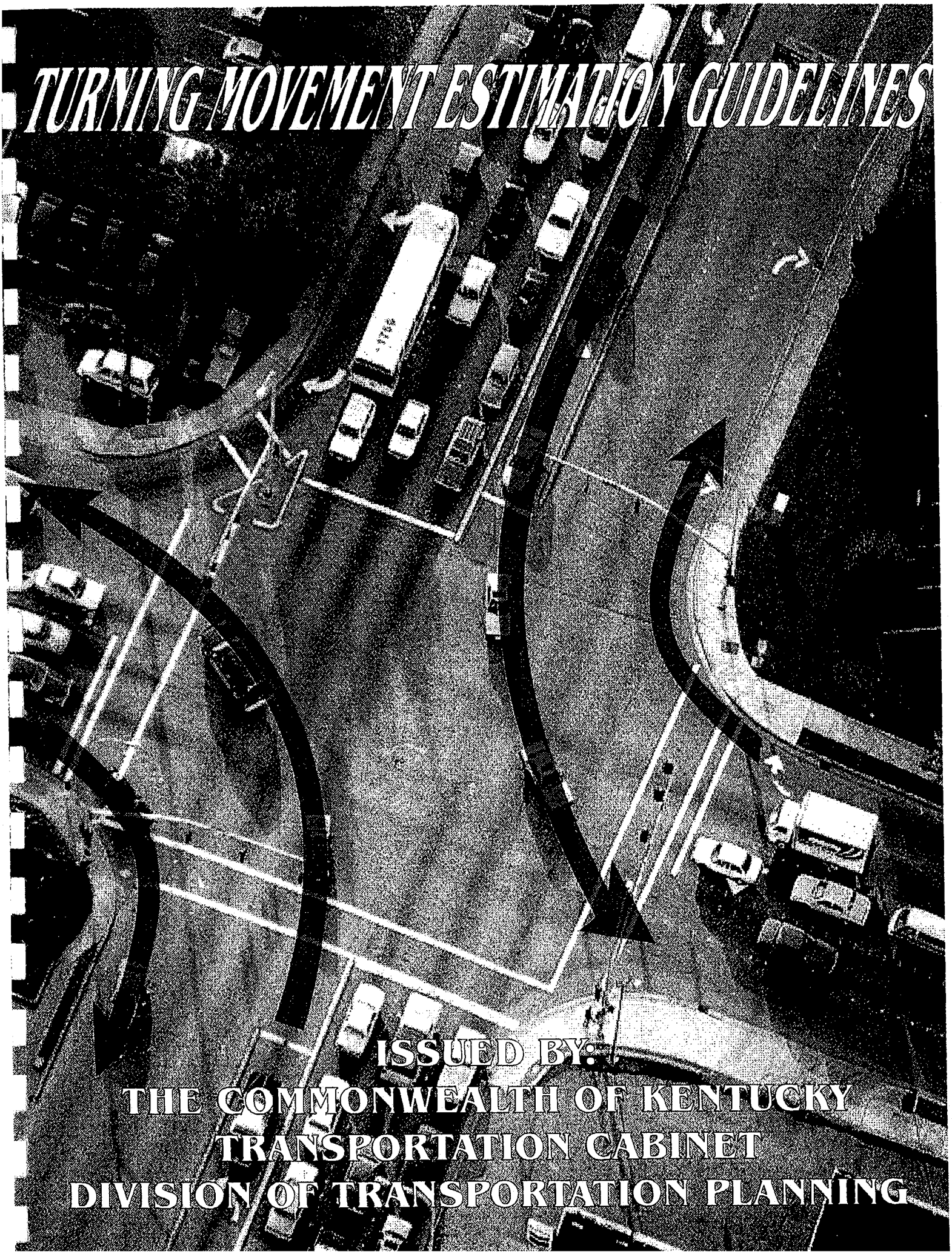
TURNING MOVEMENT ESTIMATION GUIDELINES



ISSUED BY:

THE COMMONWEALTH OF KENTUCKY
TRANSPORTATION CABINET
DIVISION OF TRANSPORTATION PLANNING

TURNING MOVEMENT ESTIMATION GUIDELINES

DECEMBER, 1997

PREPARED BY:

KENTUCKY TRANSPORTATION CABINET
DEPARTMENT OF HIGHWAYS
DIVISION OF TRANSPORTATION PLANNING

N. ROBERT BOSTROM, P. E., SECTION MANAGER

SCOTT THOMPSON-GRAVES, PROJECT ENGINEER
OF BERNARDIN / LOCHMUELLER & ASSOCIATES, INC.

REPORT COVER DESIGN BY JOHN SYKES DIVISION OF MULTIMODAL PROGRAMS PHOTO TAKEN FROM THE SEPTEMBER 1997 ISSUE OF ITE JOURNAL.

