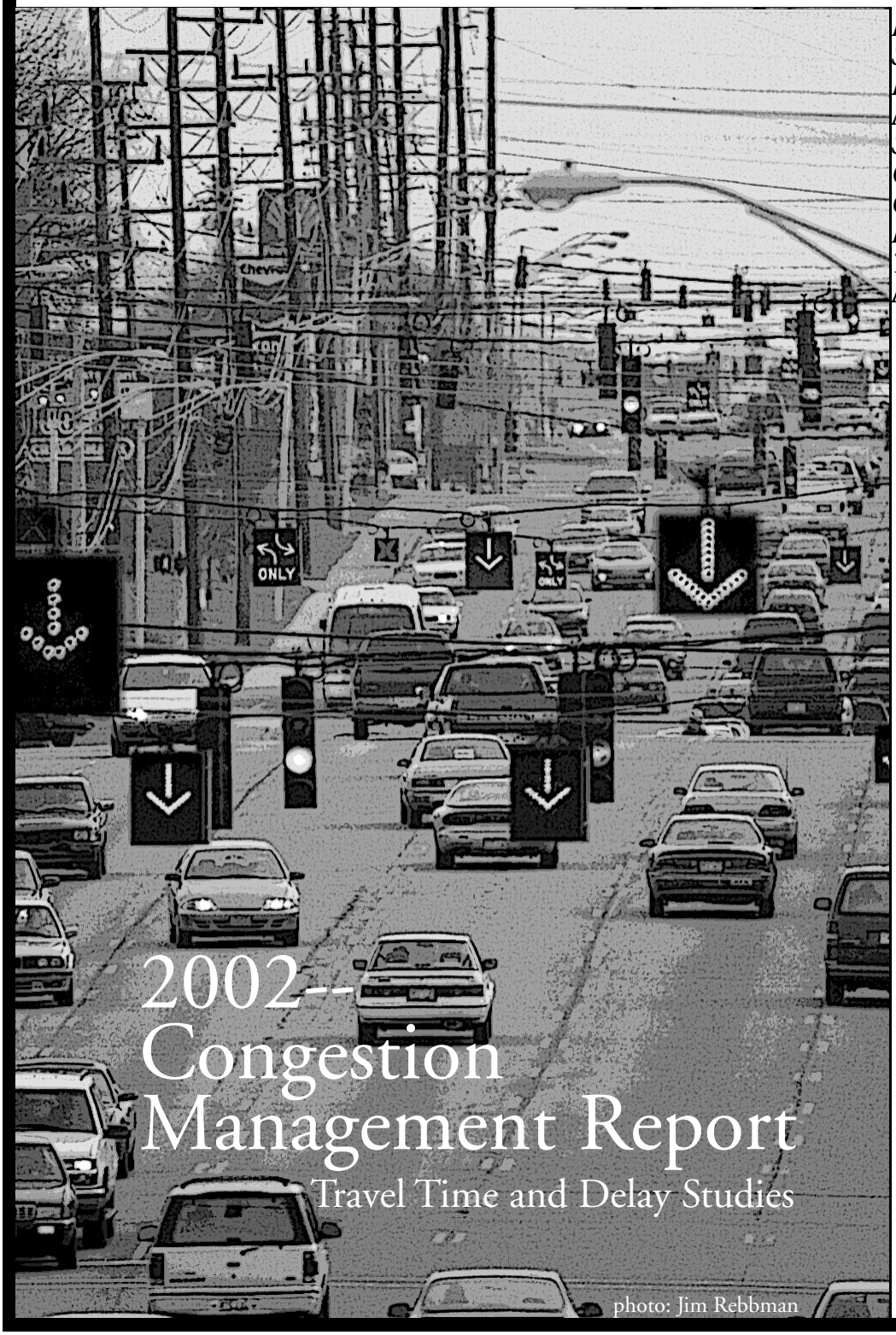
Lexington Area

Metropolitian Planning Organization



2002--Congestion Management Report

Travel Time and Delay Studies

photo: Jim Rebbman

Executive Summary

Traffic congestion is an every day fact of life, and it's getting worse every day. The Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) and the Transportation Equity Act for the 21st Century (TEA-21) have made the alleviation congestion one of their main focuses. While there is no one universally accepted definition of congestion the Transportation Research Board 's (TRB) definition was adopted for the study. It states that "Congestion is travel time or delay in excess of that normally incurred under light or free-flow travel conditions."

This report has been prepared as part of a Congestion Management System (CMS). A CMS is "a systematic process that provides information on transportation system performance and alternative strategies to alleviate congestion and enhance the mobility of persons and goods to levels that meet state and local needs."

The following actions are identified as part of the CMS work plan:

- Formulation of performance measures applicable to all modes;
- Methods to monitor and evaluate conditions of the transportation system;
- Identification of alternative actions to address areas where congestion problems are most severe;
- Assessment and implementation of cost-effective traffic congestion mitigation strategies to relieve current or projected levels of congestion;
- Evaluation of the impact of the congestion mitigation strategies implemented

To this end, a Global Positioning System (GPS) receiver was combined with a Palm Pilot (PDA) to capture positional data, store it, and plot it against a map to determine the location and severity of congestion along corridors in the MPO area. A number of MPO staff and volunteers were recruited to drive on the minor and major arterials leading into downtown Lexington. They had a number of restrictions on when they could and couldn't drive their routes. They drove in fair weather, Mondays thru Thursdays, during rush hours, avoiding construction, accidents and special events. This meant that they drove during the "average worst case" rush hours when there was nothing abnormally increasing or decreasing congestion. They drove for ten mornings and evenings, so that the average commute for the given routes could be derived.

The equipment produced the following data: date, time, latitude, longitude and altitude. From this information it was possible to derive the following: distance traveled, elapsed time, speed, cumulative distance and cumulative time. When these points were plotted on a map, one could tell where they were relative to crossing streets. All of the data together made it possible to determine the location and length of delays.

When the data from all ten morning runs was combined and plotted against the cumulative distance, it was possible to calculate the average speed over quarter mile distances. This was also true for the evening runs. It was therefore possible to quantify areas of congestion. Congestion categories were based on average speeds ranked by three levels:

Average Speed	Level of Congestion
20-30 mph	Congested
10-20 mph	Very Congested
0-10 mph	Severely Congested

This system can also provide information on intersection delay. For example, it can provide information on the probability on being stopped and the amount of time that one can expect to be delayed if stopped. This portion of the report also deals with the components of Run Time. Simply put:

Run Time = Driving time + Intersection Delay + Other Delay

Run time is the time that it actually took to make the run, on average. The driving time is the amount of time that it would take to make the run doing the posted speed limits. The intersection delay is the average time spent delayed at intersections and the other delay is the delay caused by other factors such as turning movements.

The relationship of Run Time to Driving Time can be expressed as Run Time divided by Driving Time, and is called the Travel Rate Index (TRI). The Texas Transportation Institute (TTI) developed this concept as a way to measure congestion. This measure was used as a way of comparing the amount of congestion on different routes and is shown below. The higher the TRI is, the worse the congestion.

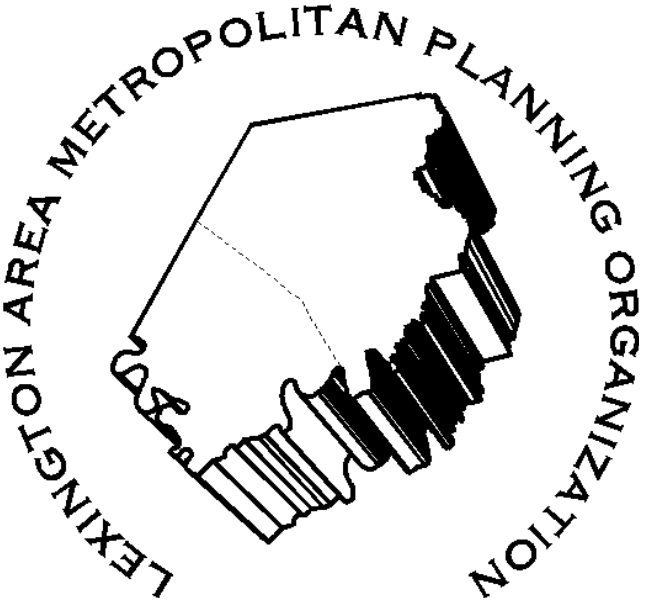
The following table gives the TRI for routes covered by the study by time of day and, in some cases, direction.

