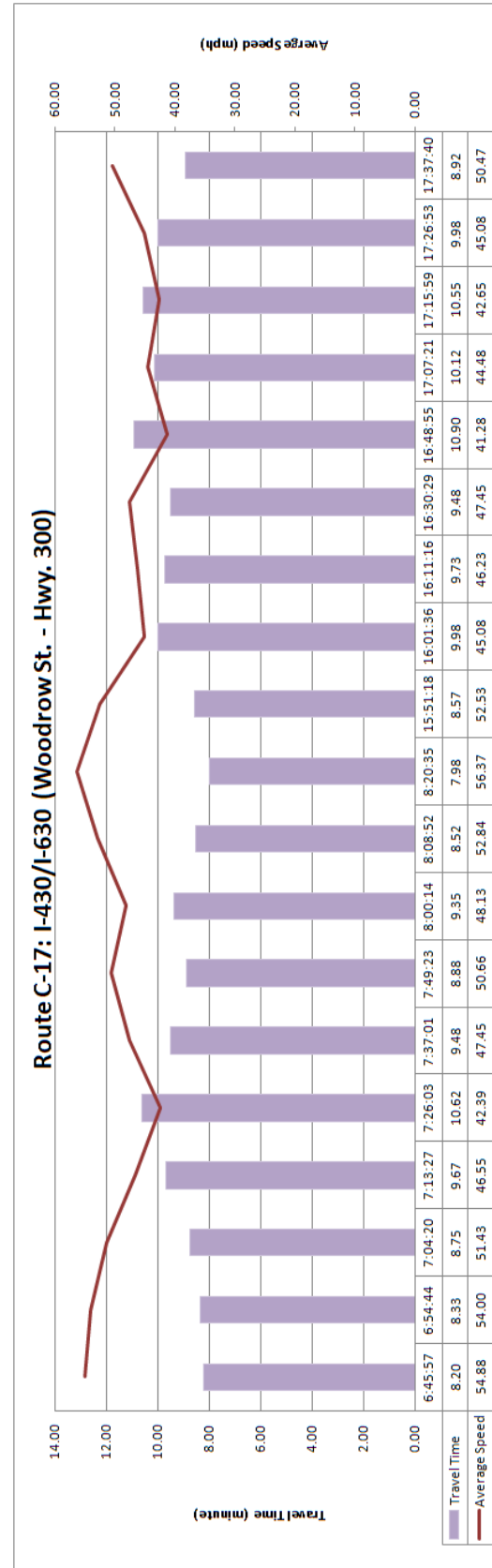
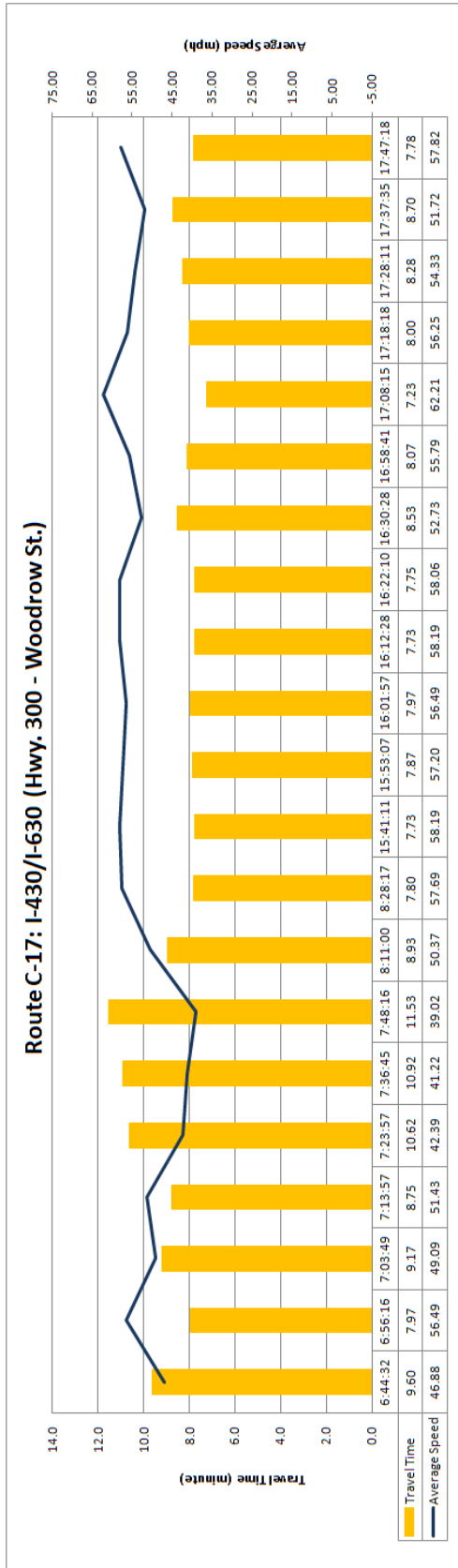


Table A.18. Route C-18 - Highway 100/I-430 Travel Time Summaries
(A @ Hwy. 10, B @Hwy. 365)

A-B	Departure Time	Travel Time (min)	Additional Time	Travel Time Index	Avg. Speed
	6:57:41	14.22	0:01:56	1.16	40.94
	7:14:28	13.10	0:00:49	1.07	44.43
	7:32:27	14.05	0:01:46	1.14	41.42
	7:48:59	15.97	0:03:41	1.30	36.45
	8:03:28	14.55	0:02:16	1.18	40.00
	8:20:32	13.57	0:01:17	1.10	42.90
	15:39:14	12.72	0:00:26	1.04	45.77
	15:52:59	15.72	0:03:26	1.28	37.03
	16:08:05	13.92	0:01:38	1.13	41.82
	16:24:38	14.08	0:01:48	1.15	41.33
	16:36:55	14.97	0:02:41	1.22	38.89
	16:57:29	13.23	0:00:57	1.08	43.98
	17:09:29	14.97	0:02:41	1.22	38.89
Poor	17:25:45	19.90	0:07:37	1.62	29.25
	17:39:24	16.62	0:04:20	1.35	35.03
B-A	Departure Time	Travel Time (min)	Additional Time	Travel Time Index	Avg. Speed
	6:58:57	14.80	0:02:31	1.20	39.32
Poor	7:12:58	19.10	0:06:49	1.55	30.47
	7:29:53	18.57	0:06:17	1.51	31.35
	7:48:24	14.63	0:02:21	1.19	39.77
	8:05:33	13.17	0:00:53	1.07	44.20
	8:18:39	12.28	0:00:00	1.00	47.38
	15:39:53	13.03	0:00:45	1.06	44.65
	15:52:32	14.65	0:02:22	1.19	39.73
	16:11:51	12.70	0:00:25	1.03	45.83
	16:22:33	13.97	0:01:41	1.14	41.67
	16:40:39	13.15	0:00:52	1.07	44.26
	16:52:49	15.68	0:03:24	1.28	37.11
	17:11:10	14.50	0:02:13	1.18	40.14
	17:25:27	13.40	0:01:07	1.09	43.43

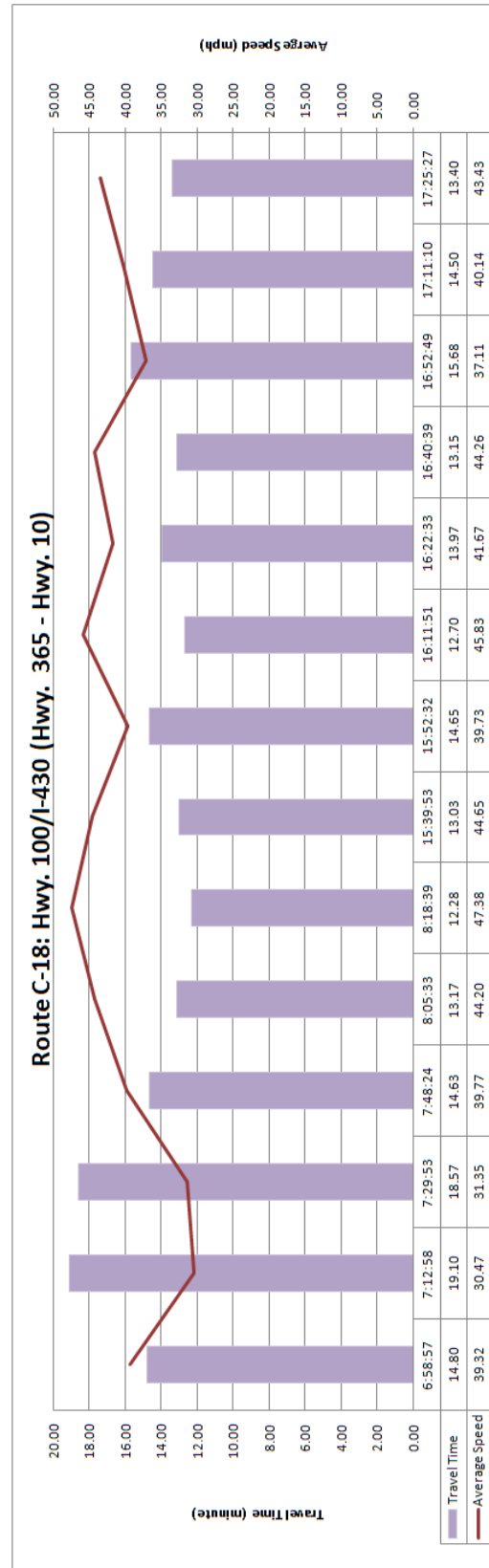
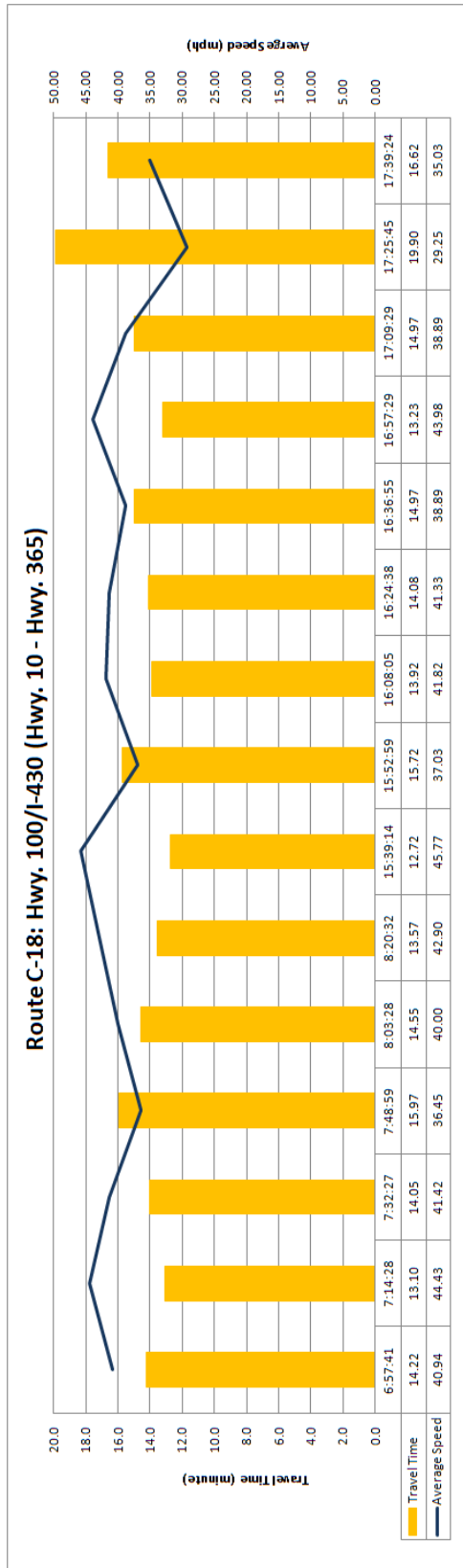


Table A.19. Route NW-1 - Highway 71B Travel Time Summaries
(A @ Co. Rd. 40, B @Hwy. 71B/8th St./Walnut St.)

A-B	Departure Time	Travel Time (min)	Additional Time	Travel Time Index	Avg. Speed
	6:55:37	24.92	0:03:59	1.19	30.1
Average	7:19:25	25.38	0:04:27	1.21	29.5
	7:58:19	22.87	0:01:56	1.09	32.8
	8:19:08	24.08	0:03:09	1.15	31.1
	11:06:09	25.13	0:04:12	1.20	29.8
	11:33:02	25.70	0:04:46	1.23	29.2
	12:06:45	25.65	0:04:43	1.23	29.2
	12:30:23	25.70	0:04:46	1.23	29.2
	13:09:44	20.93	0:00:00	1.00	35.8
	15:58:31	28.13	0:07:12	1.34	26.7
	16:26:06	23.55	0:02:37	1.13	31.8
Poor	16:56:20	32.22	0:11:17	1.54	23.3
	17:31:39	27.32	0:06:23	1.30	27.5
B-A	Departure Time	Travel Time (min)	Additional Time	Travel Time Index	Avg. Speed
	6:47:25	23.72	0:02:47	1.13	31.6
	7:21:31	24.72	0:03:47	1.18	30.3
Poor	7:45:23	30.82	0:09:53	1.47	24.3
	11:32:19	24.70	0:03:46	1.18	30.4
	11:59:24	28.48	0:07:33	1.36	26.3
	12:33:24	27.43	0:06:30	1.31	27.3
	12:56:47	28.30	0:07:22	1.35	26.5
	15:29:23	26.95	0:06:01	1.29	27.8
	15:59:19	24.57	0:03:38	1.17	30.5
	16:27:16	25.87	0:04:56	1.24	29.0
Poor	16:51:04	37.52	0:16:35	1.79	20.0
	18:00:50	23.03	0:02:06	1.10	32.6