Contents

I. Background

A. Purpose

Turning movements are needed for the proper design of turning lanes, for air/noise calculations in Environmental Impact Studies, for level of service calculations in traffic impact studies and for the estimation of traffic diversion. This document is intended to help standardize the Kentucky Transportation Cabinet's estimation of turning movements and also to review the basics of turning movement estimation.

B. Products

Typical products needed vary depending on who the customer is. Below is a list of typical products needed and the required accuracy based on the customer.

Customer	*Accuracy Needed*	*New Data Needed*		*Final Product*				
		24-hour	Manual TM	ADT-P	ADT-F	DHV-AM	DHV-PM	PHV
Highway Design	High	Yes	Depends on Volume	Yes	Yes	Yes	Yes	No
Environmental	Medium	Usually	No	Yes	Yes	No	No	Yes
Planning	Low	Sometimes	No	Yes	Yes	No	No	No

The remainder of this report will cover definitions, review the Transportation Cabinet's current turning movement tools, refer to industry sources of information in the references and review some rules of thumb.

It should be emphasized that sound judgement must always be used when calculating turning movements. It is always the duty of the analyst to use as many sources of information as are practical for the task at hand and to keep the final product in mind when preparing turning movements.

C. Rules of Thumb

General

Turning movements should always be rounded and balanced.

When doing a series of turning movements for an arterial, the adjacent movements will normally match.

The true or actual turning movement ADTs are almost never known so the final product is *always* an estimate. Therefore sound judgement must *always* be used.

Make a field trip or talk to someone who knows the area whenever possible.

Factors

Directional distributions should be based on actual counts when possible, but if none are available it is important to concentrate on the most critical design lanes and be conservative (that is overestimate when in doubt).

K-factors should normally be based on ATRs. K-factors based on portable counts are always going to be lower than an ATR-derived K-factor.

The ITE Trip Generation Manual is a good source of directional distribution information for the peak hour at new facilities.

Commercial areas often have high lunch peaks.

Mixed use areas often have lower K-factors and flatter directional distributions.

II. Tools

A. TURNS.BAT

This program has been around for a long time and is useful for producing ADT turning movements. It is run with GWBASIC.EXE or another Basic equivalent.

B. JTURNS.BAS

The JTURNS.BAS algorithm was developed by Eric Sabina, currently of HNTB and a former employee of the Division of Transportation Planning. The actual program was written by Josh Howes of Palmer Engineering and a former employee of the Division of Transportation Planning. It produces mathematically determined turning movements for four-legged intersections when six of the possible twelve movements are known. The program is also run with GWBASIC.EXE.

C. TGTURNS.XLS

This recent product was written by Scott Thompson-Graves who works for Bernardin, Lochmuellar and Associates and is on contract with the Transportation Cabinet for one year. This EXCEL program uses growth factoring and is capable of producing both ADT and DHV turning movements. The best feature of this program is its capability of yielding DHVs based on variable k-factors and directional factors.

D. TURNS.EXE

This product was written by the Nebraska DOT and can produce both ADTs and DHVs.

E. EXCEL Template

Three-legged and four-legged intersection templates that are useful for a professional display of turning movements.

F. Manual solutions

There are many manual methods of developing turning movements. All methods involve iterative uses of known data and are somewhat time consuming. One laborious method developed by the Florida DOT is attached.

III. Definitions

Terms are borrowed from the Florida DOT Design Traffic Handbook.

ADJUSTED COUNT - An estimate of a traffic statistic calculated from a base traffic count that has been adjusted by application of axle, seasonal, or other defined factors. (AASHTO)

ANNUAL AVERAGE DAILY TRAFFIC (AADT) - The total volume of traffic on a highway segment for one year, divided by the number of days in the year. This volume is usually estimated by adjusting a short-term traffic count with weekly and monthly factors. (AASHTO)

AVERAGE DAILY TRAFFIC (ADT) - The total traffic volume during a give time period (more than a day and less than a year) divided by the number of days in that time period. (AASHTO)

AXLE CORRECTION FACTOR - The factor developed to adjust vehicle axle sensor base data for the incidence of vehicles with more than two axles, or the estimate of total axles based on automatic vehicle classification data divided by the total number of vehicles counted. (AASHTO)

BASE COUNT - A traffic count that has not been adjusted for axle factors (effects of trucks) or seasonal (day of the week/month of the year) effects. (AASHTO)

BASE DATA - The unedited and unadjusted measurements of traffic volume, vehicle classification, and vehicle or axle weight. (AASHTO)

COUNT - The data collected as a result of measuring and recording traffic characteristics such as vehicle volume, classification, speed weight, or a combination of these characteristics. (AASHTO)

COUNTER - Any device that collects traffic characteristics data.

DESIGN HOUR - The 30th highest hour of the design year.

DESIGN HOUR VOLUME (DHV) - The traffic volume expected to use a highway segment during the 30th highest hour of the design year. The Design Hour Volume (DHV) is related to AADT by the K factor where DHV = K * ADT

DESIGN PERIOD - The number of years from the initial application of traffic until the first planned major resurfacing or overlay. (AASHTO)

DESIGN TRAFFIC - A forecast of the 30th highest hour traffic volume for the design year.