		Street		Am/Pm	Travel Rate* Index
Worst	1	New Circle Road	Outer	Pm	2.81
	2	Nicholasville Road		Pm	2.79
	3	New Circle Road	Inner	Pm	2.72
	4	Harrodsburg Road		Pm	2.66
	5	New Circle Road	Outer	Noon	2.59
	6	New Circle Road	Inner	Noon	2.54
	7	Man o War	Outer	Pm	2.43
	8	New Circle Road	Outer	Am	2.16
	9	Man o War	Inner	Pm	2.14
	10	New Circle Road	Inner	Am	2.12
	11	Newtown Pike		Am	2.07
	12	Tates Creek Rd		Pm	1.95
	13	Man o War	Inner	Am	1.88
	14	Man o War	Outer	Noon	1.88
	15	Richmond Road		Pm	1.84
	16	Winchester Road		Pm	1.82
	17	Harrodsburg Road		Am	1.81
	18	North Broadway		Pm	1.81
	19	Nicholasville Road		Am	1.80
	20	Man o War	Outer	Am	1.79
	21	Winchester Road		Am	1.76
	22	Tates Creek Rd		Am	1.74
	23	Man o War	Inner	Noon	1.67
	24	Newtown Pike		Pm	1.67
	25	North Broadway		Am	1.63
	26	Richmond Road		Am	1.52
	27	Leestown Road		Am	1.51
	28	Leestown Road		Pm	1.46
	29	Versailles Road		Am	1.42
Best	30	Versailles Road		Pm	1.27

Acknowledgment

We would like to thank everyone who has participated in gathering the data for the Congestion Management Report, without them this research could not be possible.

We would also like to remind everyone that efforts besides construction projects also relieve congestion, which improves our environment and quality of life. Only you can ease the impact that our automobiles have on the future. There are many options that you can choose to maintain our environment. Please call the Bluegrass Mobility Office at 233-POOL and see if there is a carpool/vanpool you could participate in. If you wish to use the transit system, call LexTran at 253-4636 for more information. Other alternative modes of transportation that may appeal to you are; telecommuting, walking or bicycling. These are the truest methods of congestion relief and it is up to you to implement them.



Introduction

The Lexington Area Metropolitan Planning Organization's (MPO) primary interest in travel time information is as a tool for developing and monitoring the effectiveness of transportation facilities for the Congestion Management System (CMS). The CMS is a regional planning instrument mandated by the Intermodal Surface Transportation Efficiency Act of 1991 and continued by the current federal transportation act, the Transportation Equity Act for the 21st Century (TEA-21). The MPO is responsible for maintaining the CMS. The purpose of the CMS is to provide information on the performance of transportation systems and alternatives for alleviating congestion. This information is used to develop strategies to increase the efficiency of existing and future transportation facilities in order to meet the present and future mobility needs of people and goods.

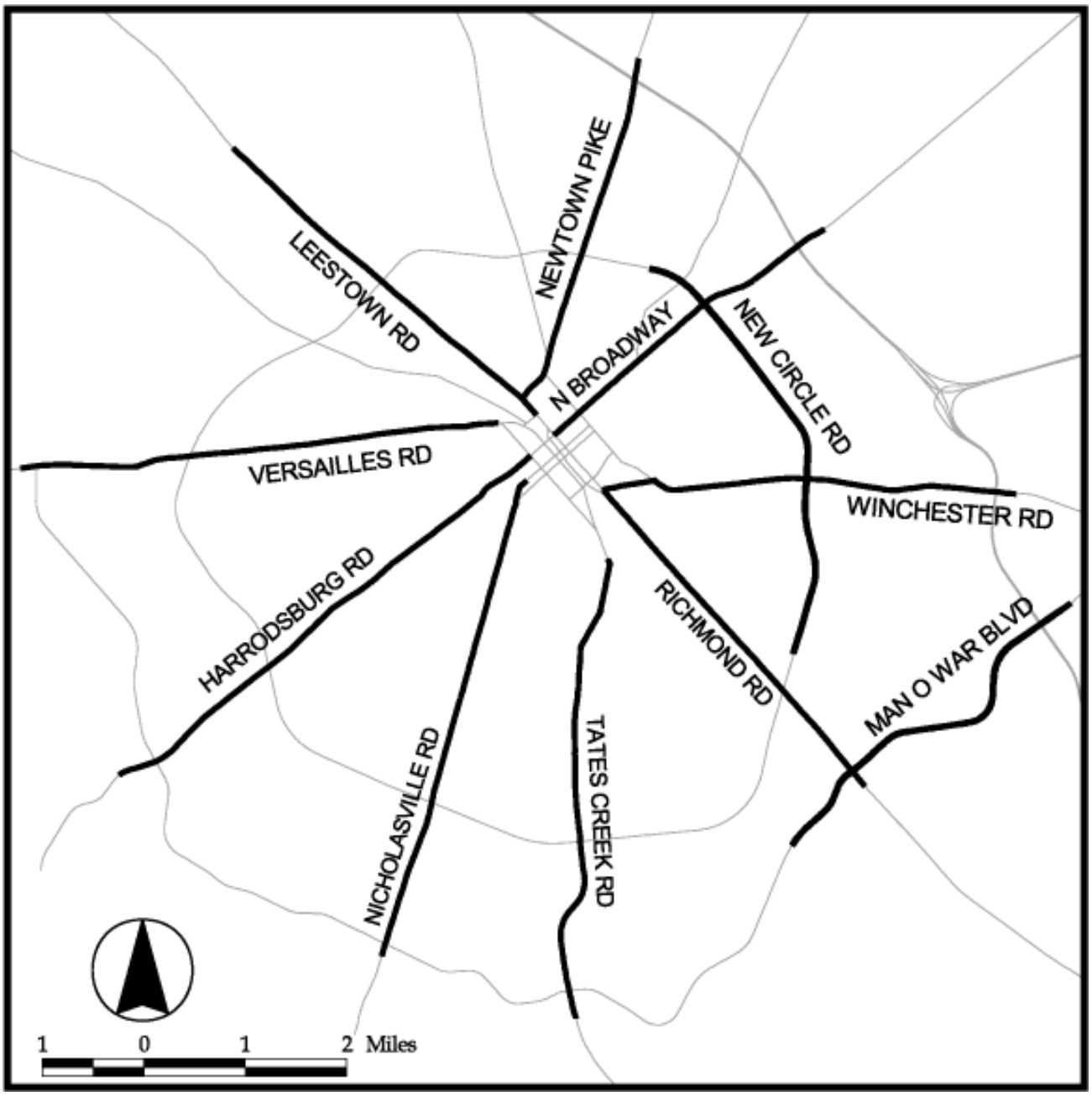
Throughout the field of transportation planning and operations, there is an emerging consensus that travel time is the most meaningful measure of congestion. To obtain these travel times the MPO determined that the use of GPS technology would yield the best information for the money available. This research will provide data for various projects including travel demand forecasting, traffic signal timing and phasing as well as the Congestion Management System. This will be a continuing effort with biannual reports such as this one.

These studies were conceived in the spring of 2001 to evaluate the effects proposed signalization improvements would have on New Circle Road and Man o' War Boulevard. Since then the scope has widened to cover most of the arterials emanating from downtown to the suburbs.

These roads include:

Route[1]	Begin	End
Harrodsburg Rd.	Maxwell St.	Man o' War Blvd.
Leestown Rd.	Jefferson St.	Masterson Station Dr.
Portions of Man o' War Blvd.	Alumni Dr.	I-75
Portions of New Circle Rd.	Woodhill Dr.	Boardwalk
Newtown Pike	Main St.	I-75/I-64
Nicholasville Rd.	Avenue of Champions	Man o' War Blvd.
North Broadway	Main St.	I-75/I-64
Richmond Rd.	Main/Vine	Man o' War Blvd.
Tates Creek Rd.	Ashland Ave.	Man o' War Blvd.
Versailles Rd.	High/Maxwell St.	Man o' War Blvd.
Winchester Rd.	Main St.	I-75

[1] New timing plans are being developed for sections of Newtown Pike, Nicholasville Rd., Tates Creek Rd. and Harrodsburg Rd.