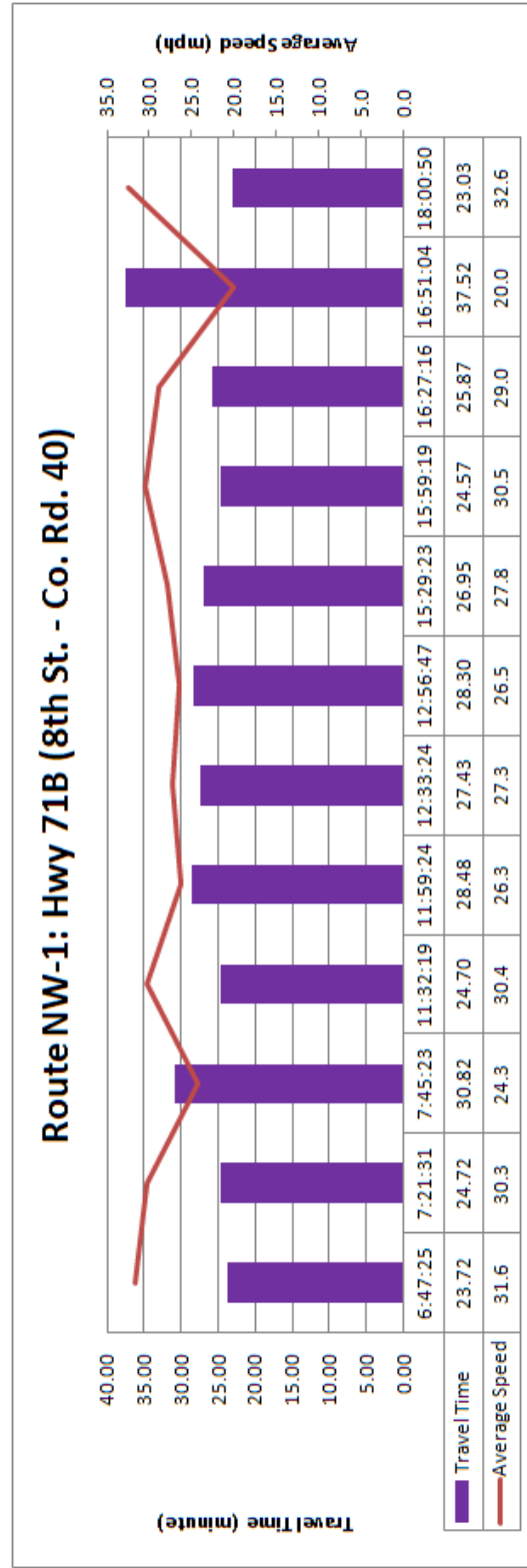
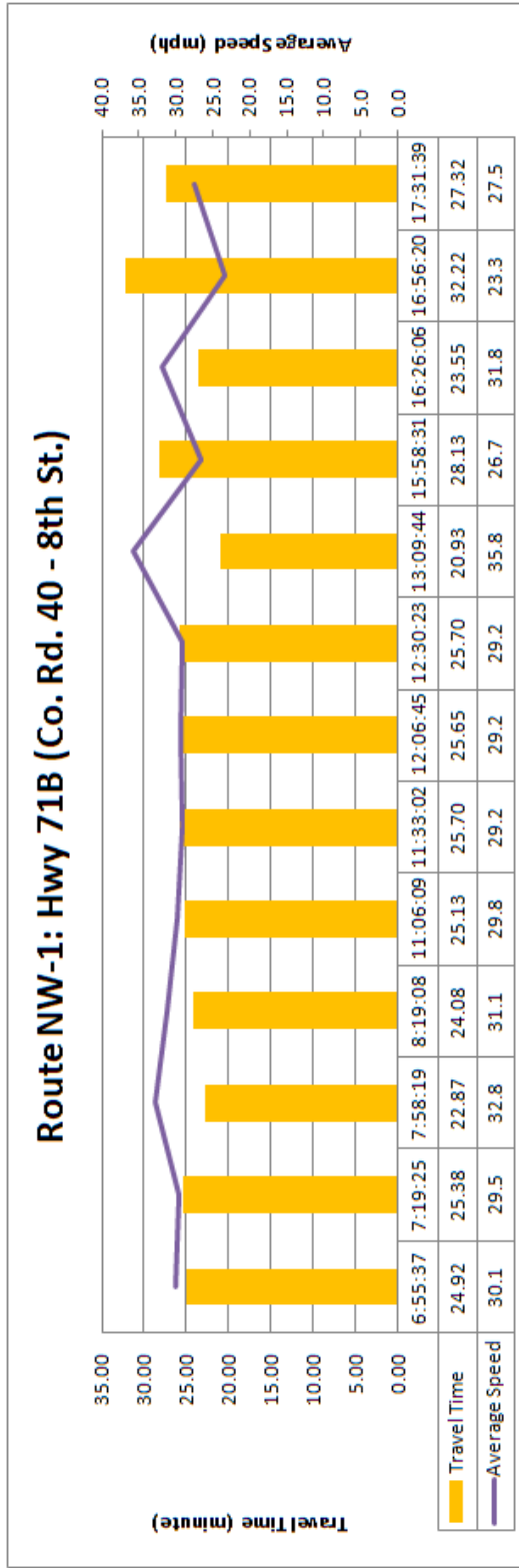


Table A.20. Route NW-2 - Highways 102/62 Travel Time Summaries
(A @ Hwy. 279, B @Rogers Airport)

A-B	Departure Time	Travel Time (min)	Additional Time	Travel Time Index	Avg. Speed
	6:51:16	26.13	0:06:25	1.33	26.4
Poor	7:20:13	38.22	0:18:30	1.94	18.1
	7:43:05	36.37	0:16:39	1.84	19.0
	8:22:39	25.57	0:05:51	1.30	27.0
	10:52:55	23.30	0:03:35	1.18	29.6
	11:25:28	24.23	0:04:31	1.23	28.5
	11:40:41	21.63	0:01:55	1.10	31.9
	12:17:18	22.90	0:03:11	1.16	30.1
	12:32:18	26.02	0:06:18	1.32	26.5
	13:08:41	26.00	0:06:17	1.32	26.5
	15:29:55	27.65	0:07:56	1.40	25.0
	15:55:02	29.68	0:09:58	1.51	23.2
	16:25:34	29.13	0:09:25	1.48	23.7
	16:52:53	27.90	0:08:11	1.42	24.7
Poor	17:42:19	32.85	0:13:08	1.67	21.0
	17:54:48	32.62	0:12:54	1.65	21.2
B-A	Departure Time	Travel Time (min)	Additional Time	Travel Time Index	Avg. Speed
	6:44:34	22.75	0:03:02	1.15	30.3
	7:18:30	23.58	0:03:52	1.20	29.3
	7:59:48	21.30	0:01:35	1.08	32.4
	8:20:41	22.45	0:02:44	1.14	30.7
	10:59:19	25.07	0:05:21	1.27	27.5
	11:17:14	19.72	0:00:00	1.00	35.0
	11:51:03	25.23	0:05:31	1.28	27.3
	12:03:18	27.88	0:08:10	1.41	24.7
	12:41:41	25.88	0:06:10	1.31	26.7
	12:59:39	27.87	0:08:09	1.41	24.8
	15:30:08	23.55	0:03:50	1.19	29.3
	15:58:49	25.20	0:05:29	1.28	27.4
	16:25:51	25.72	0:06:00	1.30	26.8
	17:04:05	31.00	0:11:17	1.57	22.3
	17:21:58	30.02	0:10:18	1.52	23.0

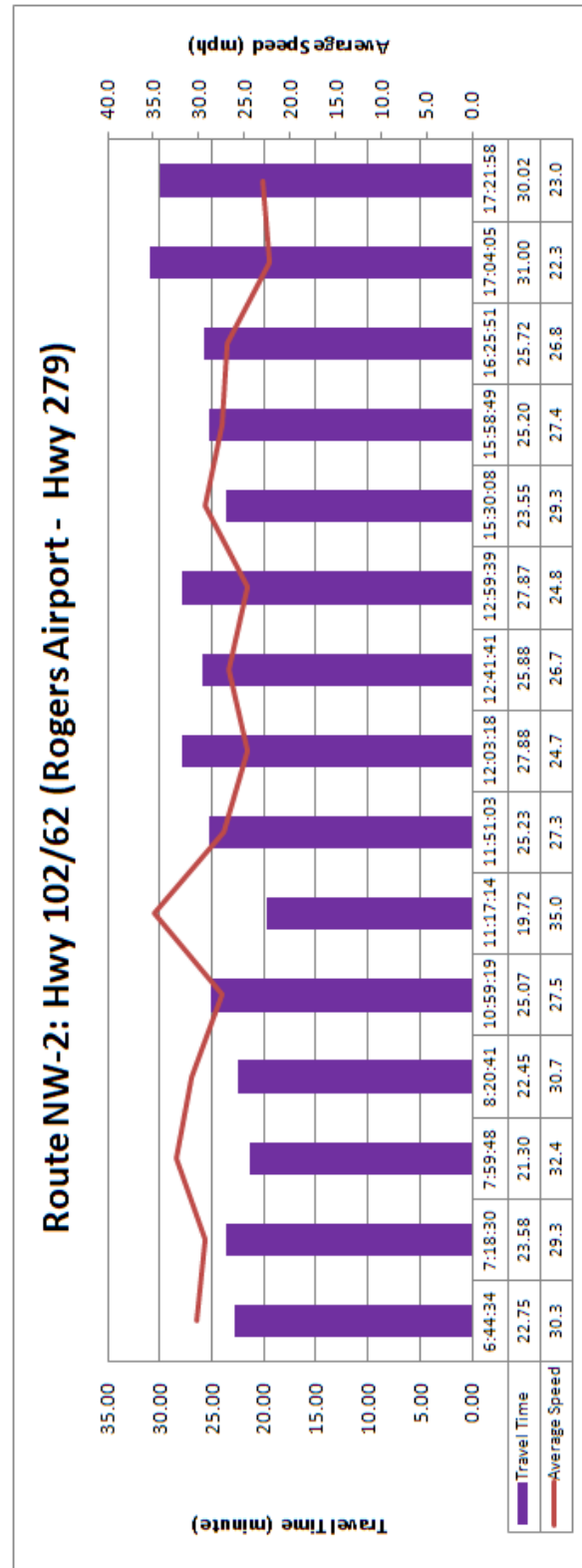
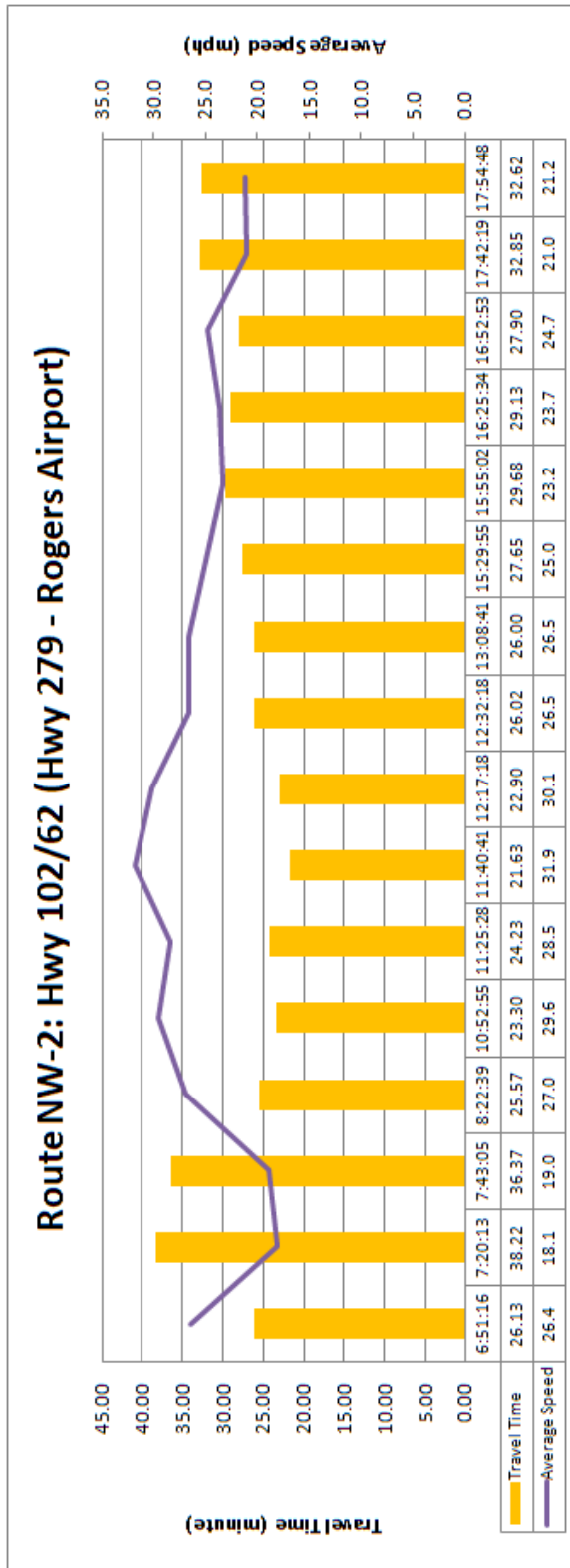


Table A.21. Route NW-3 - Highways 412/265 Travel Time Summaries
(A @ Hwy. 112, B @Hwy. 45)

A-B	Departure Time	Travel Time (min)	Additional Time	Travel Time Index	Avg. Speed
	7:03:43	22.30	0:00:00	1.00	32.3
Poor	7:30:14	30.47	0:08:10	1.37	23.6
	7:58:00	29.62	0:07:19	1.33	24.3
	10:59:27	26.12	0:03:49	1.17	27.6
	11:29:02	27.18	0:04:53	1.22	26.5
	11:56:48	28.67	0:06:22	1.29	25.1
	12:27:47	30.50	0:08:12	1.37	23.6
	13:12:40	30.17	0:07:52	1.35	23.9
	15:31:31	32.82	0:10:31	1.47	21.9
	16:07:50	36.25	0:13:57	1.63	19.9
Poor	16:38:17	41.42	0:19:07	1.86	17.4
	17:20:16	33.97	0:11:40	1.52	21.2
B-A	Departure Time	Travel Time (min)	Additional Time	Travel Time Index	Avg. Speed
	7:03:08	25.40	0:03:06	1.14	28.3
	7:28:34	28.45	0:06:09	1.28	25.3
	8:01:39	25.33	0:03:02	1.14	28.4
	11:01:34	26.48	0:04:11	1.19	27.2
	11:26:35	28.03	0:05:44	1.26	25.7
	11:57:04	29.55	0:07:15	1.33	24.4
	12:27:32	30.10	0:07:48	1.35	23.9
	12:59:35	30.62	0:08:19	1.37	23.5
	15:34:50	32.33	0:10:02	1.45	22.3
	16:06:53	30.38	0:08:05	1.36	23.7
	16:45:15	34.22	0:11:55	1.53	21.0
	17:36:49	26.62	0:04:19	1.19	27.1

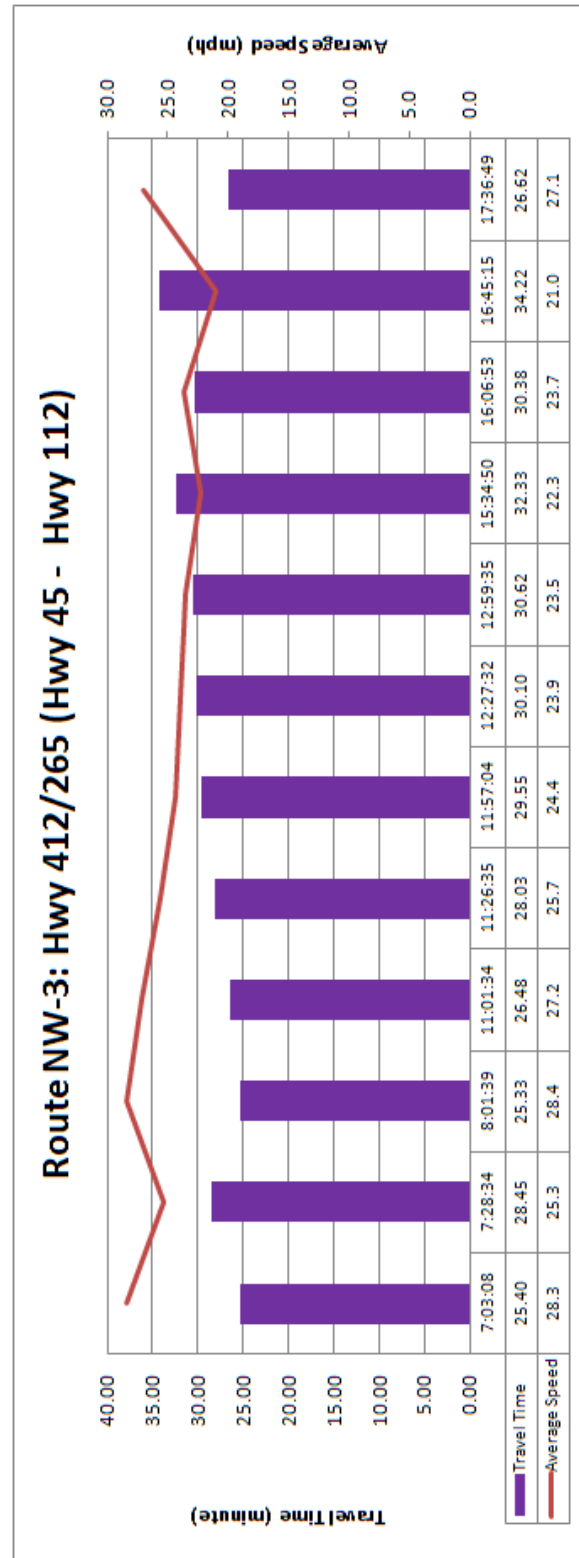
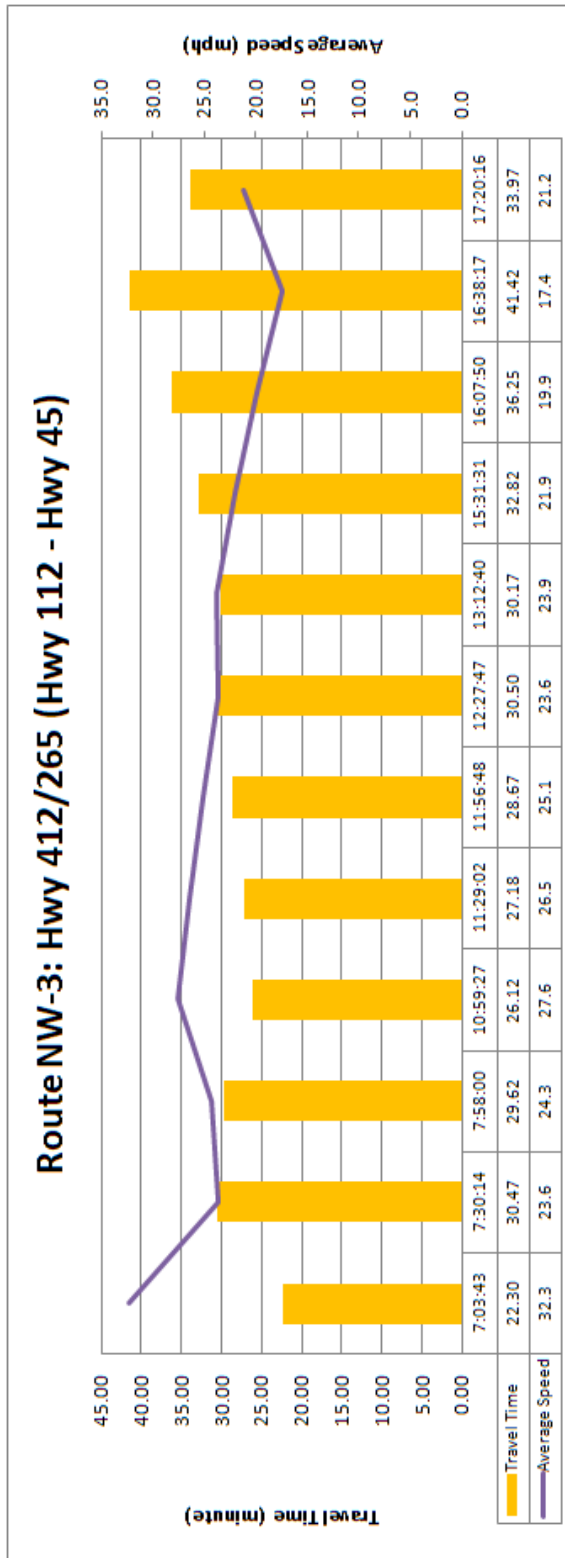