DESIGN YEAR - Usually 20 years from the Opening Year, but may be any time within a range of years from the present (for restoration type projects) to 20 years in the future (for new construction type projects). The year for which the roadway is designed.

DIRECTIONAL DESIGN HOUR VOLUME (DDHV) - The traffic volume expected to use a highway segment during the 30th highest hour of the design year in the peak direction where DDHV = D * DHV

DIRECTIONAL DISTRIBUTION (D) - The percentage of total, two-way peak hour traffic that occurs in the peak direction.

D30 - The proportion of traffic in the 30th highest hour of the design year traveling in the peak direction.

FACTOR - A number that represents a ratio of one number to another number. The factors used to adjust traffic volumes are K, D, T, Design Hour Factor, Peak Hour Factor and Seasonal Factor. The Load Equivalency Factor adjusts pavement damage calculations.

INTERMEDIATE YEAR - Any future year in the forecast period between the base year and the design year, typically halfway between the opening year and the design year.

K-FACTOR (K) - The proportion of Annual Average Daily Traffic (AADT) occurring in an hour.

K30 - The proportion of Annual Average Daily Traffic (AADT) occurring during the 30th highest hour of the design year. Commonly known as the Design Hour Factor.

K100 - The proportion of Annual Average Daily Traffic (AADT) occurring during the 100th highest hour of the design year. Commonly known as the Planning Analysis Hour Factor.

PEAK HOUR FACTOR - The hourly volume during the maximum hour of the day divided by the peak 15-minute rate of flow within the peak hour; a measure of traffic demand fluctuation within the peak hour. (HCM)

PEAK HOUR-PEAK DIRECTION - The direction of travel (during the 60-minute peak hour) that contains the highest percentage of travel.

PERMANENT COUNT - A 24-hour traffic count continuously recorded at a permanent count station.

PERMANENT COUNT STATION - Automatic Traffic Recorders (ATRs) that are permanently placed at specific locations throughout the state to record the distribution and variation of traffic flow by hours of the day, days of the week, and months of the year from year to year. These stations are the best source of K-factors.

THIRTIETH HIGHEST HOUR VOLUME (30HV) - For all edit-accepted hours of data during a one-year period, the 30th highest hourly traffic volume. This volume is commonly used as a representative hour of traffic volume in roadway design. (AASHTO)

TRUCK - Any heavy vehicle described in FHWA Scheme F (Classes 4-13 i.e., buses and trucks with six or more tires. Class 14 is available for state definition of a special truck configuration not recognized by Scheme).

IV. Acronyms

ADT	Average Daily Traffic
AADT	Annual Average Daily Traffic
D	Directional traffic split
D30 highest	Proportion of traffic in the peak direction for the 30th hour
DHV	Design Hour Volume
DDHV	Directional Design Hour Volume
HCM	Highway Capacity Manual
K30	Ratio of DHV to AADT for the 30th highest hour

V. References

A Policy on Geometric Design of Highways and Streets, American Association of State Highway and Transportation Officials (AASHTO), 1990

Design Traffic Procedure, Florida Department of Transportation, Topic No. 525-030-120, June 16, 1994.

Highway Capacity Manual (HCM), Special Report 209, Transportation Research Board, 1994.

Traffic Monitoring Guide, Federal Highway Administration, December 16, 1992.

1996 Traffic Characteristics Report, Division of Transportation Planning, Kentucky Transportation Cabinet, 1997.

Internal Memorandum to Highway Information Systems Section, Division of Transportation Planning, April 17, 1997.

Turning Movement Estimation Guidelines

Appendix 1

Examples

General Notes

In the following examples, as in all traffic and turn movement projections, there is no one "absolute" method or model that should be applied to every situation. There are some general methods that usually work, however. It is always the analyst's job to gather all of the possible sources of information and determine the best tool to use for each situation or problem. The tools presented in this manual do not replace the analyst or the analyst's need for creative thought, but they do make the analysts job easier by performing some of the tedious or difficult calculations. In some cases they at least provide the analyst with a starting point or a framework for their projections.

For example *Turns.bat* is usually a good predictor of ADT turn movements at intersections were no turn movement data is available, but the program will not calculate turn movements for intersections for every roadway combination. For example, it will not provide results where three arterials meet a collector street. The lowest volume arterial can be assumed to be a collector, or the collector can be assumed to be an arterial, but the results will not be acceptable when compared to actual counts.

Another example could be using *TGturns* when no previous data or actual counts are available. When peak hour turn movements are calculated, extra care needs to be given to the % ins that are assumed. The zero closure can be accomplished with directional splits that are completely opposite of reality, an infinite number of results can be reached with an infinite number of assumptions. With proper, logical assumptions reality can be closely approximated, but with haphazard, random guesses the results are unacceptable.