LEESTOWN RD
NEWTOWN PIKE
N BROADWAY
NEW CIRCLE RD
VERSAILLES RD
WINCHESTER RD
HARRODSBURG RD
RICHMOND RD
MAN O WAR BLVD
NICHOLASVILLE RD
TATES CREEK RD
1 0 1 2 Miles

Methodology

The method utilized to capture data for these travel time studies represents the marriage of Global Positioning Systems (GPS) and Personal Digital Assistant (PDA) technologies. The GPS, accessing information from four to twelve satellites at one time, enables it to precisely locate the absolute location of the user. The volunteers, who manned these studies, took the GPS and PDA and drove to and from work as they would everyday. They were instructed to drive in a fashion known as the "floating car" technique. This is when the driver stay with the flow of traffic, going neither faster nor slower than the surrounding traffic.

Commuter traffic places the highest level of stress on the transportation network on a daily basis. To gather data for this analysis, an average day for commuter traffic had to be defined. The process required a sample of ten runs. The morning runs heading into downtown started between 6:00 and 9:00am. The evening runs heading out of downtown started between 4:00 and 6:00pm. The runs were acquired on days with fair weather, no accidents or special events. The data was also only collected between Tuesday and Thursday. Monday and Friday is generally lighter than the rest of the work week. On the two circumferential routes, New Circle Road and Man o' War Boulevard, the studies were done in both directions for both the morning and evening peaks as well as the noon peak. All of these factors affect the flow of traffic and have been attempted to be normalized. It takes one to two months to obtain ten runs that meet all of these requirements. Some of the data for this study was collected while school was not in session which can add significant volume to the overall traffic. Due to time constraints, we were unable to gather all of the information we would have liked to for the Lexington Area; but, perhaps it will be possible in the coming year.

The equipment registered the time and vehicle location every four seconds of the run. These locations and times were stored in the PDA; later to be downloaded into a desktop computer upon returning to the office. With this information an analyst was able to determine the following:

Location of the vehicle,
Speed of the vehicle,
Direction of travel,
Location of delays,
Duration of delays

Table 1 is divided in two portions, the measured figures and the computed figures.

The measured figures include time and location:

- Date and Time (hour, minutes, and seconds)
- Latitude, Longitude and Altitude.

The second portion of the table gives the computed figures:

- Distance (distance between points),
- Elap.Time (time elapsed between points),
- Speed (the average speed between points),
- Cum. Dist. (cumulative distance), and
- Cum. Time (time elapsed from the beginning of the run)
- Cross Streets (relative location).

An example of this information for Harrodsburg Road in the morning is given here. Table 1.

Date	Time	Latitude	Longitude	Altitude	Distance	Time	Speed	Cum Dist	Cum Time	Cross Street
2/5/02	5:41:38	38.002466	-84.571316	1023	0.0329	4	29.6	4.8058	24.4	Man o War
2/5/02	5:41:34	38.002683	-84.570783	1023	0.1860	4	39.4	4.7729	24.3	
2/5/02	5:41:17	38.004383	-84.568166	1030	0.0739	4	53.2	4.5869	24.1	
2/5/02	5:41:12	38.005149	-84.567233	1030	0.0748	4	38.5	4.5130	24.0	
2/5/02	5:41:05	38.005933	-84.5663	1036	0.1858	4	44.6	4.4382	23.9	
2/5/02	5:40:50	38.007816	-84.563899	1033	0.0518	4	46.6	4.2524	23.6	Wellington
2/5/02	5:40:46	38.008316	-84.563199	1033	0.0481	4	43.3	4.2006	23.5	
2/5/02	5:40:42	38.008766	-84.562533	1040	0.0417	4	37.5	4.1525	23.5	
2/5/02	5:40:38	38.00915	-84.561949	1040	0.0481	4	21.6	4.1108	23.4	Ft. Harrods
2/5/02	5:40:30	38.009583	-84.561266	1043	0.0015	4	0.7	4.0627	23.3	
2/5/02	5:40:23	38.009599	-84.561249	1043	0.0000	4	0.0	4.0613	23.2	
2/5/02	5:40:20	38.009599	-84.561249	1043	0.0000	4	0.0	4.0613	23.1	
2/5/02	5:40:16	38.009599	-84.561249	1043	0.0122	4	11.0	4.0613	23.0	
2/5/02	5:40:12	38.009716	-84.561083	1043	0.0287	4	25.9	4.0491	23.0	
2/5/02	5:40:08	38.009966	-84.560666	1046	0.0452	4	32.6	4.0203	22.9	
2/5/02	5:40:03	38.010366	-84.560016	1053	0.0740	4	53.3	3.9751	22.8	

There is further information, shown in *Table 1*. For example, the data in the shaded cells represents an area of delay (traveling at less than ten miles per hour). We can also tell that the delay, in the example, is related to the signal at Ft. Harrold Dr.[1] (The data must be read from the bottom up with the earlier data point being below the later ones. It's almost as if one is driving up the page: one will "hit" the delays before the signal is past.)

After the ten runs were made (similar to the partial one in *Table 1*), they could be combined to yield even more information. For example, *Table 2* gives the average speed of all ten runs by quarter mile increments. Then each segment was ranked.

We rank congestion based on Average Speed with three degrees:

Average Speed	
20 - 30 mph	Congested
10 - 20 mph	Very Congested
0 - 10 mph	Severely Congested

In this example *(Table 2),* the average speed between Longview Drive and Alexandria Drive (on Harrodsburg Road during the evening) is Severely Congested. Much of the rest of Harrodsburg Road falls into the Congested to Very Congested categories. For example, the area between Maxwell Street and Waller Avenue is ranked as Very Congested.

1. Not all congestion is caused by signals, highway capacity must also be considered.

Table 2.

Harrodsburg Road (PM) Average Speed By 1/4 mile increment		
Distance	Average Speed	Crossing Street
0.0-0.25	13.6	Maxwell
0.25-0.5	16.0	
0.5-0.75	10.3	Angliana
0.75-1.0	14.1	Red Mile
1.0-1.25	15.1	American
1.25-1.5	12.3	Waller
1.5-1.75	37.8	Clays Mill
1.75-2.0	39.2	
2.0-2.25	21.3	Lane Allen
2.25-2.5	19.0	
2.5-2.75	6.3	Longview
2.75-3.0	6.6	Burbank
3.0-3.25	5.3	Alexandria
3.25-3.5	13.5	NCR s
3.5-3.75	10.6	Corporate
3.75-4.0	44.6	
4.0-4.25	23.7	Ft Harrod
4.25-4.5	44.0	Wellington
4.5-4.75	29.2	
4.75-	17.4	Man o War

Much of the intent of this report is to identify and locate the area and degree of congestion. However, it is necessary to determine some of the causes of this congestion. Most people would agree that traffic signals, representing points of competing traffic flows, contribute a great deal to congestion. We attempted to see validity of these statements.

Table 3, on the following page, displays results compiled from ten runs made on Harrodsburg Road during the evening commute. The columns below Runs 1 to 10 in the first portion display the amount of delay, in seconds, that was experienced at each of the signalized intersections along the route. The delays are then summed for each run expressed in the "Total delay of Intersection" row and then converted into minutes. The last two columns of the first section of this table show with the probability of being stopped at a particular intersection and the average delay if you are stopped.

The Run Time, under Components of Travel Time, is the total time each run took to drive. The Driving Time is the theoretical time needed to drive the route at the posted speed limit without delays from factors such as traffic control devices or other traffic. The next row, Intersection Delay, are the numbers derived from first portion of *Table 3*. Intersection Delay can stem from several sources; three of which are signals, traffic and the capacity of the intersection.

There is a limited number of factors that come into play when driving. As seen above, the sum of all the factors is the time that it actually takes to drive the route (Run Time). The first factor is the time that it would take to drive it under free flow conditions (Driving Time). The next factor is the delay caused at traffic control devices (Intersection Delay). The final factor is a bit more nebulous; it is the delay caused by other traffic (Other Delay). For example, this can take the form of turning vehicles or slow moving traffic. This implies that even if the traffic signals were set perfectly, there would still be delays in traffic.

Diving Time + Intersection Delay + Other Delay = Run Time

These tables illustrate that signals do affect congestion. The three intersections highlighted in *Table 2* also have the highest levels of delay. However, it must be noted that the intersection at Longview Drive has a low probability of delay (10%). It can be assumed that the congestion at that intersection is due to traffic backup.

These measurements can help to evaluate and rank highway improvements. It is intuitive assumption that the highways with the worst congestion should receive improvements first.