Table A.22. Route NW-4 - Highway 71B Travel Time Summaries
(A @ Hwy. 71B/8th St/Walnut St., B @Hwy. 412)

A-B	Departure Time	Travel Time (min)	Additional Time	Travel Time Index	Avg. Speed
	6:45:29	24.73	0:03:04	1.14	27.9
	7:39:51	26.17	0:04:30	1.21	26.4
	8:16:31	27.32	0:05:39	1.26	25.3
	11:02:54	26.87	0:05:12	1.24	25.7
	11:25:39	27.13	0:05:28	1.25	25.4
	11:54:15	24.43	0:02:46	1.13	28.2
	12:22:15	26.20	0:04:32	1.21	26.3
	12:45:09	23.58	0:01:55	1.09	29.3
	15:28:10	25.95	0:04:17	1.20	26.6
	16:01:28	27.67	0:06:00	1.28	24.9
	16:24:07	28.50	0:06:50	1.32	24.2
	17:01:33	29.97	0:08:18	1.38	23.0
	17:24:53	25.55	0:03:53	1.18	27.0
B-A	Departure Time	Travel Time (min)	Additional Time	Travel Time Index	Avg. Speed
	6:47:54	22.80	0:01:08	1.05	30.3
	7:10:55	27.03	0:05:22	1.25	25.5
Poor	7:45:51	28.92	0:07:15	1.33	23.9
	8:07:20	24.30	0:02:38	1.12	28.4
	10:59:19	25.57	0:03:54	1.18	27.0
	11:30:37	21.67	0:00:00	1.00	31.8
	12:19:39	24.47	0:02:48	1.13	28.2
	12:50:18	28.87	0:07:12	1.33	23.9
	15:30:47	28.82	0:07:09	1.33	23.9
	15:55:51	27.28	0:05:37	1.26	25.3
Poor	16:29:53	30.95	0:09:17	1.43	22.3
	16:53:43	30.00	0:08:20	1.38	23.0
	17:32:04	26.38	0:04:43	1.22	26.2

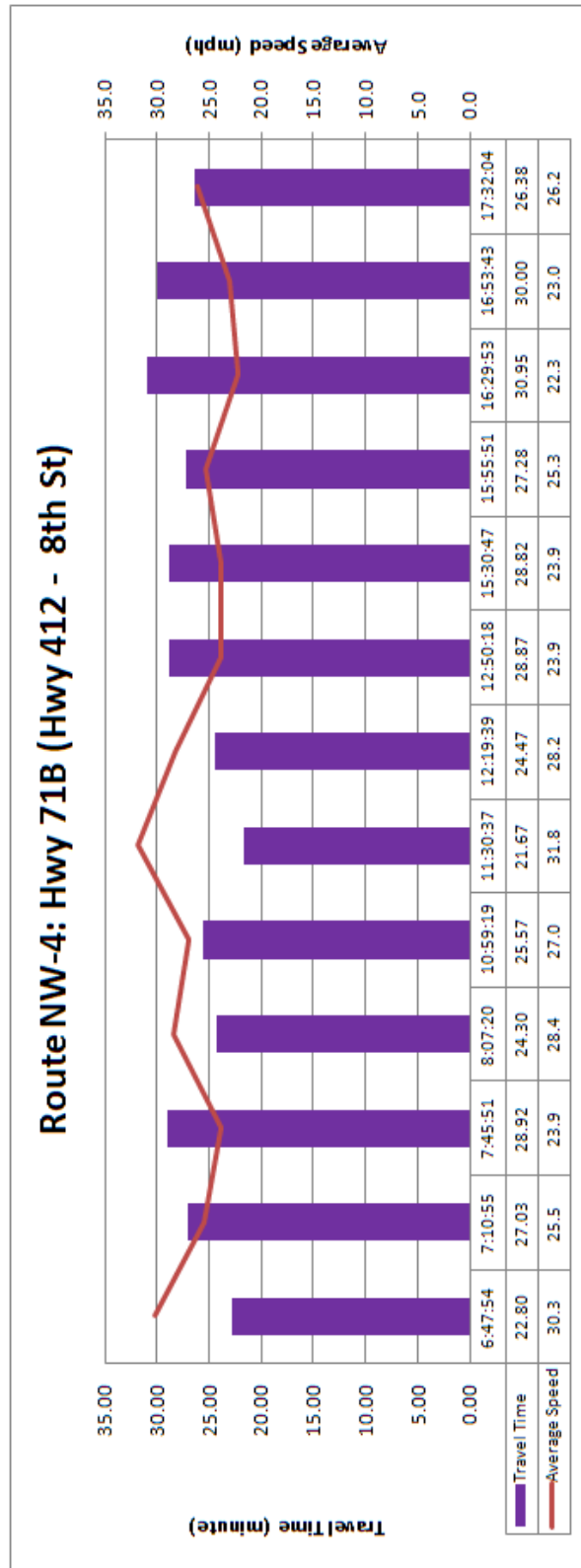
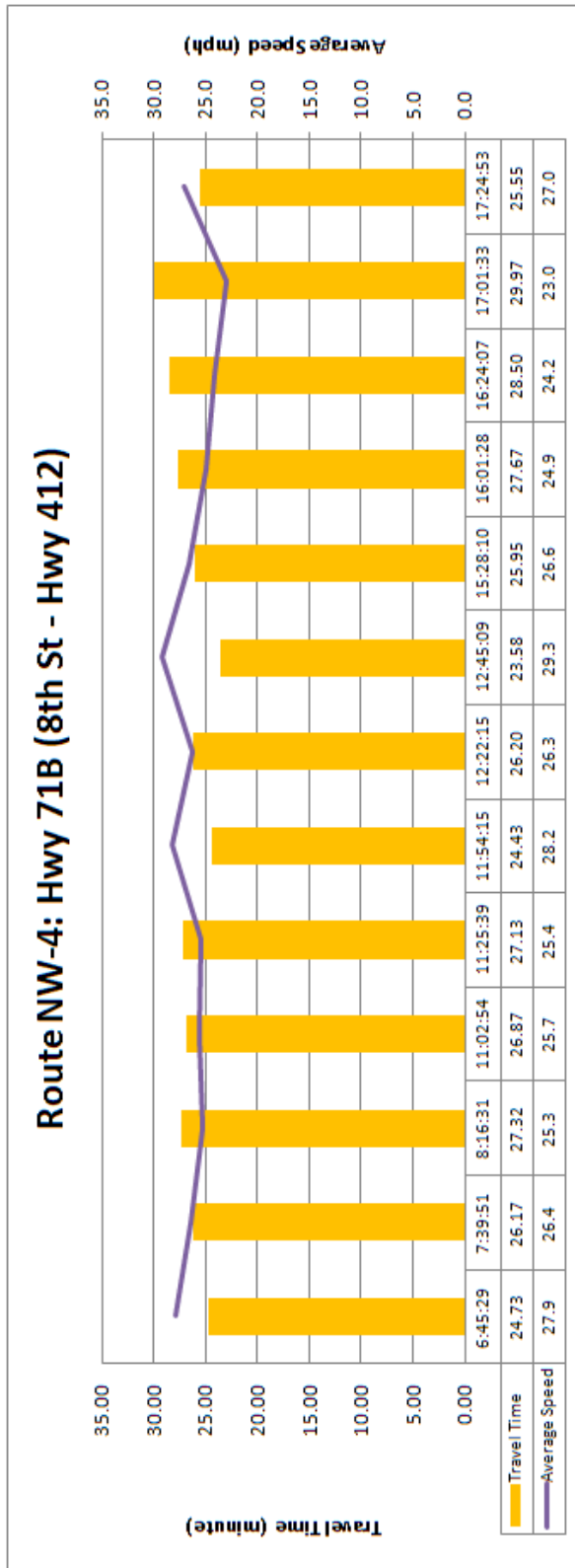


Table A.23. Route NW-5 - Highway 71B Travel Time Summaries
(A @ Hwy. 412, B @Hwy. 16)

A-B	Departure Time	Travel Time (min)	Additional Time	Travel Time Index	Avg. Speed
	6:48:06	15.35	0:01:15	1.09	33.2
	7:04:15	18.43	0:04:20	1.31	27.7
	7:21:23	18.62	0:04:31	1.32	27.4
	7:44:48	21.02	0:06:55	1.49	24.3
	8:01:28	20.25	0:06:09	1.44	25.2
	11:02:11	19.53	0:05:26	1.39	26.1
	11:35:54	22.02	0:07:55	1.56	23.2
	11:45:56	18.35	0:04:15	1.30	27.8
	12:27:05	21.18	0:07:05	1.50	24.1
Poor	12:32:08	22.20	0:08:06	1.57	23.0
	15:39:32	20.77	0:06:40	1.47	24.6
	16:05:52	17.68	0:03:35	1.25	28.8
	16:46:18	20.55	0:06:27	1.46	24.8
	17:33:58	20.33	0:06:14	1.44	25.1
	17:48:23	16.08	0:01:59	1.14	31.7
B-A	Departure Time	Travel Time (min)	Additional Time	Travel Time Index	Avg. Speed
	6:47:06	14.10	0:00:00	1.00	36.2
	7:04:23	15.45	0:01:21	1.10	33.0
	7:25:40	17.67	0:03:34	1.25	28.9
	7:41:22	19.28	0:05:11	1.37	26.4
	8:06:51	19.65	0:05:33	1.39	26.0
	11:11:11	21.43	0:07:20	1.52	23.8
	11:25:25	18.87	0:04:46	1.34	27.0
	12:00:02	20.60	0:06:30	1.46	24.8
	12:09:28	20.48	0:06:23	1.45	24.9
	12:51:39	16.55	0:02:27	1.17	30.8
	13:08:10	20.52	0:06:25	1.46	24.9
Poor	15:41:21	22.38	0:08:17	1.59	22.8
	16:25:50	18.03	0:03:56	1.28	28.3
	16:45:52	17.77	0:03:40	1.26	28.7
	16:45:53	17.75	0:03:39	1.26	28.7
	17:28:15	16.72	0:02:37	1.19	30.5

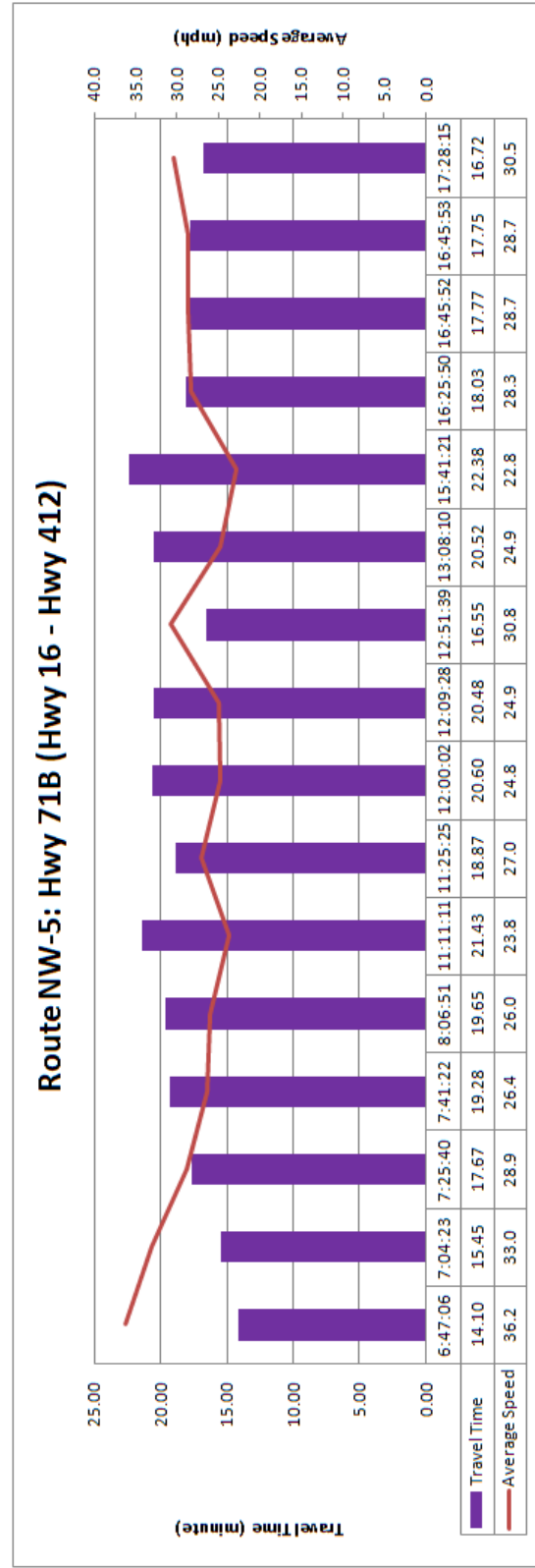
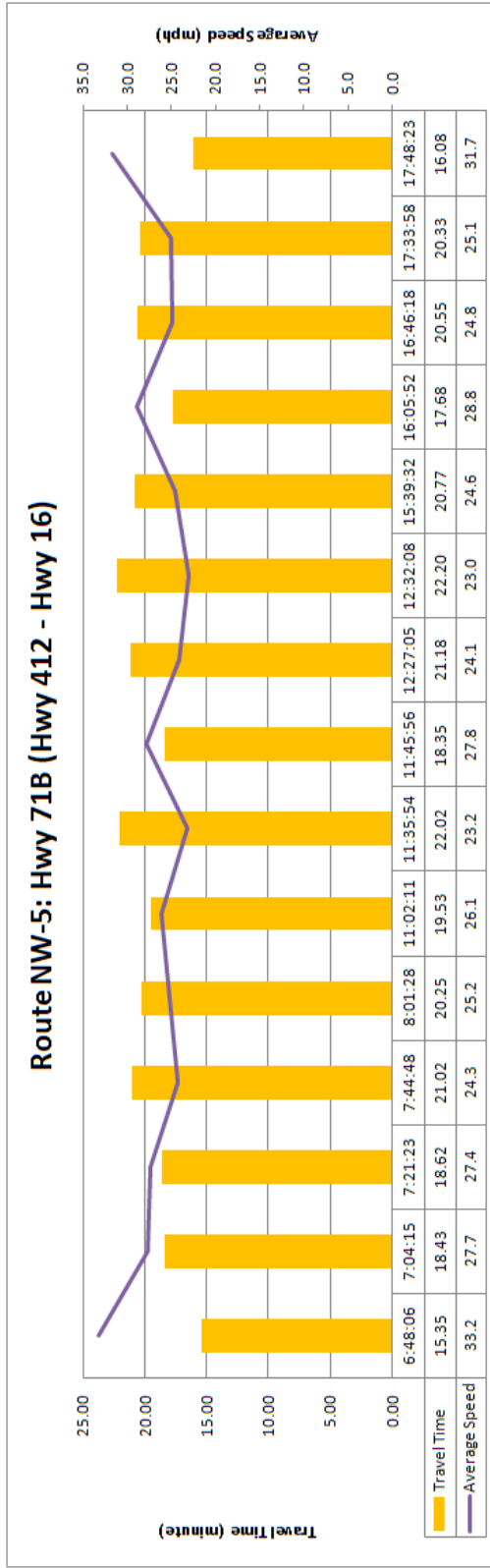