As a rule if you put garbage into any of these programs, you will get garbage out of them (the old GIGO rule), even if the program's alarms, buzzers, and whistles do not go off. Avoid million dollar mistakes by always checking the logic of your input! Does everybody really leave Louisville in the morning and return at night?

The following pages step through 4 examples covering situations where different amounts of information are available. The first two examples cover a 3 and a 4 legged intersection with no turn movement counts available. Solutions are found using both *TGturns* and *Turns.bat* The last two examples cover four legged intersections with turn movement data available, and are only performed with *TGturns*.

Intersection 1: Turfway Rd. at Sebree Dr.

This three legged intersection is located in Boone County, Kentucky. The study area is a highly developed commercial area south of Interstate 275 and Cincinnati, Ohio. Turfway Road is currently a 2 and 3 lane road beginning at US 25 (the Dixie Highway) and heading northwest through the study area. Only hourly machine counts were available for this analysis.

Step by Step Methodology

Step 1) Fill in project information in upper left hand box on the "Display" worksheet.

Step 2) Write street names into the proper cells in the ADT BOX on the "Display" worksheet.

Step 3) Enter your initial turn movement assumptions into the boxes in the CURRENT TURN MOVEMENT SECTION of the "Past to Present" worksheet. In this case 1s were entered.

Step 4) Write the directional Average Daily Traffic (ADT) into the DESIRED VALUE cells in the CURRENT TURN MOVEMENT SECTION.

Step 5) Look at the results in the 1997 ADT section of the "Display" worksheet. Manually overwrite the individual turn movement cells to make the TOTAL ADTs equal your desired values. In this case the West leg ADT needed to be 19,000 and the East leg needed to be 18,200. In order to accomplish this I removed 80 trips from the South to East couplet and gave them to the South to West couplet.

Step 6) In the AM and PM PEAK HOUR MATRIX MANIPULATION SECTIONS of the "Display" worksheet enter the desired % ins and K factors for each movement. Adjust these initial assumptions until the number in the boxes in the center of the AM and PM sections equals zero.

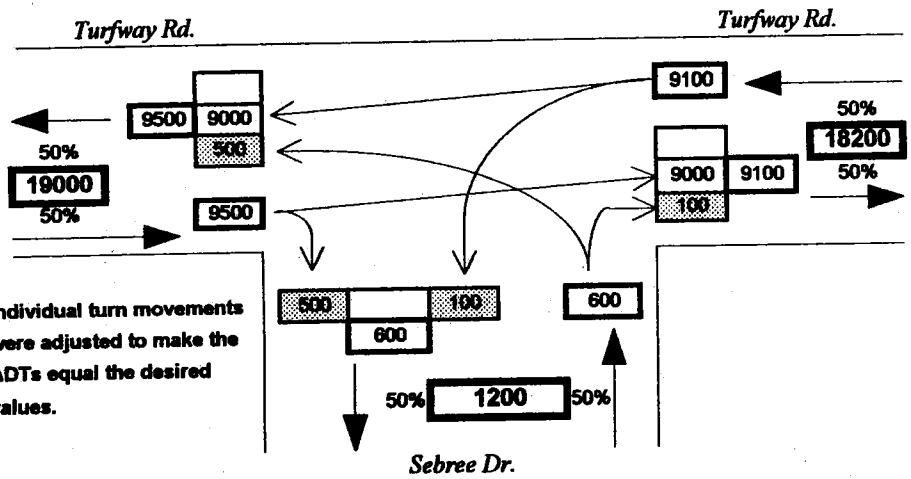
Step 7) Draw a sketch of the study area and project in the far left box labeled LOCATION MAP in the "Display" worksheet.

Step 8) Highlight the 6 boxes in the "Display" worksheet containing the project description, notes, ADT, DHVs, and Location maps. Print out what you just highlighted.

PROJECT: Turn Movement Manual ITEM NUMBER: --
REQUEST DATE: --
ANALYST: Scott Thompson-Graves
SCENARIO: **1997 ADT and Design Hour Volumes**
INTERSECTION: **Sebree Dr. at Turfway Rd. (Intersection 1)**

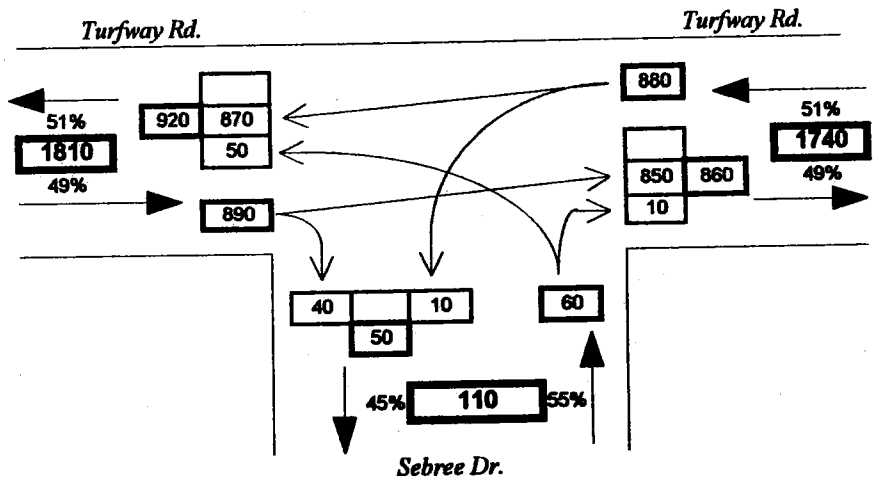
NOTE: ADTs and DHVs based on 1997 traffic counts.