Table 3.
Harrodsburg Road - PM Peak Traffic

Delay at Intersection (seconds)												
Signalized Intersection	**Run 1**	**Run 2**	**Run 3**	**Run 4**	**Run 5**	**Run 6**	**Run 7**	**Run 8**	**Run 9**	**Run 10**	**Average Delay if Stopped**	**Probablity Of Delay**
Maxwell	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**
Bolivar	-	-	42	16	48	30	4	26	-	126	**41.7**	**70%**
Angliana	146	27	93	-	-	-	-	-	76	70	**82.4**	**50%**
Red Mile	68	52	150	90	6	48	44	90	76	87	**71.1**	**100%**
American	94	-	26	92	-	32	49	20	-	13	**46.6**	**70%**
Waller	37	24	34	80	-	32	84	24	24	97	**48.4**	**90%**
Clays Mill	-	-	-	-	-	84	-	-	-	-	**84.0**	**10%**
Lane Allen	-	-	-	-	-	-	4	-	-	-	**4.0**	**10%**
Springridge	-	-	96	-	82	-	94	-	78	68	**83.6**	**50%**
Longview	-	-	-	-	-	-	-	-	257	-	**257.0**	**10%**
Burbank	15	201	264		72	68	272	188	92	502	**186.0**	**90%**
Alexandria	118	74	198		118	85	102	208	90	114	**123.0**	**90%**
NCR n	114	-	-	148	23	-	20	36	10	81	**61.7**	**70%**
NCR s	-	84	-	-	-	-	-	-	-	12	**48.0**	**20%**
Corporate	74	-	66	-	-	-	72	72	76	-	**72.0**	**50%**
Ft Harrod	8	-	-	60	68	68	18	-	36	-	**43.0**	**60%**
Wellington	-	-	-	-	-	9	-	-	-	-	**9.0**	**10%**
Man o War	60	10	48	32	46	16	-	10	-	6	**28.5**	**80%**
Total delay of (sec)	**734**	**472**	**1017**	**518**	**463**	**472**	**763**	**674**	**815**	**1176**	**710.4**	
Intersection (min)	**12.2**	**7.9**	**17.0**	**8.6**	**7.7**	**7.9**	**12.7**	**11.2**	**13.6**	**19.6**	**11.8**	

Components of Travel Time (minutes)

Run Time	19.5	17.0	27.1	18.3	16.0	16.9	24.4	20.6	23.9	28.9	**21.3**	**Avg Speed= 13.6**
Driving Time	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	**8.0**	**TRI= 2.66**
Intersection Delay	12.2	7.9	17.0	8.6	7.7	7.9	12.7	11.2	13.6	19.6	**11.8**	**Avg Delay= 39.5**
Other Delay	-0.7	1.1	2.2	1.7	0.3	1.0	3.7	1.4	2.3	1.3	**1.4**	

Components of Travel Time (percent)

Run time	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	**100%**
Driving Time	41%	47%	30%	44%	50%	47%	33%	39%	33%	28%	**38%**
Intersection Delay	63%	46%	63%	47%	48%	47%	52%	55%	57%	68%	**56%**
Other Delay	-4%	7%	8%	9%	2%	6%	15%	7%	10%	4%	**7%**

System Overview
Travel Rate Index

Measures have been developed to quantify levels of congestion. One is the average speed, measuring the inherent delay along a road. The problem with average speed is that there are unique factors on each road. An average speed of 25 mph on portions of Tates Creek Road means one thing, and another on New Circle Road. To normalize road types the Travel Rate Index was created. The index is computed by comparing the average Run Time of the ten runs versus the theoretical time needed to drive the route, Driving Time. For example, if it takes twenty minutes to drive a route that should take ten minutes, the

Table 4

Comapison of Congestion Indices--By Rank

	Rank	Rank/Street	am/pm	Travel Rate* Index	Average Speed	Average Delay Per Signal
worst	1	New Circle Road Outer	pm	2.81	19.9	20.8
	2	Nicholasville Road	pm	2.79	15.2	32.8
	3	New Circle Road Inner	pm	2.72	20.5	18.1
	4	Harrodsburg Road	pm	2.66	13.6	39.5
	5	New Circle Road Outer	noon	2.59	21.6	14.7
	6	New Circle Road Inner	noon	2.54	22.0	14.4
	7	Man o' War Boulevard Outer	pm	2.43	20.5	32.8
	8	New Circle Road Outer	am	2.16	25.9	10.5
	9	Man o' War Boulevard Inner	pm	2.14	23.2	23.5
	10	New Circle Road Inner	am	2.12	26.4	11.0
	11	Newtown Pike	am	2.07	24.7	10.0
	12	Tates Creek Road	pm	1.95	15.9	27.4
	13	Man o' War Boulevard Inner	am	1.88	26.4	12.5
	14	Man o' War Boulevard Outer	noon	1.88	26.5	17.3
	15	Richmond Road	pm	1.84	22.0	10.8
	16	Winchester Road	pm	1.82	23.5	11.6
	17	Harrodsburg Road	am	1.81	20.0	18.8
	18	North Broadway	pm	1.81	21.4	13.1
	19	Nicholasville Road	am	1.80	23.6	10.9
	20	Man o' War Boulevard Outer	am	1.79	27.8	15.4
	21	Winchester Road	am	1.76	24.3	12.2
	22	Tates Creek Road	am	1.74	17.8	19.0
	23	Man o' War Boulivard Inner	noon	1.67	26.6	19.3
	24	Newtown Pike	pm	1.67	30.7	4.9
	25	North Broadway	am	1.63	23.7	10.3
	26	Richmond Road	am	1.52	26.7	12.1
	27	Leestown Road	am	1.51	26.8	8.4
	28	Leestown Road	pm	1.46	27.6	7.1
	29	Versailles Road	am	1.42	23.1	8.2
Best	30	Versailles Road	pm	1.27	25.7	5.1

Travel Rate Index (TRI) would be 2.0, indicating that it took twice as long to drive the route than if all factors were perfect. In the *Table 3,* the TRI for Harrodsburg Road in the evening is 2.66, which indicates that it took 2.66 times the ideal time to drive the route. The TRI's for all of the routes are given here first by overall ranking and then separated time of day.

Reading these tables *(4&5)* , one should acknowledge that the higher the TRI, the worse the congestion. The signalized portion on northeast New Circle Road consistently has the worst congestion during all times of the day (*Table 5*). New Circle Road is listed three times out of the top five overall most congested routes (Table *4*); Nicholasville

Table 5
Comparison of Congestion Indices--By Time of Day

	Rank/Street			am/pm	Travel Rate* Index	Average Speed	Average Delay Per Signal
worst	1	New Circle Road	Outer	am	2.16	25.9	10.5
	2	New Circle Road	Inner	am	2.12	26.4	11.0
	3	Newtown Pike		am	2.07	24.7	10.0
	4	Man o' War Boulevard	Inner	am	1.88	26.4	12.5
	5	Harrodsburg Road		am	1.81	20.0	18.8
	6	Nicholasville Road		am	1.80	23.6	10.9
	7	Man o' War Boulevard	Outer	am	1.79	27.8	15.4
	8	Winchester Road		am	1.76	24.3	12.2
	9	Tates Creek Road		am	1.74	17.8	19.0
	10	North Broadway		am	1.63	23.7	10.3
	11	Richmond Road		am	1.52	26.7	12.1
	12	Leestown Road		am	1.51	26.8	8.4
best	13	Versailles Road		am	1.42	23.1	8.2
worst	1	New Circle Road	Outer	noon	2.59	21.6	14.7
	2	New Circle Road	Inner	noon	2.54	22.0	14.4
	3	Man o' War Boulevard	Outer	noon	1.88	26.5	17.3
best	4	Man o' War Boulevard	Inner	noon	1.67	26.6	19.3
worst	1	New Circle Road	Outer	pm	2.81	19.9	20.8
	2	Nicholasvile Road		pm	2.79	15.2	32.8
	3	New Circle Road	Inner	pm	2.72	20.5	18.1
	4	Harrodsburg Road		pm	2.66	13.6	39.5
	5	Man o' War Boulevard	Outer	pm	2.43	20.5	32.8
	6	Man o' War Boulevard	Inner	pm	2.14	23.2	23.5
	7	Tates Creek Road		pm	1.95	15.9	27.4
	8	Richmond Road		pm	1.84	22.0	10.8
	9	Winchester Road		pm	1.82	23.5	11.6
	10	North Broadway		pm	1.81	21.4	13.1
	11	Newtown Pike		pm	1.67	30.7	4.9
	12	Leestown Road		pm	1.46	27.6	7.1
best	13	Versailles Road		pm	1.27	25.7	5.1

Road (pm) being the second worst and Harrodsburg Road (pm) fourth (*Table 4*). Harrodsburg Road ranked in the top five among both the morning and evening peaks (*Table 5*). Man o' War Inner ranked in the top five in the morning while the Outer did in the evening (*Table 5*). Newtown Pike is the third worst road for the morning with Nicholasville Road ranked second for the evening (*Table 5*). It is interesting to note the observation that the evening rush hours are generally worse than in the morning is illustrated in *Table 4*.