Table A.24. Route NW-6 - Highways 62/180 Travel Time Summaries
(A @ Prairie Grove, B @Hwy. 71B)

A-B	Departure Time	Travel Time (min)	Additional Time	Travel Time Index	Avg. Speed
	6:54:12	21.20	0:04:31	1.27	34.0
	7:11:54	20.85	0:04:10	1.25	34.5
Poor	7:39:40	25.53	0:08:51	1.53	28.2
	7:55:13	21.03	0:04:21	1.26	34.2
	11:02:25	17.23	0:00:33	1.03	41.8
	11:22:12	19.70	0:03:01	1.18	36.5
	11:43:59	18.82	0:02:08	1.13	38.3
	12:06:08	17.33	0:00:39	1.04	41.5
	12:24:58	19.63	0:02:57	1.18	36.7
	12:47:27	20.70	0:04:01	1.24	34.8
	13:12:32	16.68	0:00:00	1.00	43.2
	15:29:09	20.42	0:03:44	1.22	35.3
	16:02:38	19.60	0:02:55	1.17	36.7
	16:20:02	18.85	0:02:10	1.13	38.2
	16:44:08	17.80	0:01:07	1.07	40.4
	17:02:53	18.98	0:02:18	1.14	37.9
	17:25:14	20.67	0:03:59	1.24	34.8
B-A	Departure Time	Travel Time (min)	Additional Time	Travel Time Index	Avg. Speed
	6:46:02	19.87	0:03:11	1.19	36.2
	7:16:56	22.17	0:05:29	1.33	32.5
	7:34:22	18.82	0:02:08	1.13	38.3
	8:07:20	19.65	0:02:58	1.18	36.6
	11:02:41	18.33	0:01:39	1.10	39.3
	11:24:19	18.25	0:01:34	1.09	39.5
	11:43:30	18.63	0:01:57	1.12	38.6
	12:04:28	19.38	0:02:42	1.16	37.1
	12:26:26	18.02	0:01:20	1.08	40.0
	12:49:11	19.18	0:02:30	1.15	37.5
Poor	15:40:04	21.80	0:05:07	1.31	33.0
	15:51:31	20.67	0:03:59	1.24	34.8
	16:24:01	19.38	0:02:42	1.16	37.1
	16:40:49	20.35	0:03:40	1.22	35.4
	17:03:11	20.63	0:03:57	1.24	34.9
	17:24:49	21.22	0:04:32	1.27	33.9

Table A.25. Route NW-7 - I-540/Highway 71 Travel Time Summaries
(A @ Hwy. 62/180, B @Hwy. 71B/Joyce Blvd.)

A-B	Departure Time	Travel Time (min)	Additional Time	Travel Time Index	Avg. Speed
	6:47:30	7.92	0:01:24	1.21	53.1
	6:55:56	6.68	0:00:10	1.03	62.8
	7:07:12	7.07	0:00:33	1.08	59.4
	7:15:18	6.85	0:00:20	1.05	61.3
	7:24:51	6.58	0:00:04	1.01	63.8
	7:33:28	8.60	0:02:05	1.32	48.8
	7:40:17	10.25	0:03:44	1.57	41.0
Poor	7:51:41	12.02	0:05:30	1.84	35.0
	8:04:03	11.30	0:04:47	1.73	37.2
	8:13:10	7.32	0:00:48	1.12	57.4
	10:59:46	8.80	0:02:17	1.35	47.7
	11:11:55	6.73	0:00:13	1.03	62.4
	11:20:04	8.35	0:01:50	1.28	50.3
	11:28:45	7.70	0:01:11	1.18	54.5
	11:37:31	10.73	0:04:13	1.65	39.1
	11:47:31	8.88	0:02:22	1.36	47.3
	11:57:05	7.60	0:01:05	1.17	55.3
	12:05:52	6.73	0:00:13	1.03	62.4
	12:14:22	8.02	0:01:30	1.23	52.4
	12:39:18	7.23	0:00:43	1.11	58.1
	12:53:38	7.03	0:00:31	1.08	59.7
	12:59:31	6.92	0:00:24	1.06	60.7
	13:11:56	8.40	0:01:53	1.29	50.0
	13:17:35	8.72	0:02:12	1.34	48.2
	15:35:17	8.98	0:02:28	1.38	46.8
	15:43:56	8.70	0:02:11	1.34	48.3
	15:55:20	9.28	0:02:46	1.42	45.2
	16:06:25	7.20	0:00:41	1.10	58.3
	16:17:30	11.07	0:04:33	1.70	38.0
	16:24:45	9.60	0:03:05	1.47	43.8
	16:39:38	10.88	0:04:22	1.67	38.6
	16:47:13	8.18	0:01:40	1.26	51.3
Poor	17:12:58	12.75	0:06:14	1.96	32.9
	17:34:54	11.55	0:05:02	1.77	36.4
	17:46:17	10.08	0:03:34	1.55	41.7
B-A	Departure Time	Travel Time (min)	Additional Time	Travel Time Index	Avg. Speed
	6:47:39	7.77	0:01:15	1.19	54.1
	6:56:12	6.52	0:00:00	1.00	64.5
	7:04:58	7.17	0:00:39	1.10	58.6
	7:14:56	8.80	0:02:17	1.35	47.7
	7:32:06	7.38	0:00:52	1.13	56.9
	7:42:43	8.32	0:01:48	1.28	50.5
Poor	7:51:30	12.12	0:05:36	1.86	34.7
	8:04:28	8.30	0:01:47	1.27	50.6
	8:16:18	7.17	0:00:39	1.10	58.6
	11:01:01	7.90	0:01:23	1.21	53.2
	11:12:07	7.43	0:00:55	1.14	56.5

	11:21:14	7.03	0:00:31	1.08	59.7
	11:30:13	6.88	0:00:22	1.06	61.0
	11:38:43	8.42	0:01:54	1.29	49.9
	11:49:31	7.07	0:00:33	1.08	59.4
	11:57:17	7.03	0:00:31	1.08	59.7
	12:05:59	7.57	0:01:03	1.16	55.5
	12:15:20	7.73	0:01:13	1.19	54.3
	12:23:30	8.60	0:02:05	1.32	48.8
	12:51:06	6.87	0:00:21	1.05	61.2
	13:02:46	8.48	0:01:58	1.30	49.5
	13:08:59	8.17	0:01:39	1.25	51.4
	13:22:46	9.08	0:02:34	1.39	46.2
	15:32:45	7.12	0:00:36	1.09	59.0
	15:45:28	6.90	0:00:23	1.06	60.9
	15:56:46	6.75	0:00:14	1.04	62.2
	16:05:55	9.50	0:02:59	1.46	44.2
	16:15:17	7.78	0:01:16	1.19	54.0
	16:29:57	7.92	0:01:24	1.21	53.1
	16:35:10	7.32	0:00:48	1.12	57.4
	16:51:50	9.38	0:02:52	1.44	44.8
	17:02:53	7.93	0:01:25	1.22	52.9
Poor	17:20:30	12.87	0:06:21	1.97	32.6
	17:28:59	10.27	0:03:45	1.58	40.9
	17:48:27	7.78	0:01:16	1.19	54.0

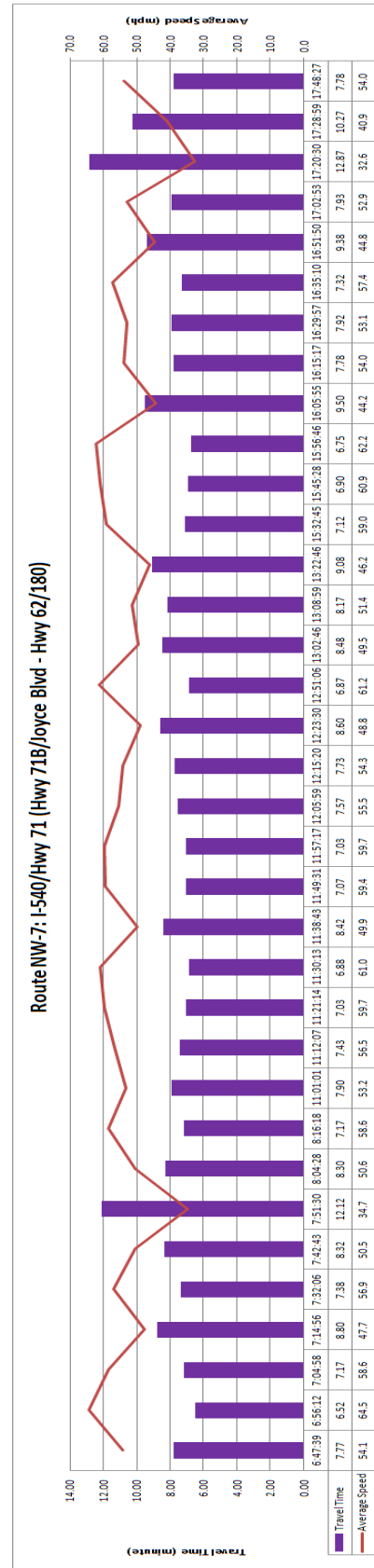
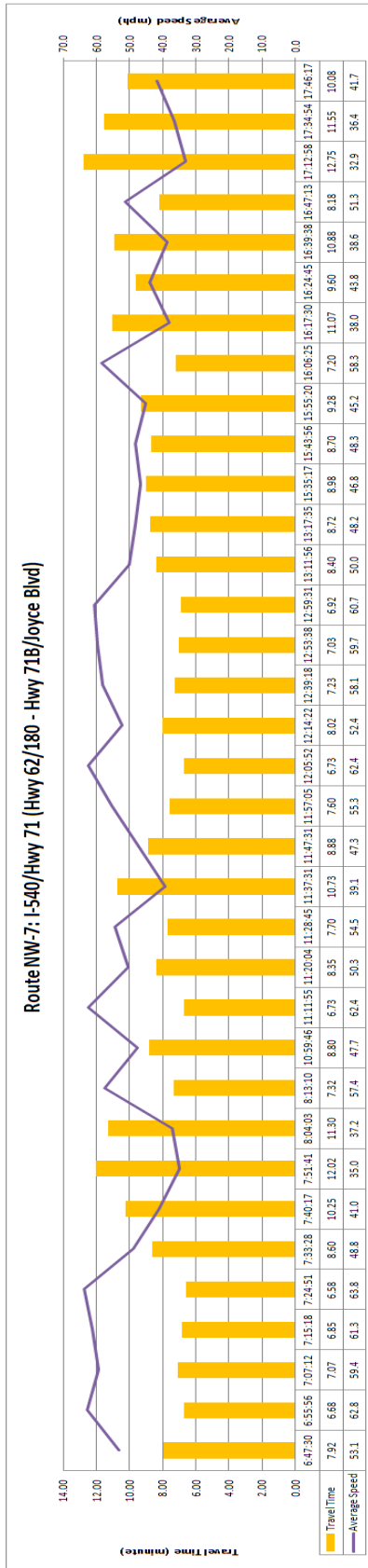


Table A.26. Route NW-8 - Highways 12/112 Travel Time Summaries
(A @ XNA Airport Rd., B @Hwy. 102)

A-B	Departure Time	Travel Time (min)	Additional Time	Travel Time Index	Avg. Speed
	6:46:39	15.85	0:02:44	1.21	37.9
Poor	7:27:06	28.65	0:15:32	2.18	20.9
	7:48:21	19.40	0:06:17	1.48	30.9
	8:14:30	16.12	0:03:00	1.23	37.2
	8:27:29	16.90	0:03:47	1.29	35.5
	11:17:00	14.87	0:01:45	1.13	40.4
	11:29:50	14.65	0:01:32	1.12	41.0
	11:47:21	15.77	0:02:39	1.20	38.1
	12:08:07	14.95	0:01:50	1.14	40.1
	12:18:39	15.57	0:02:27	1.19	38.5
	12:44:46	14.98	0:01:52	1.14	40.0
	12:58:28	14.30	0:01:11	1.09	42.0
	15:29:58	14.92	0:01:48	1.14	40.2
	15:48:28	14.13	0:01:01	1.08	42.5
	16:01:52	15.52	0:02:24	1.18	38.7
	16:19:49	14.68	0:01:34	1.12	40.9
	16:37:47	16.62	0:03:30	1.27	36.1
	16:51:53	14.97	0:01:51	1.14	40.1
Poor	17:13:36	19.67	0:06:33	1.50	30.5
	17:28:15	18.05	0:04:56	1.38	33.2
	18:04:57	13.58	0:00:28	1.04	44.2
B-A	Departure Time	Travel Time (min)	Additional Time	Travel Time Index	Avg. Speed
	6:55:16	13.77	0:00:39	1.05	43.6
	7:07:05	15.57	0:02:27	1.19	38.5
	7:32:38	14.52	0:01:24	1.11	41.3
	7:58:36	15.17	0:02:03	1.16	39.6
	11:02:24	14.23	0:01:07	1.09	42.2
	11:33:26	13.17	0:00:03	1.00	45.6
	12:04:46	13.12	0:00:00	1.00	45.7
	12:30:21	13.15	0:00:02	1.00	45.6
	12:39:34	14.70	0:01:35	1.12	40.8
	13:01:37	14.30	0:01:11	1.09	42.0
	13:14:03	13.55	0:00:26	1.03	44.3
	15:33:56	13.85	0:00:44	1.06	43.3
	15:46:55	14.13	0:01:01	1.08	42.5
	16:04:33	14.52	0:01:24	1.11	41.3
	16:21:46	14.62	0:01:30	1.11	41.0
	16:36:50	14.30	0:01:11	1.09	42.0
	16:56:34	14.45	0:01:20	1.10	41.5
	17:09:31	18.07	0:04:57	1.38	33.2
	17:35:34	17.38	0:04:16	1.33	34.5
	17:48:39	15.62	0:02:30	1.19	38.4