1997 ADT

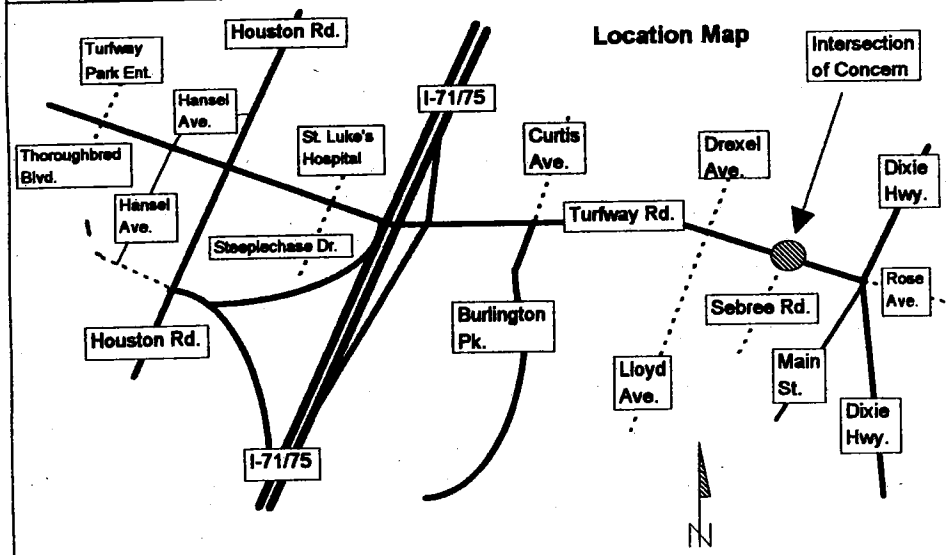


Individual turn movements were adjusted to make the ADTs equal the desired values.