In conclusion, we have determined that there are ways to meaningfully measure traffic congestion. These measures are sensitive to different levels of congestion and they can be compared to each other across various types of roads. However, these studies are not sensitive enough to determine specific location where quick improvements are feasible. This study just locates areas of congestion. It is up to further studies to determine how to correct these problem areas. In the following section, we will review the most significant features of each route.

Commute Descriptions

This section describes the various attributes of the commutes along the eleven routes studied. It includes various measures of congestion and the locations of congested areas according to their levels of congestions. The extent of congestion along a route and descriptions of various intersections are also included.

The direction of traffic measured during these studies were the dominant flows for the time period. These direction are in the **Morning**-towards downtown; in the **Evening**-outbound from downtown. The directions of the cirumferential roads was done for both ways for both the evening and the morning plus during the noon peak.

The **Travel Rate Index** (**TRI**) measures the relationship between the time it actually takes to drive a route compared to the time that it should take to drive under free flow conditions. The free flow conditions are constrained by the posted speed limits.

TRI= Actual Time / Free Flow Time

The **Average Speed** is computed by dividing the distance by the travel time. Therefore, it includes stopped time as well as travel time; usually meaning that the speed is relatively low.

The **Average Driving Time** is given, primarily, to give commuters an idea of how long it takes to traverse the route, on the average.

For the purpose of this study, we ranked areas where the average speed is:

-less than 10 miles as **Severely Congested.**
-between 10 and 20 mph as **Heavily Congested** .
-between 20 and 30 mph as **Congested.**

Harrodsburg Road
(Maxwell to Man o War Blvd)

While not an unreasonably bad commute in the morning, Harrodsburg Road is one of the worst commutes in the evening. There are two areas of concern in the morning; an area south of **Corporate Drive** to **Alexandria Drive** and the intersection with **Maxwell Street**. In the evening, the problem area is similar to the morning. That area is **Longview Drive** to **Corporate Drive**. It should be noted that this congestion may be due to capacity problems with the New Circle Road interchange. The evening commute on Harrodsburg Road was the **second worst** in the city.

Morning

Travel Rate Index –	1.81
Average Speed –	20.0 mph
Average Driving Time –	14.5 min.
Severely congested areas:	Corporate Dr., Maxwell St.
Heavily congested areas:	New Circle Rd., Alexandria Dr., Waller Ave., Clays Mill Rd.
Congested areas:	Lane Allen Rd., American Ave., Red Mile Rd., Bolivar St.
Total congested length:	3.0 miles out of 4.83 miles
Signals:	
Greater than 50% chance of getting stopped	Corporate Dr. - 70% chance, 133 sec. delay Waller Dr. – 90% chance, 59.9 sec. delay Maxwell St. – 80% chance, 31.8 sec. delay

Evening

Travel Rate Index –	2.66
Average Speed –	13.6 mph
Average Driving Time –.	21.3 min.
Severely congested areas:	Longview Dr., Burbank Dr., Alexandria Dr.
Heavily congested areas:	Maxwell St., Angliana Ave., Red Mile Rd., American Ave., Waller Ave., New Circle Rd., Corporate Dr., Man o' War Blvd.
Congested areas:	Lane Allen Dr., Ft. Harrod Dr.
Total congested length:	4.0 out of 4.83 miles
Signals:	
Greater than 50% chance of getting stopped	Bolivar St. – 70% chance, 41.7 sec delay Red Mile Rd. – 100% chance 71.1, sec delay American Ave.- 70% chance, 46.6 sec delay Waller Ave. – 90% chance, 48.4 sec delay Burbank Dr. – 90% chance, 186.0 sec delay Alexandria Dr. – 90% chance, 123.0 sec delay New Circle Rd. (n) – 70% chance, 61.7 sec delay Fort Harrod Dr. – 60% chance, 43.0 sec delay

Leestown Road
(Jefferson St. to Masterson Station Dr.)

Leestown Road is one of the better commutes in the city. The are no severely congested area in the morning or evening. The are relatively few heavily congested areas. Signal delays are few and of minor duration.

Morning

Travel Rate Index –	1.51
Average Speed –	26.8 mph
Average Driving Time –	8.6 min.
Severely congested areas:	none
Heavily congested areas:	Boiling Springs Dr., Newtown Pike, Jefferson St.
Congested areas:	Masterson Station Dr., Votech Dr., New Circle Rd. (east), Lisle Rd., Forbes Rd.
Total congested length:	1.75 miles out of 3.80 miles
Signals: Greater than 50% chance of getting stopped	Boiling Springs Dr., 80%, 28.0 sec delay

Evening

Travel Rate Index –	1.46
Average Speed –	27.6 mph
Average Driving Time –	8.4 min
Severely congested areas:	none
Heavily congested areas:	Jefferson St.
Congested areas:	Forbes Rd., Lisle Rd., Boiling Springs Dr., New Circle Rd. (east), Greendale Rd., Trade St.
Total congested length:	2.0 miles out of 3.8 miles
Signals:	Newtown Pike, 90%, 42.3 sec. delay
Greater than 50% chance of getting stopped	Forbes Rd., 60%, 20.3 sec. delay Boiling Springs DR., 70%, 12.0 sec. delay

---

Man o' War[1]
(Alumni to I75)

There are some problems on the inner loop at **Richmond Road** in the morning. At noon, the problems are located at **Sir Barton Way, Richmond Road** and, particularly, at **Alumni Drive** which is severely congested on the inner loop. In the evening, the congestion is located on the inner loop between **Rio Dosa** and **Richmond Road**. Man o' War has two of the ten worst commutes in the city.

[1] Man o' War measurements taken before signalization improvements were made.

Morning

Inner

Travel Rate Index –	1.88
Average Speed –	26.4 mph
Average Driving Time –	8.1 min.
Severely congested areas:	none
Heavily congested areas:	Richmond Rd., Alumni Dr.
Congested areas:	Sir Barton Way, Pink Pigeon Pkwy., Liberty, Maple Leaf Dr.
Total congested length:	1.75 miles out of 3.5 miles
Signals:	
Greater than 50% chance of getting stopped	Alumni Dr., 67% chance, 34.7 sec delay Richmond Rd., 78% chance, 58.6 sec delay Liberty Rd., 56% chance. 25.8 sec. delay

Morning

Outer

Travel Rate Index –	1.79
Average Speed –	27.8 mph
Average Driving Time –	7.7 min.
Severely congested areas:	none
Heavily congested areas:	Beaver Creek Dr.
Congested areas:	Maple Leaf Dr., Palumbo Dr., Rio Dosa Dr., Alumni Dr.
Total congested length:	1.75 miles out of 3.5 miles
Signals:	
Greater than 50% chance of getting stopped	Richmond Rd., 67% chance, 40.8 sec. delay Palumbo Dr., 56% chance, 36.6 sec delay Maple Leaf Dr., 67% chance, 23.7 sec. delay Pink Pigeon Pkwy., 56% chance, 27.4 sec. delay

Noon

At noon, there is a good chance of getting stopped on the inner loop at **Richmond Road** and **Alumni Drive**. The average speeds are approximately the same in both directions. While there are no severely congested areas on the outer loop, there are more congested areas.

Noon

Inner

Travel Rate Index –	1.86
Average Speed –	26.6 mph
Average Driving Time –	8.0 min.
Severely congested areas:	Alumni Dr.
Heavily congested areas:	Sir Barton Way, Richmond Rd.
Congested areas:	Maple Leaf Dr.
Total congested length:	1.25 miles out of 3.5 miles

Signals:	
Greater than 50% chance	Richmond Rd., 80% chance, 43.5 sec. delay
of getting stopped	Alumni Dr., 90% chance, 44.2 sec. delay

Noon

Outer

Travel Rate Index –	1.88
Average Speed –	26.5 mph
Average Driving Time –	8.1 min.
Severely congested areas:	none
Heavily congested areas:	Alumni Dr., Rio Dosa Dr.
Congested areas:	Beaver Creek Dr., Palumbo Dr., Maple Leaf Dr., Pink Pigeon Pkwy, Sir Barton Way
Total congested length:	2.25 miles out of 3.5 miles
Signals:	
Greater than 50% chance	Alumni Dr., 60% chance, 41.7 sec. delay
of getting stopped	Palumbo Dr., 60% chance, 44.3 sec. delay

Evening

Evenings are the most congested on Man o' War Boulevard. There are four intersections with a greater than 50% chance of stopping traffic, four of which are for greater than 60 seconds in each direction. Travel speeds are at their lowest for the four time periods.