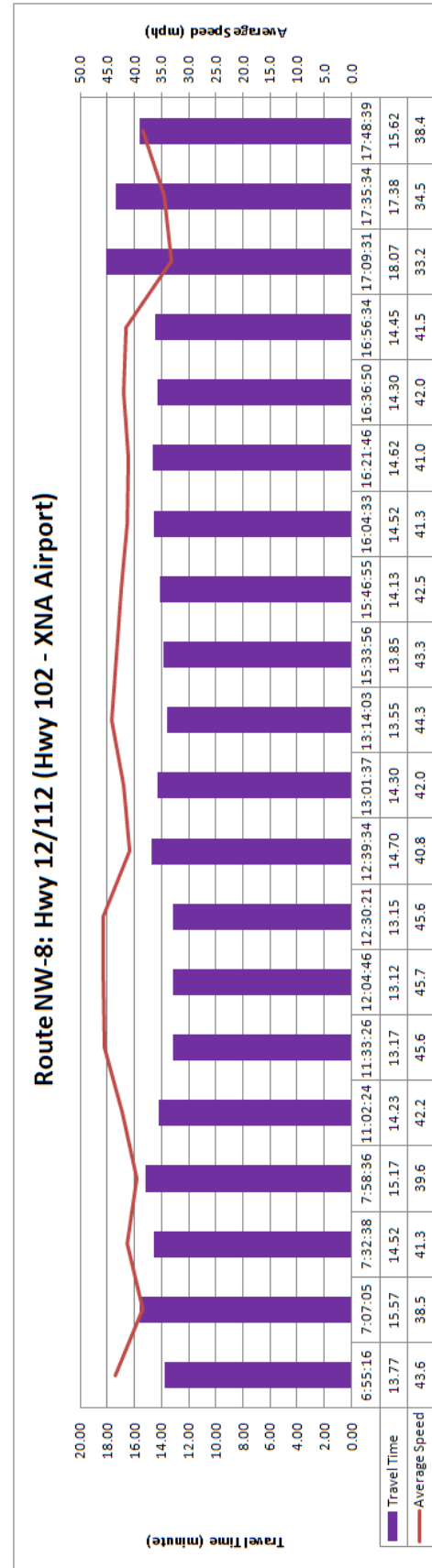
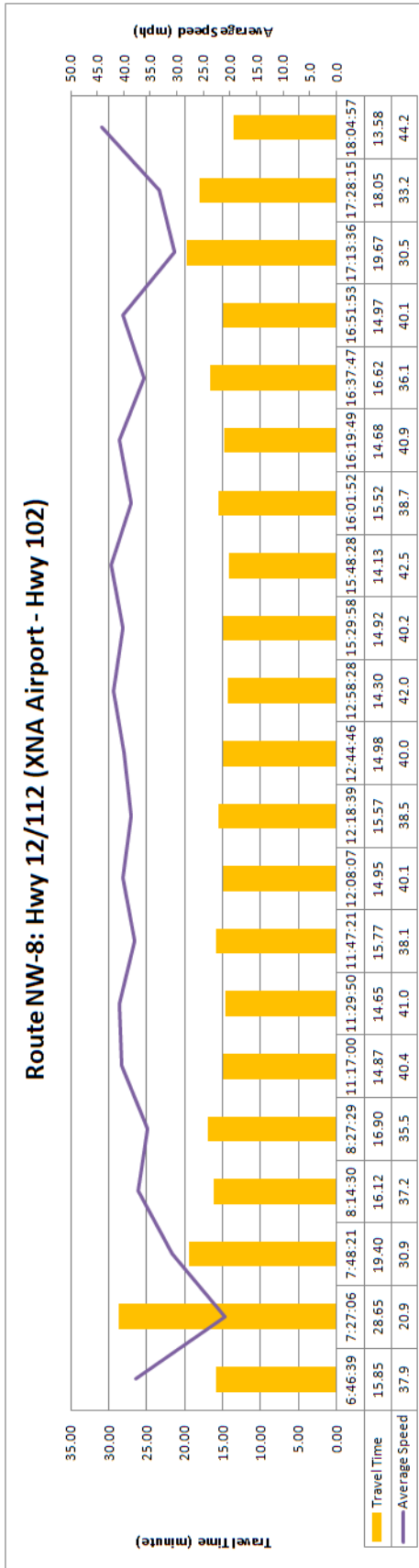


Table A.27. Route NW-9 - I-540 Travel Time Summaries
(A @ Hwy. 16/102., B @Hwy. 264)

A-B	Departure Time	Travel Time (min)	Additional Time	Travel Time Index	Avg. Speed
	7:01:03	6.70	0:00:09	1.02	69.0
	7:11:10	7.87	0:01:19	1.20	58.7
	7:18:28	7.58	0:01:02	1.16	60.9
	7:29:19	9.32	0:02:46	1.42	49.6
	7:36:26	6.93	0:00:23	1.06	66.6
Poor	7:48:05	10.70	0:04:09	1.63	43.2
	7:55:17	6.82	0:00:16	1.04	67.8
	8:08:53	8.07	0:01:31	1.23	57.3
	8:14:24	6.87	0:00:19	1.05	67.3
	15:53:06	8.03	0:01:29	1.23	57.5
	16:11:28	9.10	0:02:33	1.39	50.8
	16:23:49	6.90	0:00:21	1.05	67.0
	16:31:54	8.50	0:01:57	1.30	54.4
	16:40:43	6.55	0:00:00	1.00	70.5
	16:51:31	8.93	0:02:23	1.36	51.7
	16:58:11	6.77	0:00:13	1.03	68.3
	17:11:06	9.27	0:02:43	1.41	49.9
	17:15:36	9.10	0:02:33	1.39	50.8
	17:34:53	8.92	0:02:22	1.36	51.8
	17:39:21	7.78	0:01:14	1.19	59.4
B-A	Departure Time	Travel Time (min)	Additional Time	Travel Time Index	Avg. Speed
	7:02:06	7.92	0:01:22	1.21	58.4
	7:09:27	7.32	0:00:46	1.12	63.1
	7:19:31	9.42	0:02:52	1.44	49.1
	7:27:36	7.47	0:00:55	1.14	61.9
	7:39:26	8.18	0:01:38	1.25	56.5
	7:46:02	8.20	0:01:39	1.25	56.3
	7:59:16	9.17	0:02:37	1.40	50.4
	8:04:16	7.55	0:01:00	1.15	61.2
	8:17:22	9.48	0:02:56	1.45	48.7
	15:40:01	7.87	0:01:19	1.20	58.7
	15:56:56	6.75	0:00:12	1.03	68.4
	16:02:39	8.63	0:02:05	1.32	53.5
	16:14:42	7.08	0:00:32	1.08	65.2
Poor	16:20:54	9.85	0:03:18	1.50	46.9
	16:31:34	7.02	0:00:28	1.07	65.8
	16:41:17	8.77	0:02:13	1.34	52.7
	16:49:32	7.17	0:00:37	1.09	64.5
	17:00:57	8.55	0:02:00	1.31	54.0
	17:07:03	6.88	0:00:20	1.05	67.1
	17:24:33	8.78	0:02:14	1.34	52.6
	17:30:45	7.22	0:00:40	1.10	64.0
	17:44:05	8.77	0:02:13	1.34	52.7

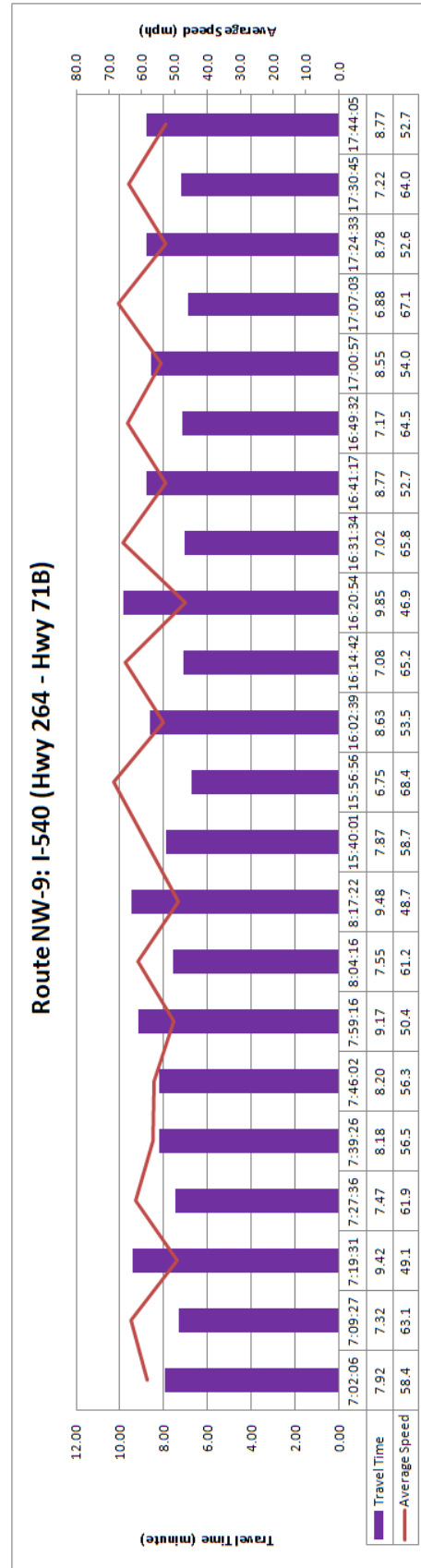
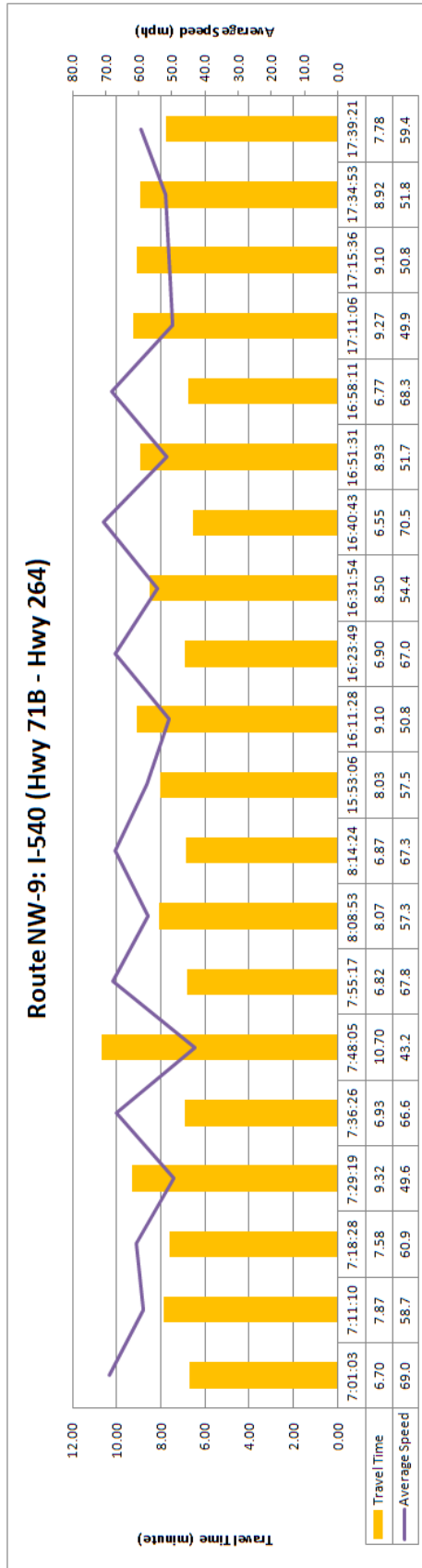


Table A.28. Route NW-10 - Highway 16/112 Travel Time Summaries
(A @ Double Springs Rd., B @ Agri Park)

A-B	Departure Time	Travel Time (min)	Additional Time	Travel Time Index	Avg. Speed
	6:44:38	9.90	0:01:05	1.12	36.4
	6:56:59	9.70	0:00:53	1.10	37.1
	7:06:22	8.82	0:00:00	1.00	40.8
	7:17:51	10.90	0:02:05	1.24	33.0
Poor	7:29:57	14.72	0:05:54	1.67	24.5
	7:43:46	13.12	0:04:18	1.49	27.4
	7:59:58	13.48	0:04:40	1.53	26.7
	8:10:15	10.77	0:01:57	1.22	33.4
	11:00:05	9.28	0:00:28	1.05	38.8
	11:14:42	9.50	0:00:41	1.08	37.9
	11:21:58	9.72	0:00:54	1.10	37.0
	11:36:43	10.53	0:01:43	1.19	34.2
	11:43:33	8.93	0:00:07	1.01	40.3
	12:03:09	9.92	0:01:06	1.12	36.3
	12:09:32	10.68	0:01:52	1.21	33.7
	15:34:39	12.07	0:03:15	1.37	29.8
	15:48:58	9.43	0:00:37	1.07	38.2
	16:02:25	9.62	0:00:48	1.09	37.4
	16:10:17	9.75	0:00:56	1.11	36.9
	16:24:47	9.97	0:01:09	1.13	36.1
	16:34:32	11.35	0:02:32	1.29	31.7
	16:47:25	11.03	0:02:13	1.25	32.6
	16:59:03	11.95	0:03:08	1.36	30.1
	17:13:53	10.72	0:01:54	1.22	33.6
	17:25:42	10.23	0:01:25	1.16	35.2
	17:38:49	9.92	0:01:06	1.12	36.3
B-A	Departure Time	Travel Time (min)	Additional Time	Travel Time Index	Avg. Speed
	6:46:57	9.33	0:00:31	1.06	38.6
	6:55:29	9.60	0:00:47	1.09	37.5
	7:07:34	9.13	0:00:19	1.04	39.4
	7:16:03	11.62	0:02:48	1.32	31.0
	7:30:12	11.35	0:02:32	1.29	31.7
	7:46:15	12.23	0:03:25	1.39	29.4
	7:58:06	10.63	0:01:49	1.21	33.9
	8:14:20	10.05	0:01:14	1.14	35.8
	11:02:48	10.87	0:02:03	1.23	33.1
	11:10:15	10.53	0:01:43	1.19	34.2
	11:25:26	10.25	0:01:26	1.16	35.1
	11:32:51	9.97	0:01:09	1.13	36.1
	11:48:21	10.53	0:01:43	1.19	34.2
	11:53:29	10.13	0:01:19	1.15	35.5
	12:14:06	9.97	0:01:09	1.13	36.1
Poor	15:34:14	13.28	0:04:28	1.51	27.1
	15:50:41	10.92	0:02:06	1.24	33.0
	15:59:19	10.05	0:01:14	1.14	35.8
	16:13:01	10.90	0:02:05	1.24	33.0
	16:21:19	10.47	0:01:39	1.19	34.4
	16:35:46	10.62	0:01:48	1.20	33.9
	16:47:04	11.07	0:02:15	1.26	32.5
	17:01:18	10.78	0:01:58	1.22	33.4
	17:12:18	12.45	0:03:38	1.41	28.9
	17:36:37	10.70	0:01:53	1.21	33.6

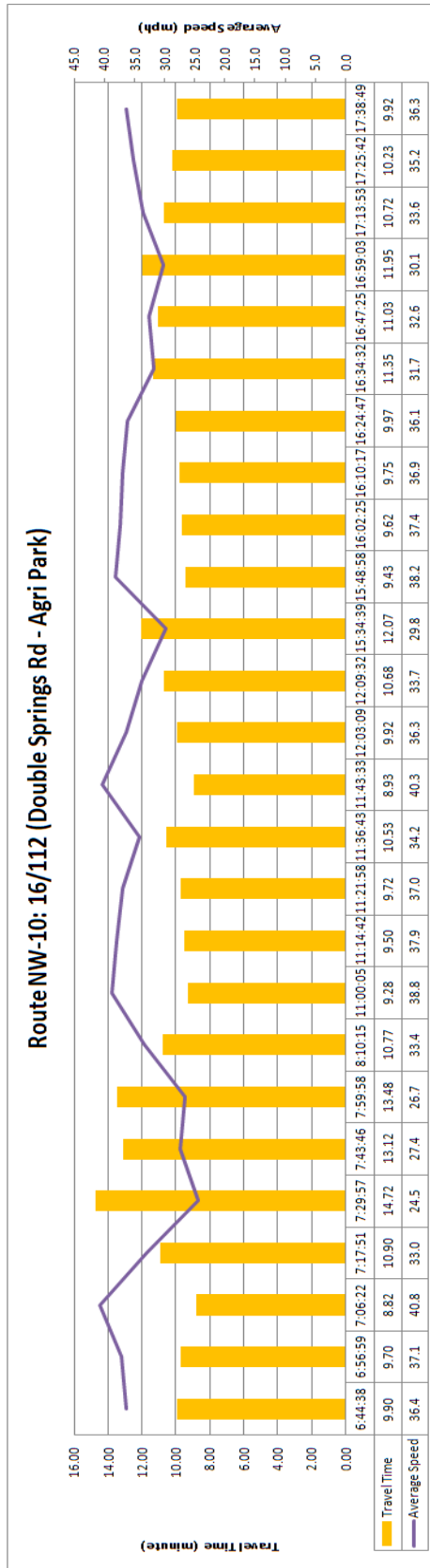


Table A.29. Route NW-11 - I-540 Travel Time Summaries
(A @ Hwy. 264, B @ Hwy. 112)