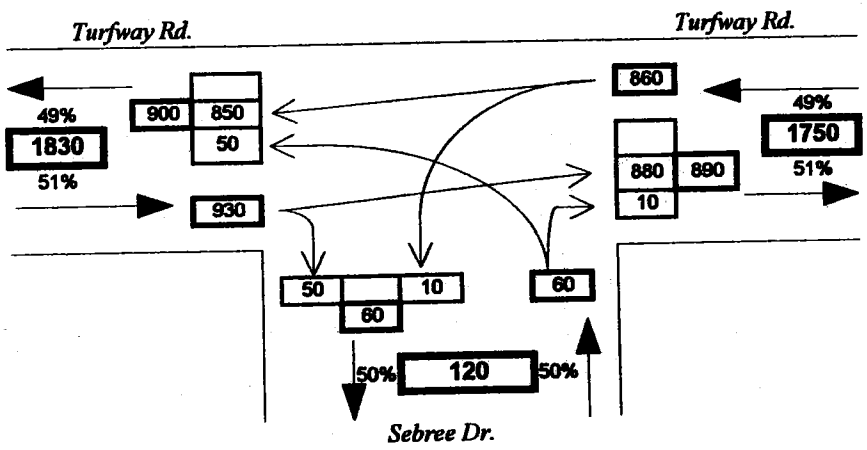
1997 Midday Design Hour



Location Map

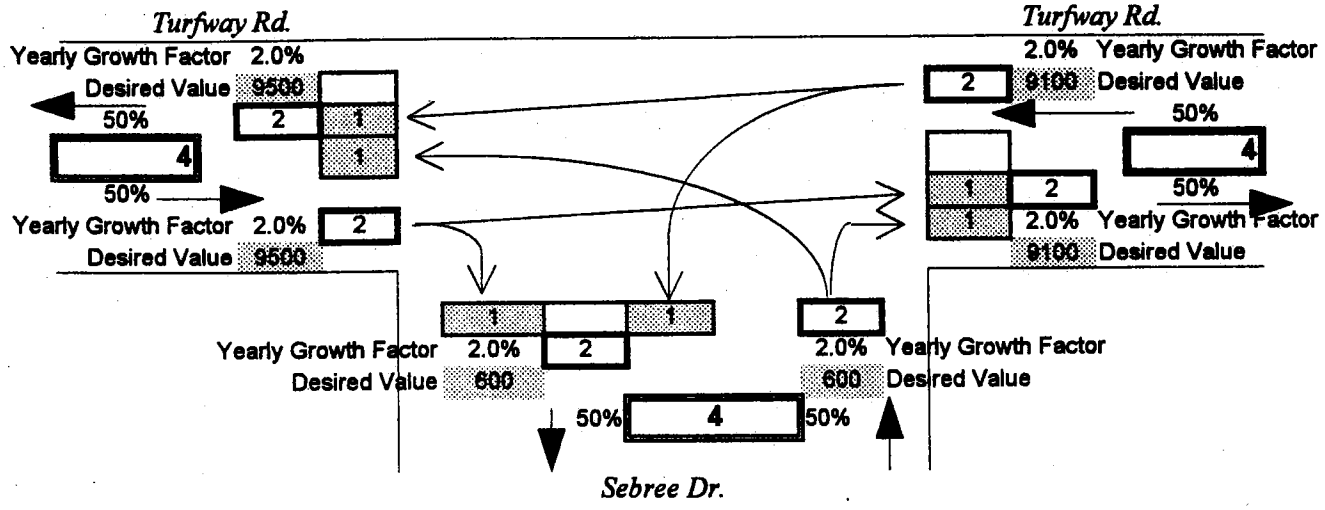


1997 PM Design Hour



"Display" worksheet, this is the final printout of your results (minus the highlights and comments in the ADT section)

Current Turn Movements

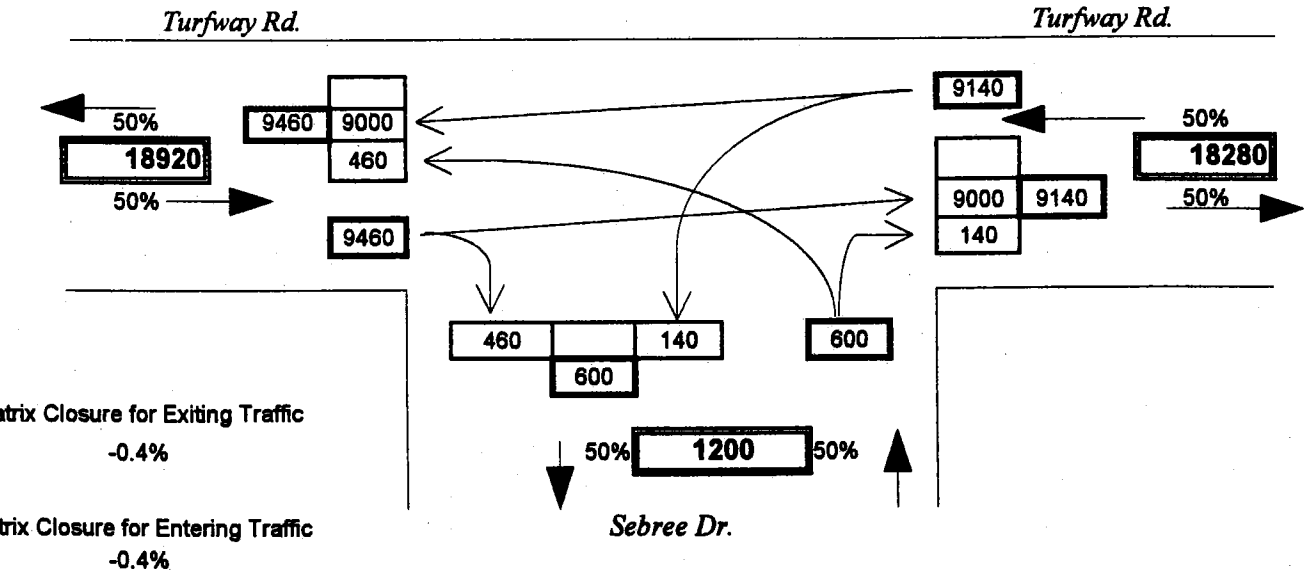


Current Year 1997
Desired Year 1997

Matrix Results

Assume 50/50 Split?

Yes

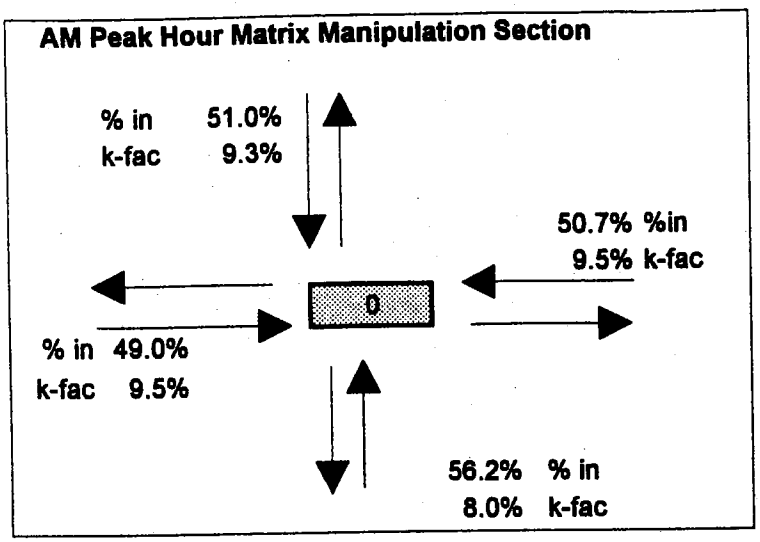


Matrix Closure for Exiting Traffic
-0.4%

Matrix Closure for Entering Traffic
-0.4%

"Past to Present" worksheet

In this example 1 was entered into the highlighted boxes in the CURRENT TURN MOVEMENT section.
The directional average daily traffic was entered into the highlighted DESIRED VALUE cells.