Evening

Inner

Travel Rate Index –	2.14
Average Speed –	23.2 mph
Average Driving Time –	9.2 min.
Severely congested areas:	South of Rio Dosa Dr.
Heavily congested areas:	I-75, Rio Dosa Dr., Richmond Rd.
Congested areas:	Sir Barton Way, Pink Pigeon Pkwy, Palumbo Dr., Beaver Creek Dr.
Total congested length:	2.25 miles out of 3.5 miles
Signals:	
Greater than 50% chance	Richmond Rd., 100% chance, 75.7 sec. delay
of getting stopped	Rio Dosa Dr., 70% chance, 41.7 sec. delay
	Palumbo Dr., 60% chance, 67.8 sec. delay
	Pink Pigeon Pkwy, 70% chance, 28.0 sec. delay

Evening

Outer

Travel Rate Index –	2.43
Average Speed –	20.5 mph
Average Driving Time –	10.4 min.

Severely congested areas:	none
Heavily congested areas:	Alumni Dr., Beaver Creek Dr., Richmond Rd., Rio Dosa Dr., Maple Leaf, Liberty Rd.
Congested areas:	East Hills Dr., Palumbo Dr., Sir Barton Way
Total congested length:	2.25 miles out of 3.5 miles
Signals:	
Greater than 50% chance of getting stopped	Richmond Rd., 70% chance, 72 sec. delay Rio Dosa Dr., 70% chance, 35.9 sec. delay Palumbo Dr., 80% chance, 50.1 sec. delay Liberty Rd., 90% chance., 64.4 sec. delay

---

New Circle Road[2]
(Georgetown Rd. to Richmond Rd)

Morning

Mornings on New Circle Road are more congested than most roads are in the evening. Although there are no severely congested portions in the mornings, there is sufficient congestion to give the inner and outer loops TRI's of 2.12 and 2.16, respectively. This means that it take over twice as long to travel these routes as under free flow conditions. On New Circle Road, in the morning, on the inner loop, the is congestion from **Russell Cave** to **N. Broadway** and at **Palumbo**. On the outer loop, there is congestion at **Boardwalk** and between **Palumbo** and **Woodhill.**

Morning

Inner

Travel Rate Index –	2.12
Average Speed –	26.4 mph
Average Driving Time –	10.4 min.
Severely congested areas:	none
Heavily congested areas:	Russell Cave Rd., N. Broadway, Palumbo Dr.
Congested areas:	Bryan Station Rd., Woodhill Dr.
Total congested length:	1.5 miles out of 4.5 miles
Signals:	
Greater than 50% chance of getting stopped	Russell Cave Rd., 70% chance, 40.9 sec. delay N. Broadway, 80% chance, 80.3 sec. delay N Limestone, 70% chance, 22.4 sec. delay Palumbo Dr., 80% chance, 48.0 sec. delay

[2] New Circle Road measurements taken before signalization improvement were made.

Morning

Outer

Travel Rate Index –	2.16
Average Speed –	25.9 mph
Average Driving Time –	10.6 min.
Severely congested areas:	none
Heavily congested areas:	Boardwalk, N. Limestone, South of Palumbo Dr.
Congested areas:	Russell Cave Rd., N. Broadway, Bryan Station Rd., Meadow Lane, Family Circle, Woodhill Dr.
Total congested length:	2.75 miles out of 4.5 miles
Signals:	
Greater than 50% chance of getting stopped	none

Noon

Noon traffic is more congested than in the morning. Although the TRI's for the two loops are almost identical, the number of intersections with significant probabilities of delay are almost double for the inner loop. The number of congested quarter miles is the same. At noon, there was severe congestion at **Woodhill Drive** on the inner loop and at **Meadow Lane** on the outer loop.

Noon

Inner

Travel Rate Index –	2.54
Average Speed –	22.0 mph
Average Driving Time –	12.5 min.
Severely congested areas:	Woodhill Dr.
Heavily congested areas:	Russell Cave Rd., N. Broadway, Bryan Station Rd., Family Circle, Liberty Rd., Palumbo Dr.
Congested areas:	N. Limestone, Meadow Lane, Trade Center Dr.
Total congested length:	3.25 miles out of 4.5 miles
Signals:	
Greater than 50% chance of getting stopped	Russell Cave Rd., 60% chance, 22.0 sec. delay N Broadway, 90%, 29.2 sec. delay Bryan Station Rd., 90%, 19 sec. delay Family Circle, 60%, 27.0 sec. delay Liberty Rd., 80%, 36.5 sec. delay Young Dr., 70%, 41.1 sec. delay Woodhill Dr, 100%, 33.2 sec. delay

Noon

Outer

Travel Rate Index –	2.59
Average Speed –	21.6 mph
Average Driving Time –	12.7 min.
Severely congested areas:	none
Heavily congested areas:	N. Broadway, N. Limestone, Meadow Lane, Woodhill
Congested areas:	Russell Cave Rd., Eastland Dr., Family Circle, Liberty Rd., Palumbo Dr.
Total congested length:	3.25 miles out of 4.5 miles
Signals:	
Greater than 50% chance of getting stopped	Palumbo Dr., 70%, 18.7 sec. delay Bryan Station Rd., 90%, 76.3 sec. delay Russell Cave Rd., 70%, 20.6 sec. delay Boardwalk, 90%, 28.4 sec. delay

Evening

Evening peak hour traffic brings the worst congestion to New Circle Road, with TRI's of 2.72 and 2.81. There are more heavily congested areas on the outer loop. In the evening, on the inner loop, there is heavy to severe congestion from **Boardwalk** to **N. Broadway** and heavy congestion between **Liberty Road** and **Palumbo Drive**. On the outer loop, there is heavy congestion around **N. Limestone**, between **Family Circle** and **Palumbo** and at **Woodhill Drive**. New Circle Road has six out of the ten worst commutes in the city. Signalization improvements have been made since the road was surveyed. The survey points out that a significant proportion of the delay experienced on New Circle was due to factors other than signals.

Evening

Inner

Travel Rate Index –	2.72
Average Speed –	20.5 mph
Average Driving Time –	13.3 min.
Severely congested areas:	N. Broadway
Heavily congested areas:	Boardwalk, Russell Cave Rd., Palumbo Dr.
Congested areas:	N. Limestone, Bryan Station Rd., Woodhill Dr.
Total congested length:	2.5 miles out of 4.5 miles
Signals:	
Greater than 50% chance of getting stopped	Russell Cave Rd., 100%, 46.0 sec. delay N. Broadway, 100%, 80.5 sec. delay Bryan Station Rd., 90%, 21.5 sec. delay Industry Rd., 60%, 10.0 sec. delay Young Dr., 100%, 31.0 sec. delay Palumbo Dr., 70%, 17.6 sec. delay

Evening

Outer

Travel Rate Index –	2.81
Average Speed –	19.9 mph
Average Driving Time –	13.8 min.
Severely congested areas:	none
Heavily congested areas:	Boardwalk, N. Limestone, Meadow Lane, Family Circle, Liberty Rd., Woodhill Dr.
Congested areas:	Russell Cave rd., N. Broadway, Bryan Station Rd., Eastland Dr., Palumbo Dr.
Total congested length:	4.0 miles out of 4.5 miles
Signals:	
Greater than 50% chance of getting stopped	Liberty Rd., 60%, 49.4 sec. delay Family Circle, 60%, 13.2 sec. delay Trade Center Dr., 60%, 20.6 sec. delay Bryan Station Rd., 90%, 62.8 sec. delay

---

Newtown Pike
(Main St. to I-64/I-75)

Newtown Pike is one of two roads where congestion is heavier in the morning than in the evening. There are no severely congested areas in the morning or evening. **Main Street, Newtown Court,** and **Citation Boulevard** all show up as congested in the morning and evening.