A-B	Departure Time	Travel Time (min)	Additional Time	Travel Time Index	Avg. Speed
	6:44:39	10.37	0:00:12	1.02	67.7
	7:09:11	11.65	0:01:29	1.15	60.3
	7:15:56	10.23	0:00:04	1.01	68.6
	7:38:25	11.60	0:01:26	1.14	60.5
	7:48:26	10.32	0:00:09	1.01	68.0
	8:04:28	10.78	0:00:37	1.06	65.1
	8:12:48	10.17	0:00:00	1.00	69.0
	15:49:18	10.18	0:00:01	1.00	68.9
	16:04:19	11.25	0:01:05	1.11	62.4
	16:14:12	10.47	0:00:18	1.03	67.1
	16:29:18	11.35	0:01:11	1.12	61.9
	16:39:16	10.28	0:00:07	1.01	68.3
	16:55:44	10.77	0:00:36	1.06	65.2
	17:04:57	10.33	0:00:10	1.02	67.9
	17:24:58	12.45	0:02:17	1.22	56.4
	17:36:32	11.25	0:01:05	1.11	62.4
	17:58:13	11.42	0:01:15	1.12	61.5
B-A	Departure Time	Travel Time (min)	Additional Time	Travel Time Index	Avg. Speed
	6:55:36	11.38	0:01:13	1.12	61.7
	7:03:59	10.78	0:00:37	1.06	65.1
Poor	7:21:46	13.25	0:03:05	1.30	53.0
	7:33:11	11.07	0:00:54	1.09	63.4
	7:51:21	11.33	0:01:10	1.11	61.9
	8:00:12	11.00	0:00:50	1.08	63.8
	8:16:15	12.27	0:02:06	1.21	57.2
	15:51:06	12.27	0:02:06	1.21	57.2
	16:00:38	10.92	0:00:45	1.07	64.3
	16:16:25	11.88	0:01:43	1.17	59.1
	16:25:34	11.23	0:01:04	1.10	62.5
Poor	16:42:12	12.83	0:02:40	1.26	54.7
	17:07:49	11.23	0:01:04	1.10	62.5
	17:22:31	10.92	0:00:45	1.07	64.3
	17:44:42	10.88	0:00:43	1.07	64.5

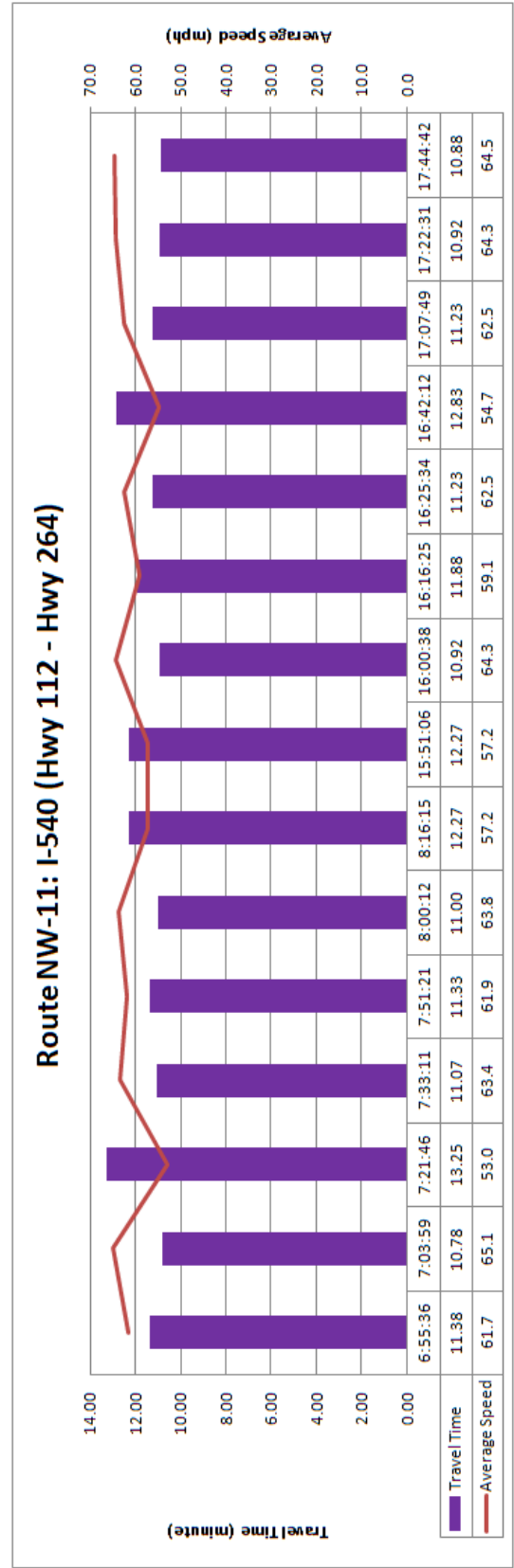
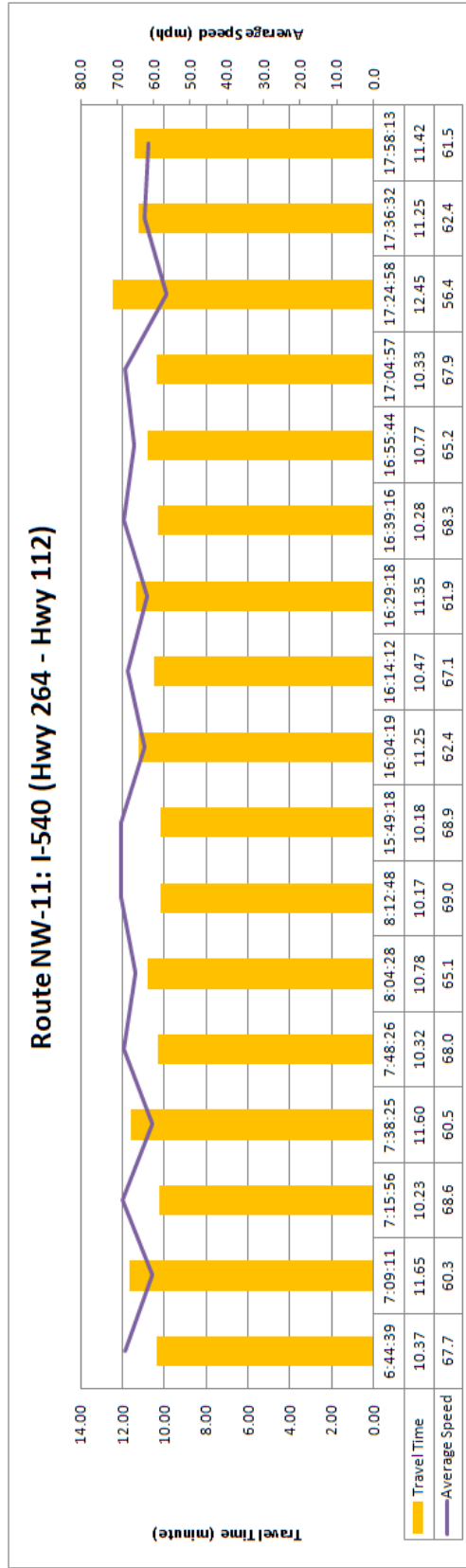


Table A.30. Route HS-1 - Highways 7/88 Travel Time Summaries
(A @ Hwy. 7, B @ Hwy. 290)

A-B	Departure Time	Travel Time (min)	Additional Time	Travel Time Index	Avg. Speed
	6:49:34	10.23	0:00:04	1.01	35.2
	7:16:10	10.48	0:00:19	1.03	34.3
	7:27:49	10.90	0:00:44	1.07	33.0
	7:41:26	11.92	0:01:45	1.17	30.2
Poor	7:51:02	12.23	0:02:04	1.20	29.4
	8:05:10	11.35	0:01:11	1.12	31.7
	11:10:00	13.20	0:03:02	1.30	27.3
	11:22:51	11.85	0:01:41	1.17	30.4
	11:40:05	13.03	0:02:52	1.28	27.6
	11:51:13	14.12	0:03:57	1.39	25.5
	12:10:57	14.63	0:04:28	1.44	24.6
	12:20:36	13.43	0:03:16	1.32	26.8
	12:39:21	14.43	0:04:16	1.42	24.9
	12:52:05	13.48	0:03:19	1.33	26.7
	13:14:58	13.23	0:03:04	1.30	27.2
	15:36:43	12.68	0:02:31	1.25	28.4
	15:51:59	10.75	0:00:35	1.06	33.5
	16:03:56	11.65	0:01:29	1.15	30.9
	16:19:40	14.50	0:04:20	1.43	24.8
	16:32:14	16.73	0:06:34	1.65	21.5
	16:52:35	14.23	0:04:04	1.40	25.3
	17:08:01	17.42	0:07:15	1.71	20.7
	17:27:25	10.72	0:00:33	1.05	33.6
B-A	Departure Time	Travel Time (min)	Additional Time	Travel Time Index	Avg. Speed
	6:49:51	10.17	0:00:00	1.00	35.4
	7:00:55	10.18	0:00:01	1.00	35.4
	7:17:02	10.22	0:00:03	1.00	35.2
	7:30:44	10.25	0:00:05	1.01	35.1
	7:40:02	10.45	0:00:17	1.03	34.4
	7:54:13	10.55	0:00:23	1.04	34.1
	8:04:43	11.58	0:01:25	1.14	31.1
	11:10:24	11.33	0:01:10	1.11	31.8
	11:26:06	12.73	0:02:34	1.25	28.3
	11:38:03	12.40	0:02:14	1.22	29.0
	11:55:35	10.90	0:00:44	1.07	33.0
	12:09:29	10.73	0:00:34	1.06	33.5
	12:27:40	10.77	0:00:36	1.06	33.4
	12:38:27	12.02	0:01:51	1.18	30.0
	13:06:56	10.43	0:00:16	1.03	34.5
	15:36:32	11.53	0:01:22	1.13	31.2
	15:51:51	11.10	0:00:56	1.09	32.4
	16:04:16	11.42	0:01:15	1.12	31.5
	16:19:30	11.93	0:01:46	1.17	30.2
	16:36:22	15.68	0:05:31	1.54	23.0
	16:50:41	16.47	0:06:18	1.62	21.9
Poor	17:08:51	17.73	0:07:34	1.74	20.3
	17:27:26	12.42	0:02:15	1.22	29.0

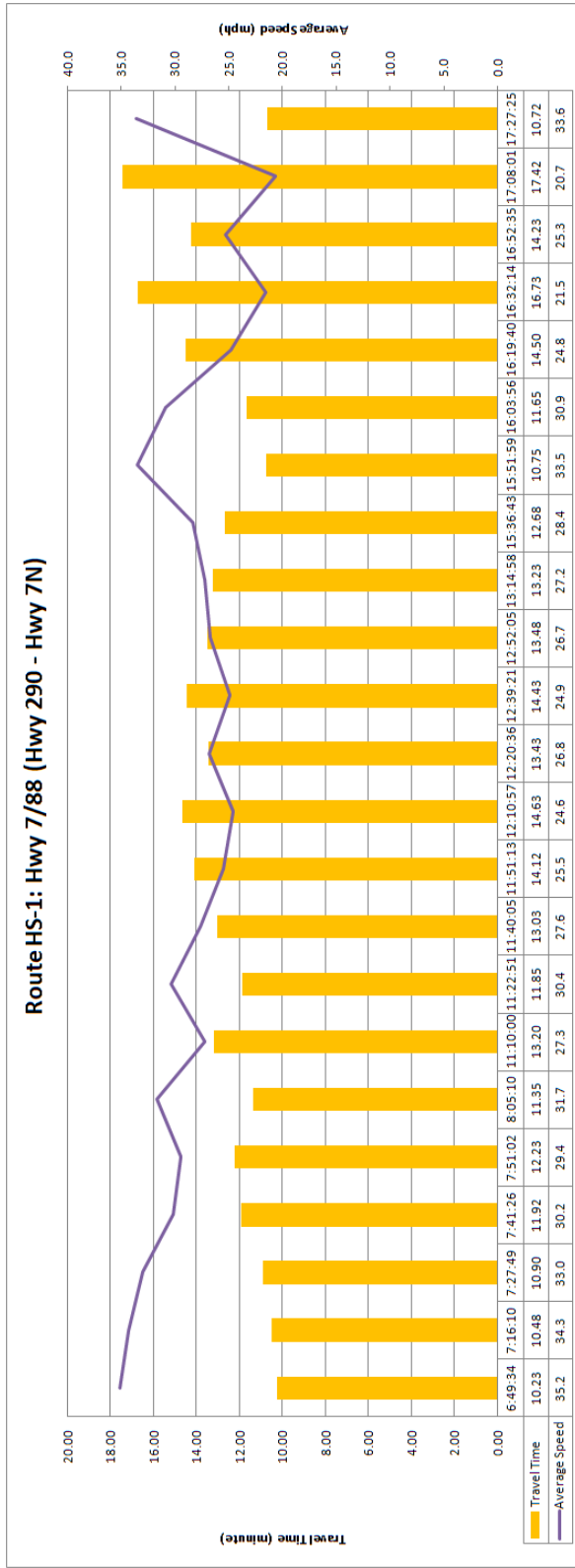


Table A.31. Route HS-2 - Highway 7 Travel Time Summaries
(A @ Hwy. 88, B @ Hwy. 70)

A-B	Departure Time	Travel Time (min)	Additional Time	Travel Time Index	Avg. Speed
	6:47:00	12.02	0:00:56	1.08	30.0
	6:47:09	13.15	0:02:04	1.19	27.4
	7:11:16	12.77	0:01:41	1.15	28.2
Poor	7:44:20	17.45	0:06:22	1.57	20.6
	7:59:33	13.27	0:02:11	1.20	27.1
	8:16:25	12.70	0:01:37	1.15	28.3
	11:02:05	16.75	0:05:40	1.51	21.5
	11:21:22	16.43	0:05:21	1.48	21.9
	11:38:01	16.27	0:05:11	1.47	22.1
	12:00:47	18.60	0:07:31	1.68	19.4
	12:22:10	19.35	0:08:16	1.75	18.6
Poor	12:42:55	22.30	0:11:13	2.01	16.1
	13:02:25	18.42	0:07:20	1.66	19.5
	15:38:23	18.38	0:07:18	1.66	19.6
	15:56:00	15.65	0:04:34	1.41	23.0
	16:16:35	15.63	0:04:33	1.41	23.0
	16:32:11	15.27	0:04:11	1.38	23.6
Poor	16:50:35	21.25	0:10:10	1.92	16.9
	17:07:41	16.95	0:05:52	1.53	21.2
	17:30:00	14.55	0:03:28	1.31	24.7
B-A	Departure Time	Travel Time (min)	Additional Time	Travel Time Index	Avg. Speed
	6:47:09	13.15	0:02:04	1.19	27.4
	7:11:33	11.08	0:00:00	1.00	32.5
	7:24:48	12.22	0:01:08	1.10	29.5
	7:44:25	13.98	0:02:54	1.26	25.7
	8:02:46	12.80	0:01:43	1.15	28.1
	8:13:59	13.63	0:02:33	1.23	26.4
	11:02:16	17.53	0:06:27	1.58	20.5
	11:20:29	16.13	0:05:03	1.46	22.3
	11:40:01	15.08	0:04:00	1.36	23.9
	12:05:20	16.10	0:05:01	1.45	22.4
	12:21:22	13.83	0:02:45	1.25	26.0
	12:42:34	19.18	0:08:06	1.73	18.8
	13:07:01	15.83	0:04:45	1.43	22.7
	15:38:29	17.08	0:06:00	1.54	21.1
	15:58:23	17.73	0:06:39	1.60	20.3
	16:12:48	17.82	0:06:44	1.61	20.2
	16:32:55	16.42	0:05:20	1.48	21.9
	16:48:52	17.32	0:06:14	1.56	20.8
	17:12:55	16.52	0:05:26	1.49	21.8
	17:31:38	15.87	0:04:47	1.43	22.7