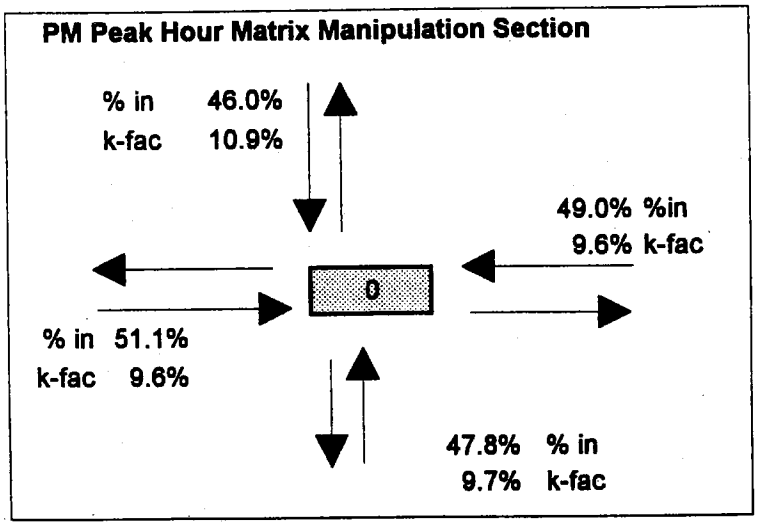


Matrix Closure for Exiting Traffic

-0.2%

Matrix Closure for Entering Traffic

-0.3%



Matrix Closure for Exiting Traffic

0.0%

Matrix Closure for Entering Traffic

0.0%

"Display" worksheet

As in all of these examples the % in and K factor estimates were entered into the AM and PM PEAK HOUR MATRIX MANIPULATION SECTIONS. These estimates were adjusted until the highlighted boxes equalled zero.

KENTUCKY TRANSPORTATION CABINET DEPARTMENT OF HIGHWAYS
DIVISION OF TRANSPORTATION PLANNING

PORTABLE TRAFFIC RECORDER REPORT

ROUTE: KY1017 BOONE COUNTY STATION: Y02

WEEK OF MARCH 04 TO MARCH 10 1997

DATE:	04	05	06	07	08	09	10	
DAY:	TUE	WED	THU	FRI	SAT	SUN	MON	TOTALS
12- 1 AM		210	240					450
1- 2 AM		140	120					260
2- 3 AM		90	110					200
3- 4 AM		70	70					140
4- 5 AM		90	110					200
5- 6 AM		280	250					530
6- 7 AM		550	590					1140
7- 8 AM		850	830					1680
8- 9 AM		800	770					1570
9-10 AM		860	880					1740
10-11 AM		990	1010					2000
11-12 AM	1160	1130						2290
12- 1 PM	1410	1310						2720
1- 2 PM	1320	1320						2640
2- 3 PM	1350	1280						2630
3- 4 PM	1320	1280						2600
4- 5 PM	1380	1370						2750
5- 6 PM	1450	1380						2830
6- 7 PM	1350	1230						2580
7- 8 PM	1020	940						1960
8- 9 PM	790	750						1540
9-10 PM	620	580						1200
10-11 PM	420	440						860
11-12 PM	320	360						680
TOTALS:	13910	18300	4980					37190

AVERAGE DAILY TRAFFIC: 18961

MONTHLY FACTOR: 103
AXLE FACTOR: 99
TOTAL HOURS: 48
AM HIGH HOUR: 1160 BETWEEN 11-12 AM ON TUESDAY
PM HIGH HOUR: 1450 BETWEEN 5- 6 PM ON TUESDAY