Morning

Travel Rate Index –	2.07
Average Speed –	24.7 mph
Average Driving Time –	8.3 min.
Severely congested areas:	none
Heavily congested areas:	Nandino Dr., Newtown Ct., Main St.
Congested areas:	I-75, Aristides, Sugar Maple Ln., Citation Blvd., Eastern State Hosp., Fourth St.
Total congested length:	2.25 miles out of 3.41 miles
Signals:	
Greater than 50% chance of getting stopped	Citation Blvd., 60%, 24.8 sec. delay Nandino Dr., 70%, 39.1 sec. delay Main St., 70%, 64.4 sec. delay

Evening

Travel Rate Index –	1.67
Average Speed –	30.7 mph
Average Driving Time –	6.7min.
Severely congested areas:	none
Heavily congested areas:	Newtown Ct.
Congested areas:	Main St., Eastern State Hosp., Citation, Sugar Maple Ln., Aristides
Total congested length:	1.75 miles out of 3.41 miles
Signals:	
Greater than 50% chance of getting stopped	Citation Blvd., 56%, 17.0 sec. delay

---

Nicholasville Road
(Avenue of Champions to Man o' War)

Nicholasville Road is a study in contrasts when looking at the morning versus the evening commutes. Whereas the morning commute is fairly average in terms of it's Travel Rate Index, the evening commute is the second worst of those studied. There are areas of heavy congestion from north of **Alumni** to the **Avenue of Champions**, However, from **New Circle Road** to **Alumni Drive** traffic moves at average speeds in the lower to upper thirty miles per hour range. In the evening, it's entirely a different story. In the evening, Nicholasville Road is the **second worst commute** in the city. There is heavy to severe congestion in the area of **Avenue of Champions** to **Virginia Avenue** and from **Lowry Lane** to **New Circle Road** (south). Again, it should be noted that some of this congestion may be due to capacity problems with the New Circle Road interchange.
(Although technically in the study area, Man o' War statistics are not reflected in the results, as the volunteer had to make a left turn on Man o' War off Nicholasville Rd. and this strongly affected the results.)

Morning

Travel Rate Index –	1.80
Average Speed –	23.6 mph
Average Driving Time –	12.2 min.
Severely congested areas:	none
Heavily congested areas:	Man o' War Blvd., Dundee Dr., Leader Ave., Virginia Ave., Avenue of Champions
Congested areas:	Reynolds Rd., New Circle Rd. (n), Cooper Dr., Scott St.
Total congested length:	2.5 miles out of 4.80 miles

Signals:	
Greater than 50% chance of getting stopped	Tiverton Way, 70%, 38 sec. delay Reynolds Rd., 80%, 22.6 sec. delay Leader Ave., 60%, 35.3 sec. delay Prall St., 70%, 22.3 sec. delay Avenue of Champions, 60%, 16.0 sec. delay

Evening

Travel Rate Index –	2.79
Average Speed –	15.2 mph
Average Driving Time –	19.0 min.
Severely congested areas:	Scott St., Pasadena Dr., New Circle Rd. (s)
Heavily congested areas:	Avenue of Champions, Cooper Dr., Lowry Ln., Tiverton Way
Congested areas:	Alumni Dr., Cherokee Park, Rosemont Garden, Southland Dr., Zandale Dr., Dundee Dr., Wilson Downing Rd.
Total congested length:	4.25 miles out of 4.80 miles
Signals:	
Greater than 50% chance of getting stopped	Prall St., 90%, 46.6 sec. delay Virginia Ave., 70%, 66.4 sec. delay Alumni Dr., 60%, 54.0 sec. delay Moore Dr., 100%, 61.9 sec. delay New Circle Rd., 70%, 29.6 sec. delay Canary St., 80%, 50.8 sec. delay

---

North Broadway
(Main to I-75)

North Broadway is more heavily congested in the evening as is the usual case for the roads that we studied. North Broadway is an average commute in the morning. There is heavy congestion in three areas: Main Street, between **Loudon Avenue** and **Northland** and north of **New Circle Road**. The evening commute is a little worse but still average. There is severe congestion at **New Circle Road** and heavy congestion at **Main Street, Fifth Street** and **Loudon Avenue**.

Morning

Travel Rate Index –	1.63
Average Speed –	23.7 mph
Average Driving Time –	7.8 min.
Severely congested areas:	none
Heavily congested areas:	Main St.
Congested areas:	Third St.
Total congested length:	2.0 miles out of 3.10 miles

Signals:	
Greater than 50% chance	Loudon Ave., 80%, 39.4 sec. delay
of getting stopped	New Circle, 100%, 56.5 sec. delay

Evening

Travel Rate Index –	1.81
Average Speed –	21.4 mph
Average Driving Time –	8.7 min.
Severely congested areas:	New Circle Rd.
Heavily congested areas:	Main St., Fifth St., Loudon Ave.
Congested areas:	Third St., Northland Dr., Haggard Ave.
Total congested length:	2.0 miles out of 3.10 miles
Signals:	
Greater than 50% chance	Seventh St., 70%, 13.0 sec. delay
of getting stopped	Loudon Ave., 60%, 25.8 sec. delay
	New Circle Rd., 80%, 85.7 sec. delay

Richmond Road
(Main/Vine to Man o War)

Richmond Road is an average commute in the morning, with average speed equaling or surpassing the posted speeds along much of the route. There are, however, areas of heavy congestion; such as **Man o' War Boulevard, Todds Road, Fontaine and Vine Street.** In the evening, there is a similar picture. Traffic moves very well along much of the route. The areas of heavy congestions are: **Vine Street, Walton Avenue, Chinoe Road, Lexington Mall, New Circle Road** and **Man o' War**.

Morning

Travel Rate Index –	1.52
Average Speed –	26.7 mph
Average Driving Time –	8.4 min.
Severely congested areas:	none
Heavily congested areas:	Man o' War Blvd., Todd's Rd., Fontaine Rd., Vine St.
Congested areas:	French Quarter, Lexington Mall, Chinoe Rd., Ashland Ave., Walton Ave.,
Total congested length:	2.24 miles out of 3.73 miles

Signals:	
Greater than 50% chance	Man o' War Blvd., 90%, 112.4 sec. delay
of getting stopped	Chinoe Rd., 70%, 15.3 sec. delay
	Vine St., 80%, 28.6 sec. delay

Evening

Travel Rate Index –	1.84
Average Speed –	22.0 mph
Average Driving Time –	10.1 min.
Severely congested areas:	none
Heavily congested areas:	Vine St., Walton Ave., Chinoe Rd., Lexington Mall,
	New Circle Rd (w), Man o' War Blvd.
Congested areas:	Ashland Ave., Todd's Rd.
Total congested length:	2.75 miles out of 3.73 miles
Signals:	
Greater than 50% chance	Ashland Ave., 70%, 21.1 sec. delay
of getting stopped	Chinoe Rd., 80%, 57.6
	Lexington Mall, 60%, 29.2 sec. delay

Tates Creek Road
(Ashland Avenue to Man o' War)

Tates Creek has one severely congested area in the morning. Tates Creek Road is an average commute in the morning. There is heavy to severe congestion from south of **Armstrong Mill Road** to **Gainesway Drive**. There is heavy congestion from south of **Cooper Drive** to **Ashland Avenue.** Speeds from **New Circle Road** to **Old Mount Tabo**r are in the thirties to low forties. It is the beginning and end of the route that slow the commute down. This is also true for the evening commute. There is severe congestion from **Ashland** almost to **Cooper**. There is also a slow down from **Lansdowne Drive** to **New Circle Road** and, again, at **Armstrong Mill**.