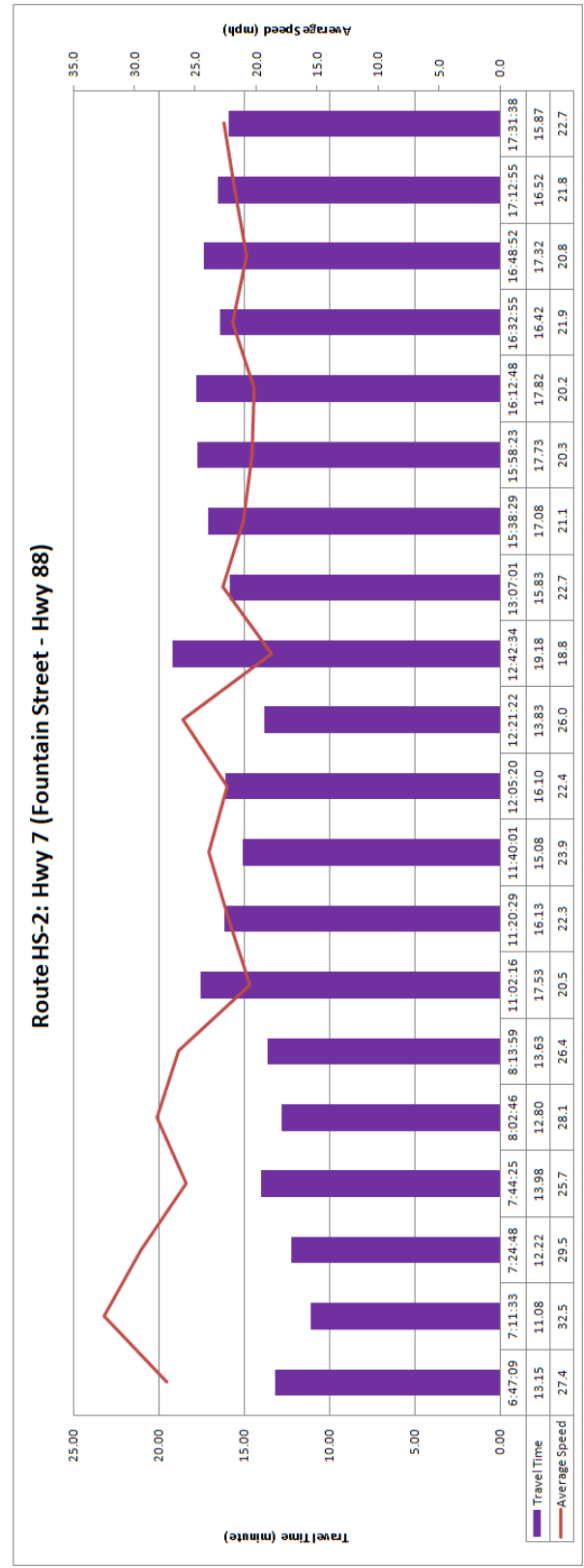
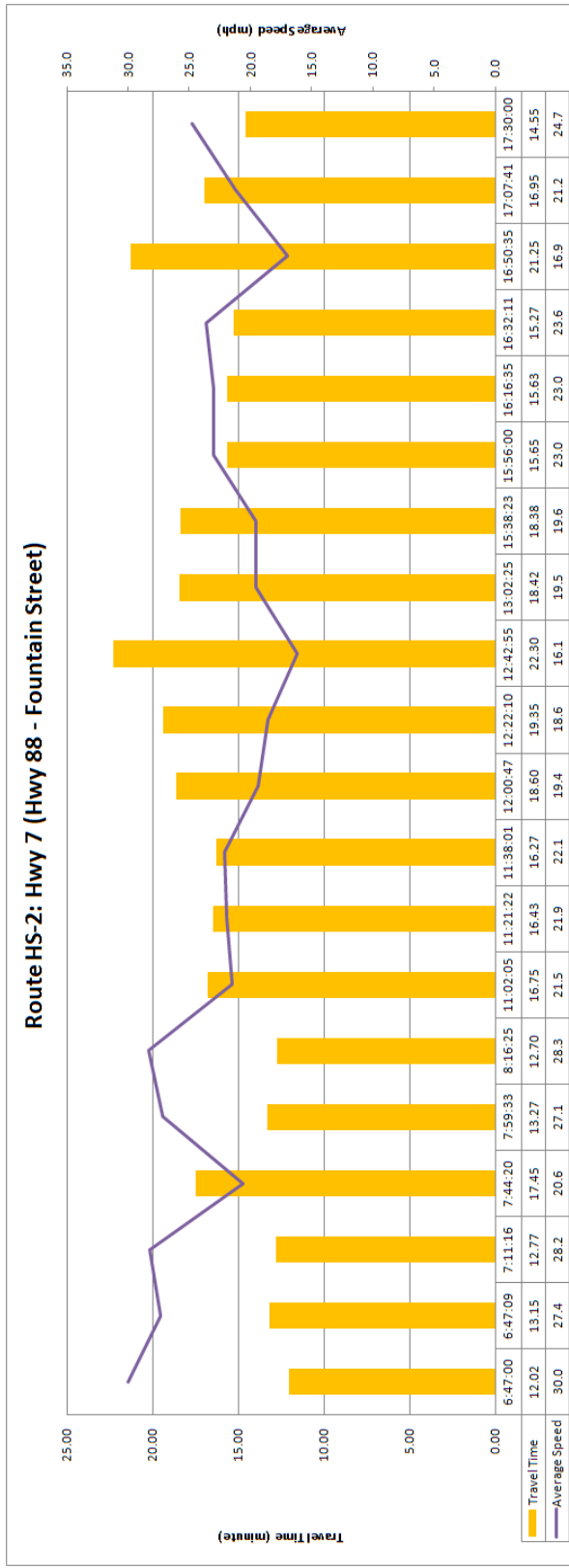


Table A.32. Route HS-3 - Highway 7 Travel Time Summaries
(A @ Hwy. 70, B @Hwy. 5)

A-B	Departure Time	Travel Time (min)	Additional Time	Travel Time Index	Avg. Speed
	6:53:38	10.27	0:00:42	1.07	46.8
	7:04:25	10.72	0:01:09	1.12	44.8
	7:15:30	9.63	0:00:04	1.01	49.8
	7:26:34	10.75	0:01:11	1.12	44.7
	7:35:45	9.62	0:00:03	1.01	49.9
	7:49:26	10.70	0:01:08	1.12	44.9
	10:57:20	9.77	0:00:12	1.02	49.1
	11:08:07	10.63	0:01:04	1.11	45.1
	11:18:35	9.73	0:00:10	1.02	49.3
	11:30:48	10.82	0:01:15	1.13	44.4
	11:39:58	10.12	0:00:33	1.06	47.4
Poor	11:58:05	12.05	0:02:29	1.26	39.8
	12:10:34	10.03	0:00:28	1.05	47.8
	12:22:39	11.17	0:01:36	1.17	43.0
	12:37:47	10.75	0:01:11	1.12	44.7
	12:45:53	11.25	0:01:41	1.18	42.7
	15:35:41	9.57	0:00:00	1.00	50.2
	15:46:43	10.43	0:00:52	1.09	46.0
	16:00:00	10.28	0:00:43	1.07	46.7
	16:09:59	10.92	0:01:21	1.14	44.0
	16:21:40	10.25	0:00:41	1.07	46.8
B-A	Departure Time	Travel Time (min)	Additional Time	Travel Time Index	Avg. Speed
	6:53:26	10.57	0:01:00	1.10	45.4
	7:04:24	10.65	0:01:05	1.11	45.1
	7:15:25	10.92	0:01:21	1.14	44.0
	7:25:36	9.73	0:00:10	1.02	49.3
	7:38:26	10.92	0:01:21	1.14	44.0
	7:45:58	11.48	0:01:55	1.20	41.8
	10:57:14	10.38	0:00:49	1.09	46.2
	11:07:57	9.68	0:00:07	1.01	49.6
	11:19:02	11.42	0:01:51	1.19	42.0
	11:29:18	9.72	0:00:09	1.02	49.4
	11:42:03	11.37	0:01:48	1.19	42.2
	11:58:30	11.03	0:01:28	1.15	43.5
Poor	12:10:37	11.75	0:02:11	1.23	40.9
	12:22:38	11.65	0:02:05	1.22	41.2
	12:34:23	11.10	0:01:32	1.16	43.2
	12:49:22	10.27	0:00:42	1.07	46.8
	15:35:22	11.02	0:01:27	1.15	43.6
	15:48:50	10.32	0:00:45	1.08	46.5
	15:57:37	10.90	0:01:20	1.14	44.0
	16:10:52	10.30	0:00:44	1.08	46.6
	16:21:23	10.88	0:01:19	1.14	44.1
	16:32:37	10.17	0:00:36	1.06	47.2

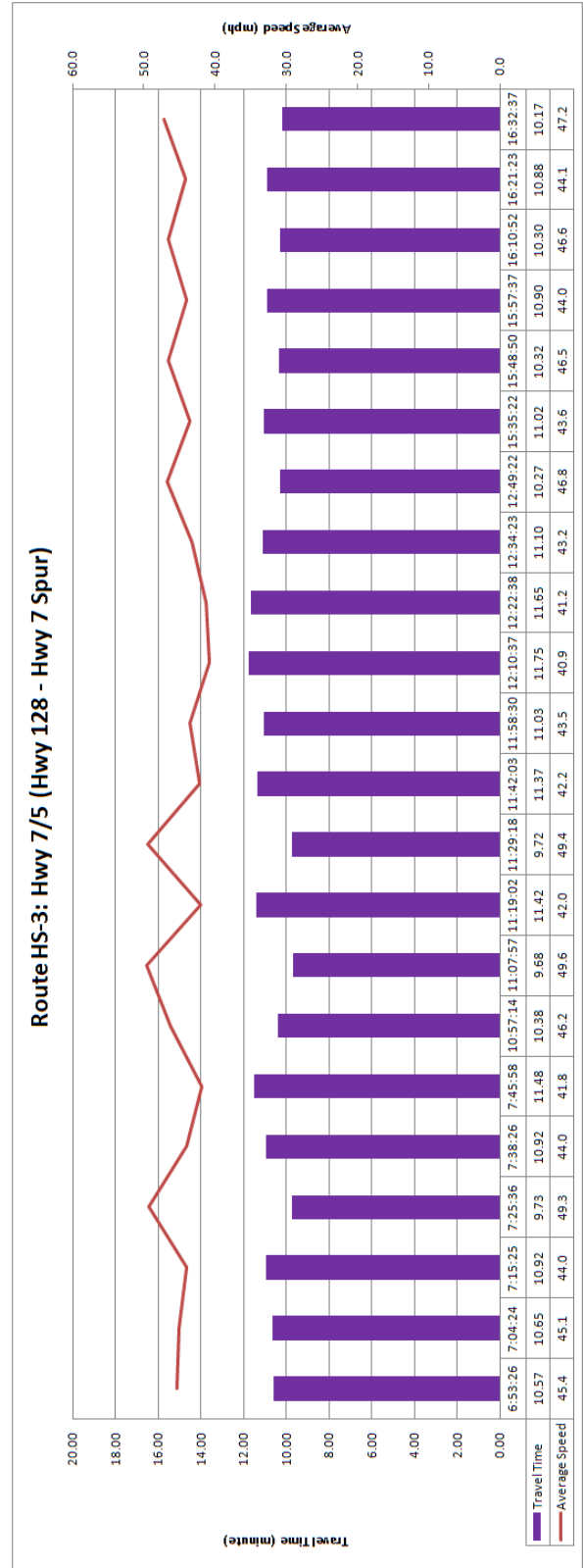
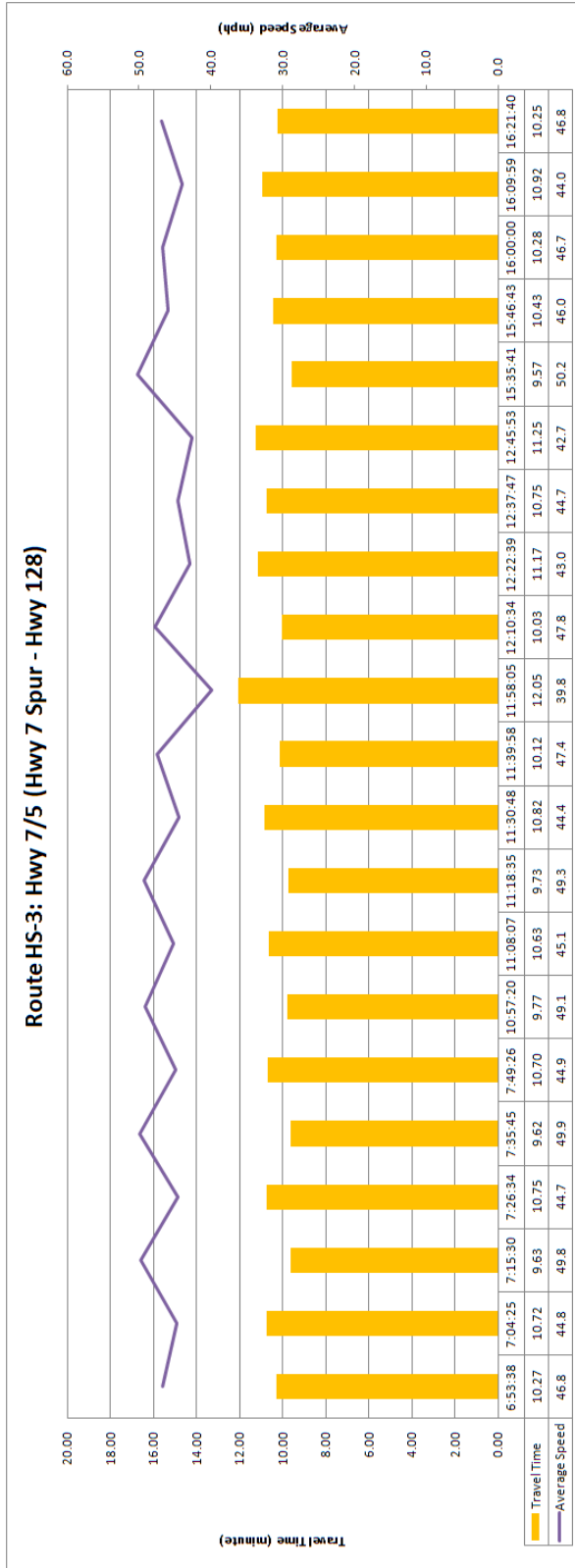


Table A.33. Route HS-4 - Highway 70B/270 Travel Time Summaries
(A @ Phillips St., B @ Meadow Creek Ln.)