Morning

Travel Rate Index –	1.74
Average Speed –	17.8 mph
Average Driving Time –	12.5 min.
Severely congested areas:	South of Armstrong Mill Rd.
Heavily congested areas:	Man o' War Blvd., Armstrong Mill Rd., Gainesway Dr.,
	Cooper Dr., Cochran Rd., Ashland Ave.
Congested areas:	New Circle Rd. (s), Alumni Dr.
Total congested length:	2.5 miles out 4.45 of miles

Signals:	Armstrong Mill Rd., 67%, 114.6 sec. delay
Greater than 50% chance	Gainesway Dr., 56%, 70.0 sec. delay
of getting stopped	Cooper Dr., 67%, 50.0 sec. delay
	Euclid Ave., 56%, 32.7 sec. delay

Evening

Travel Rate Index –	1.95
Average Speed –	15.9 mph
Average Driving Time –	14.1 min.
Severely congested areas:	Ashland Ave., Cochran Rd.
Heavily congested areas:	Lansdowne Rd., Dove Run Rd., New Circle Rd., Armstrong Mill Rd., Appian Way
Congested areas:	Gainesway, Albany Rd.
Total congested length:	3.75 miles out of 4.45 miles
Signals:	
Greater than 50% chance	Euclid Ave., 100%, 46.1 sec. delay
of getting stopped	Cochran Rd., 56%, 54.4 sec. delay
	Hart Rd., 89%, 54.4 sec. delay.
	Cooper Dr., 89%, 117.3 sec. delay
	Alumni Dr., 56%, 29.0 sec. delay
	Malabu Dr., 56%, 59.6 sec. delay
	New Circle Rd. (n), 78%, 22.1 sec. delay
	Armstrong Mill Rd., 67%, 54.7 sec. delay
	Appian Way, 56%, 52.4 sec. delay

Versailles Road (High/Maxwell to Man o' War)

Versailles is the best commute in the city, both morning and evening. There is some congestion around **Man o' War, Parkers Mill Road** and **Forbes Road** in the morning and around **Bennett Street** and **Forbes Road** in the evening

Morning

Travel Rate Index –	1.42
Average Speed –	23.1 mph
Average Driving Time –	9.6 min.
Severely congested areas:	none
Heavily congested areas:	Man o' War Blvd., Parkers Mill Rd., Forbes Rd.
Congested areas:	Alexandria Dr., Delmont Ct.,
Total congested length:	1.25 miles out of 4.71 miles

Signals:	
Greater than 50% chance of getting stopped	Parkers Mill Rd., 70%, 90 sec. delay Forbes Rd., 70%, 37.9 sec. delay

Evening

Travel Rate Index –	1.27
Average Speed –	25.7 mph
Average Driving Time –	8.7 min.
Severely congested areas:	none
Heavily congested areas:	Bennett Ave., Forbes Rd.
Congested areas:	Maxwell/High St., Angliana Ave., Terrace View Dr., Mason Headley Rd., Village Dr., Alexandria Dr., Man o War Blvd.
Total congested length:	2.0 miles out of 4.71 miles
Signals:	
Greater than 50% chance of getting stopped	Forbes Rd., 80%, 43.8 sec. delay

---

Winchester Road (Main/Vine to I-75)

Winchester is a fairly typical commute both in the morning and evening . There is severe congestion at **Main Street** and heavy congestion at **Loudon Avenue** in the morning. In the evening there is heavy congestion at the following areas: **Main Street, Liberty Road**, and **Loudon Avenue**.

Morning

Travel Rate Index –	1.76
Average Speed –	24.3mph
Average Driving Time –	9.5 min.
Severely congested areas:	Main St.
Heavily congested areas:	I-75 w, Loudon Ave.
Congested areas:	Sir Barton Way, Fortune Dr., New Circle Rd., Liberty Rd., Delaware Ave., Walton Ave., Third St.
Total congested length:	3.0 miles out of 3.84 miles

Signals:	
Greater than 50% chance	Main St., 100%, 61.3 sec. delay
of getting stopped	Third St., 70%, 17.7 sec. delay
	Loudon Ave., 60%, 25.5 sec. delay
	New Circle Rd., 60%, 32.5 sec. delay
	Sir Barton Way, 80%, 28.3 sec. delay

Evening

Travel Rate Index –	1.82
Average Speed –	23.5mph
Average Driving Time –	9.8 min.
Severely congested areas:	none
Heavily congested areas:	Main St., Liberty Rd., Loudon Ave.,
Congested areas:	Third St., Walton Ave., Delaware Ave., Industry Rd., New Circle Rd., Sir Barton Way, I-75 w
Total congested length:	3.25 miles out of 3.84 miles
Signals:	
Greater than 50% chance	Elkhorn Rd., 80%, 30.5 sec. delay
of getting stopped	Eastland Dr., 70%, 26.6 sec. delay
	Industry Dr., 80%, 14.0 sec. delay
	Loudon Dr., 90%, 30.2 sec., delay

Travel Time

Travel time is the distance that one can travel in a given amount of time. The following maps show the a comparative view of the road network based on travel time. The AM Peak shows a count down to the end point while the PM Peak shows the distance traveled as time elapsed. The closer the lines are the slower the traffic is moving through that area.

2002 Congestion Management Report

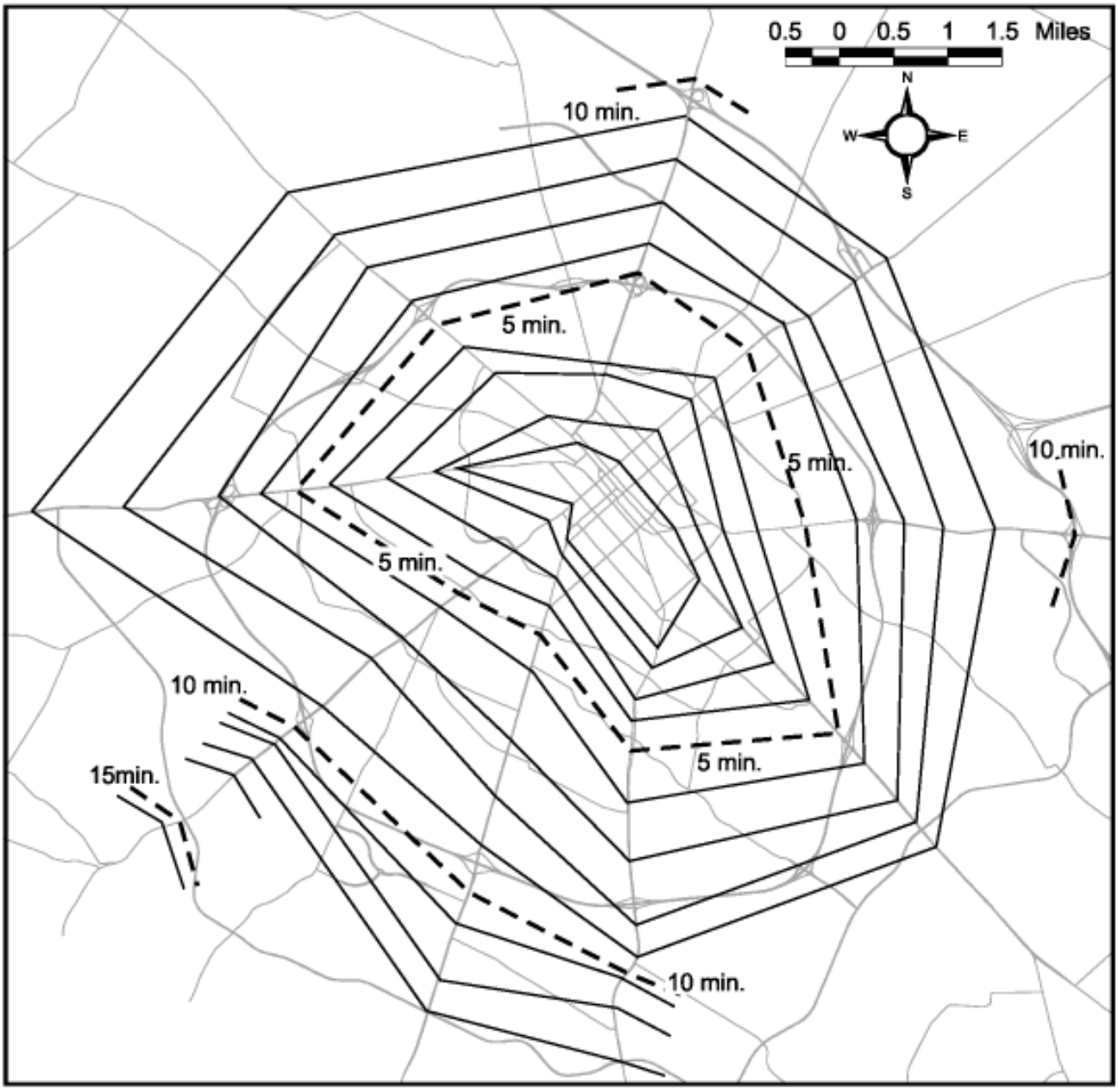
AM Peak Travel-Time

Travel-Time

These are the average distance one can travel along each route at a given amount of time.

One minute Intervals

Five minute Intervals



2002 Congestion Management Report

PM Peak Travel-Time

Travel-Time

These are the average distance one can travel along each route at a given amount of time.

One minute Intervals

Five minute Intervals