A-B	Departure Time	Travel Time (min)	Additional Time	Travel Time Index	Avg. Speed
	7:24:49	15.98	0:02:05	1.15	41.3
	7:43:00	15.93	0:02:02	1.15	41.4
	7:58:59	16.50	0:02:36	1.19	40.0
	8:17:25	13.90	0:00:00	1.00	47.5
	11:18:45	15.83	0:01:56	1.14	41.7
	11:36:42	17.18	0:03:17	1.24	38.4
	11:53:41	15.90	0:02:00	1.14	41.5
	12:20:21	16.20	0:02:18	1.17	40.7
	12:38:25	17.35	0:03:27	1.25	38.0
	12:56:52	14.98	0:01:05	1.08	44.0
	13:15:31	16.55	0:02:39	1.19	39.9
	15:46:11	16.30	0:02:24	1.17	40.5
Poor	16:04:47	17.55	0:03:39	1.26	37.6
	16:23:32	15.63	0:01:44	1.12	42.2
	16:42:08	17.28	0:03:23	1.24	38.2
	16:58:19	15.48	0:01:35	1.11	42.6
	17:17:52	15.82	0:01:55	1.14	41.7
	17:33:29	15.62	0:01:43	1.12	42.3
	17:52:10	16.45	0:02:33	1.18	40.1
B-A	Departure Time	Travel Time (min)	Additional Time	Travel Time Index	Avg. Speed
	7:24:56	16.87	0:02:58	1.21	39.1
	7:41:29	16.65	0:02:45	1.20	39.6
	8:16:48	15.90	0:02:00	1.14	41.5
	11:18:24	15.23	0:01:20	1.10	43.3
	11:36:01	16.65	0:02:45	1.20	39.6
	11:55:02	16.77	0:02:52	1.21	39.4
	12:10:14	17.73	0:03:50	1.28	37.2
	12:37:47	16.78	0:02:53	1.21	39.3
	12:57:28	17.12	0:03:13	1.23	38.6
	13:17:13	17.63	0:03:44	1.27	37.4
	15:47:01	16.93	0:03:02	1.22	39.0
	16:04:02	15.70	0:01:48	1.13	42.0
Poor	16:22:56	17.78	0:03:53	1.28	37.1
	16:39:47	15.37	0:01:28	1.11	43.0
	17:00:01	16.98	0:03:05	1.22	38.9
	17:14:21	17.53	0:03:38	1.26	37.6
	17:34:46	16.65	0:02:45	1.20	39.6
	17:49:43	15.23	0:01:20	1.10	43.3

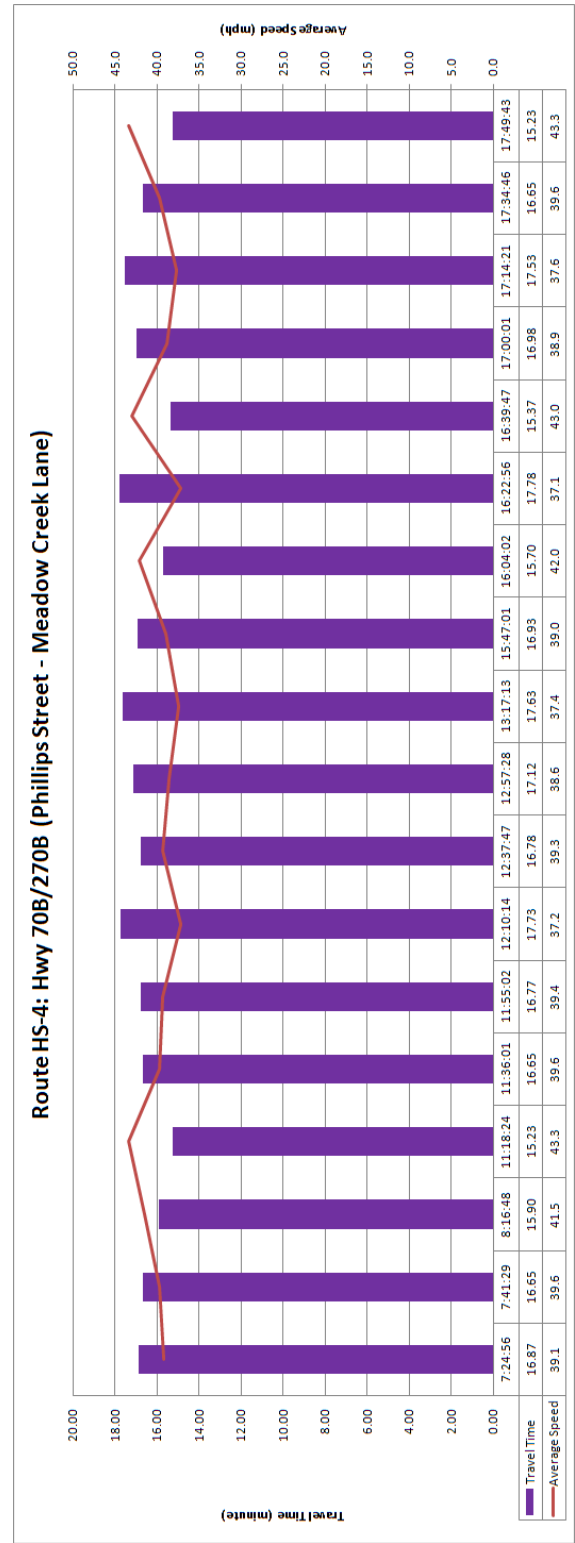
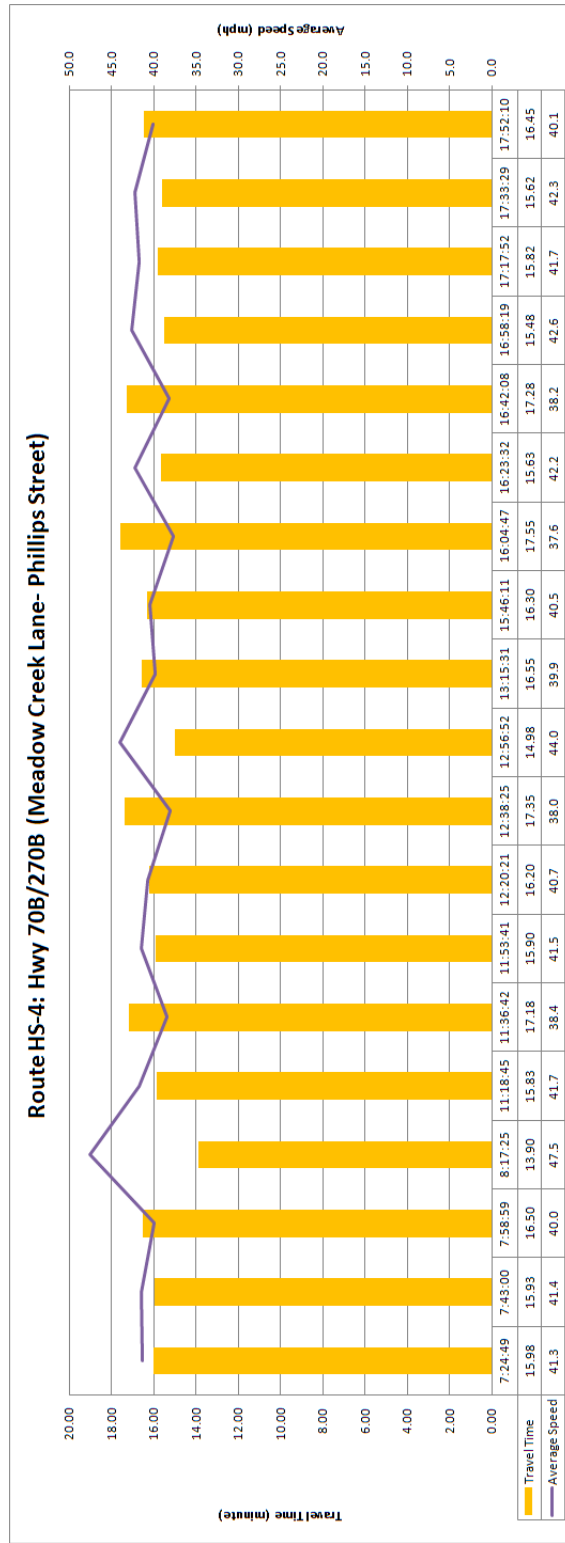


Table A.34. Route HS-5 - Highway 128 Travel Time Summaries
(A @ Highway 290, B @ Highway 270B)

A-B	Departure Time	Travel Time (min)	Additional Time	Travel Time Index	Avg. Speed
	7:08:09	6.92	0:01:27	1.27	39.0
	7:15:02	6.42	0:00:57	1.17	42.1
	7:23:03	6.22	0:00:45	1.14	43.4
Poor	7:50:10	7.22	0:01:45	1.32	37.4
	8:08:21	6.48	0:01:01	1.19	41.6
	11:06:58	6.95	0:01:29	1.27	38.8
	11:13:53	5.92	0:00:27	1.08	45.6
	11:21:59	6.67	0:01:12	1.22	40.5
	11:27:09	6.13	0:00:40	1.12	44.0
	12:02:42	6.80	0:01:20	1.24	39.7
	15:31:43	6.05	0:00:35	1.11	44.6
	15:39:45	6.40	0:00:56	1.17	42.2
	15:50:42	6.32	0:00:51	1.16	42.7
	15:57:54	6.75	0:01:17	1.23	40.0
	16:04:43	6.37	0:00:54	1.16	42.4
	16:34:50	6.45	0:00:59	1.18	41.9
	16:37:50	6.10	0:00:38	1.12	44.3
Poor	17:01:10	7.92	0:02:27	1.45	34.1
	17:27:44	6.10	0:00:38	1.12	44.3
B-A	Departure Time	Travel Time (min)	Additional Time	Travel Time Index	Avg. Speed
	7:08:38	5.88	0:00:25	1.08	45.9
	7:16:07	6.52	0:01:03	1.19	41.4
	7:22:06	5.47	0:00:00	1.00	49.4
	7:44:54	6.23	0:00:46	1.14	43.3
	7:58:02	5.65	0:00:11	1.03	47.8
	11:07:07	6.15	0:00:41	1.13	43.9
	11:15:23	6.02	0:00:33	1.10	44.9
	11:20:22	6.13	0:00:40	1.12	44.0
	11:30:08	5.97	0:00:30	1.09	45.3
	12:03:39	6.37	0:00:54	1.16	42.4
	15:32:03	6.30	0:00:50	1.15	42.9
	15:44:03	5.68	0:00:13	1.04	47.5
	15:51:01	6.03	0:00:34	1.10	44.8
	15:57:53	6.13	0:00:40	1.12	44.0
	16:05:44	6.28	0:00:49	1.15	43.0
	16:31:11	5.82	0:00:21	1.06	46.4
	16:42:49	6.82	0:01:21	1.25	39.6
	17:02:11	6.35	0:00:53	1.16	42.5
	17:32:15	5.97	0:00:30	1.09	45.3

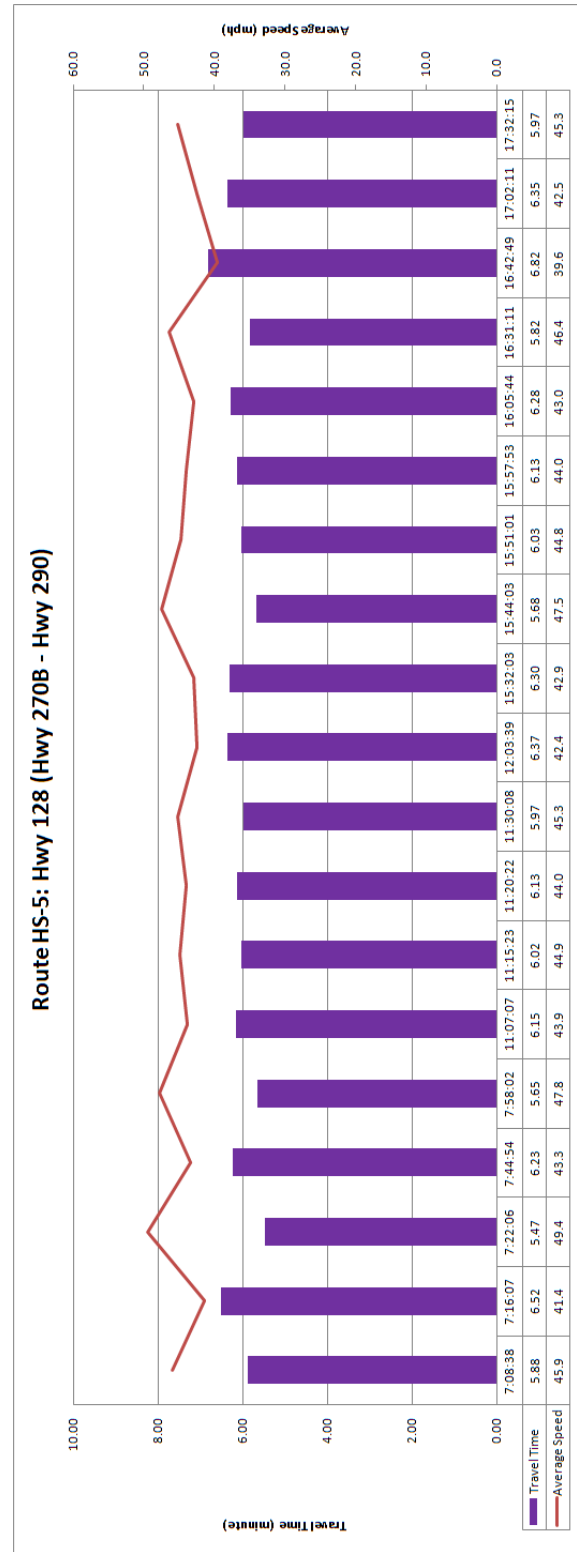
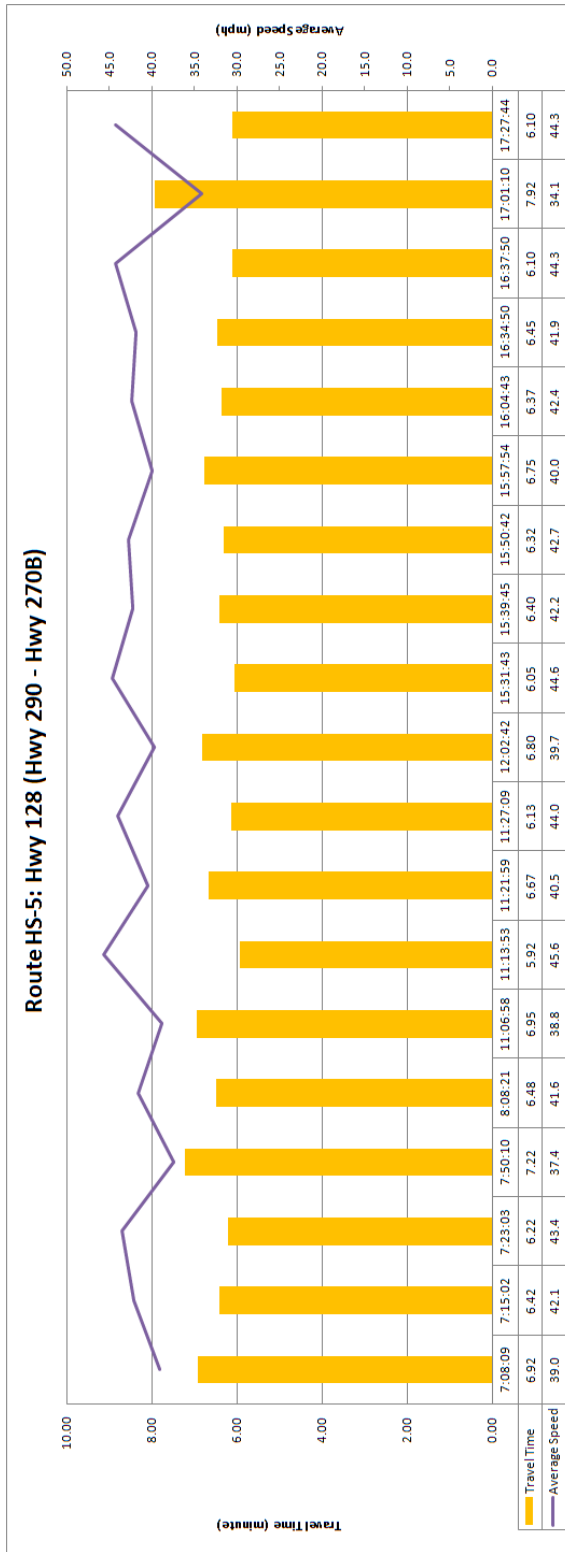


Table A.35. Route HS-6 – Highways 70/270 Travel Time Summaries
(A @ Highway 270B, B @ Highway 70)

A-B	Departure Time	Travel Time (min)	Additional Time	Travel Time Index	Avg. Speed
	7:10:45	11.00	0:00:14	1.02	70.9
Poor	7:24:54	12.87	0:02:06	1.20	60.6
	15:31:45	11.77	0:01:00	1.09	66.3
	15:43:52	11.67	0:00:54	1.08	66.9
	15:58:23	10.77	0:00:00	1.00	72.4
	16:09:55	11.78	0:01:01	1.09	66.2
	16:59:27	11.40	0:00:38	1.06	68.4
	17:13:16	11.90	0:01:08	1.11	65.5
	17:26:21	11.05	0:00:17	1.03	70.6
	17:39:48	11.48	0:00:43	1.07	67.9
B-A	Departure Time	Travel Time (min)	Additional Time	Travel Time Index	Avg. Speed
	7:12:33	12.10	0:01:20	1.12	64.5
	7:23:59	11.23	0:00:28	1.04	69.4
	15:31:22	12.35	0:01:35	1.15	63.2
	15:45:42	11.67	0:00:54	1.08	66.9
	15:57:22	11.93	0:01:10	1.11	65.4
	16:12:03	11.78	0:01:01	1.09	66.2
	17:00:37	11.43	0:00:40	1.06	68.2
	17:13:42	11.90	0:01:08	1.11	65.5
Poor	17:27:16	12.03	0:01:16	1.12	64.8
	17:40:01	11.48	0:00:43	1.07	67.9