MACHINE NUMBER: P94
MULTIPLE: N
ONE-WAY: N
DATA SOURCE: V

KENTUCKY TRANSPORTATION CABINET-DEPARTMENT OF HIGHWAYS
DIVISION OF TRANSPORTATION PLANNING

PORTABLE TRAFFIC RECORDER REPORT

ROUTE: SEBREE DR BOONE COUNTY STATION: Y23

WEEK OF MARCH 04 TO MARCH 10 1997

DATE:	04	05	06	07	08	09	10	
DAY:	TUE	WED	THU	FRI	SAT	SUN	MON	TOTALS
12- 1 AM		20	20					40
1- 2 AM		10	10					20
2- 3 AM		10	10					20
3- 4 AM		10	10					20
4- 5 AM		10	10					20
5- 6 AM		20	20					40
6- 7 AM		40	40					80
7- 8 AM		40	50					90
8- 9 AM		70	50					120
9-10 AM		50	30					80
10-11 AM		30	40					70
11-12 AM		50	40					90
12- 1 PM	70	60						130
1- 2 PM	60	60						120
2- 3 PM	70	50						120
3- 4 PM	80	90						170
4- 5 PM	80	80						160
5- 6 PM	70	90						160
6- 7 PM	80	110						190
7- 8 PM	80	70						150
8- 9 PM	90	60						150
9-10 PM	60	40						100
10-11 PM	40	40						80
11-12 PM	30	40						70
TOTALS:	810	1150	330					2290

AVERAGE DAILY TRAFFIC: 1167

MONTHLY FACTOR: 103
AXLE FACTOR: 99
TOTAL HOURS: 48
AM HIGH HOUR: 70 BETWEEN 8- 9 AM ON WEDNESDAY
PM HIGH HOUR: 110 BETWEEN 6- 7 PM ON WEDNESDAY

MACHINE NUMBER: M26
MULTIPLE: N
ONE-WAY: N
DATA SOURCE: V

KENTUCKY TRANSPORTATION CABINET-DEPARTMENT OF HIGHWAYS
DIVISION OF TRANSPORTATION PLANNING

PORTABLE TRAFFIC RECORDER REPORT

ROUTE: KY1017 BOONE COUNTY STATION: Y22

WEEK OF MARCH 04 TO MARCH 10 1997

DATE:	04	05	06	07	08	09	10	
DAY:	TUE	WED	THU	FRI	SAT	SUN	MON	TOTALS
12- 1 AM		210	230					440
1- 2 AM		110	100					210
2- 3 AM		90	100					190
3- 4 AM		60	70					130
4- 5 AM		90	110					200
5- 6 AM		260	240					500
6- 7 AM		550	580					1130
7- 8 AM		810	810					1620
8- 9 AM		750	730					1480
9-10 AM		830	870					1700
10-11 AM		980	980					1960
11-12 AM	1160	1110						2270
12- 1 PM	1370	1250						2620
1- 2 PM	1290	1290						2580
2- 3 PM	1310	1250						2560
3- 4 PM	1270	1240						2510
4- 5 PM	1320	1330						2650
5- 6 PM	1390	1310						2700
6- 7 PM	1280	1160						2440
7- 8 PM	1000	880						1880
8- 9 PM	750	720						1470
9-10 PM	580	560						1140
10-11 PM	400	380						780
11-12 PM	280	320						600
TOTALS:	13400	17540	4820					35760

AVERAGE DAILY TRAFFIC: 18232

MONTHLY FACTOR: 103
AXLE FACTOR: 99
TOTAL HOURS: 48
AM HIGH HOUR: 1160 BETWEEN 11-12 AM ON TUESDAY
PM HIGH HOUR: 1390 BETWEEN 5- 6 PM ON TUESDAY

MACHINE NUMBER: P92
MULTIPLE: N
ONE-WAY: N
DATA SOURCE: V

```
                    approach 3:
                    left turns          0
                    thru moves          0
                    right turns         0
                    exiting             0
```

Turfway Road

```
approach 1:                          approach 2:
left turns      0                    left turns      90
thru moves      8989                 thru moves      9010
right turns     511                  right turns     0
exiting         9497                 exiting         9102
```

Turfway Road

```
                    approach 4:
                    left turns          487
                    thru moves          0
                    right turns         113
                    exiting             601

Do another intersection (y or n)?
```

Sebree Drive

Intersection 1 using Turns.bat

Steps/Assumptions:

-- assume Turfway Road is an arterial

-- assume Sebree Drive is a collector

Intersection 2: Turfway Rd. at Drexel and Lloyd Avenues

This four legged intersection is located in Boone County, Kentucky. The study area is a highly developed commercial area south of Interstate 275 and Cincinnati, Ohio. Turfway Road is currently a 2 and 3 lane road beginning at US 25 (the Dixie Highway) and heading northwest through the study area. Only hourly machine counts were available for this analysis.

Step by Step Methodology

Step 1) Fill in project information in upper left hand box on the "Display" worksheet.

Step 2) Write street names into the proper cells in the ADT BOX on the "Display" worksheet.

Step 3) Enter your initial turn movement assumptions into the boxes in the CURRENT TURN MOVEMENT SECTION of the "Past to Present" worksheet. In this case estimates were entered.

Step 4) Write the directional Average Daily Traffic (ADT) into the DESIRED VALUE cells in the CURRENT TURN MOVEMENT SECTION.

Step 5) Look at the results in the 1997 ADT section of the "Display" worksheet. Manually overwrite the individual turn movement cells to make the TOTAL ADTs equal your desired values. In this case the individual turn movements and ADTs appear adequate.

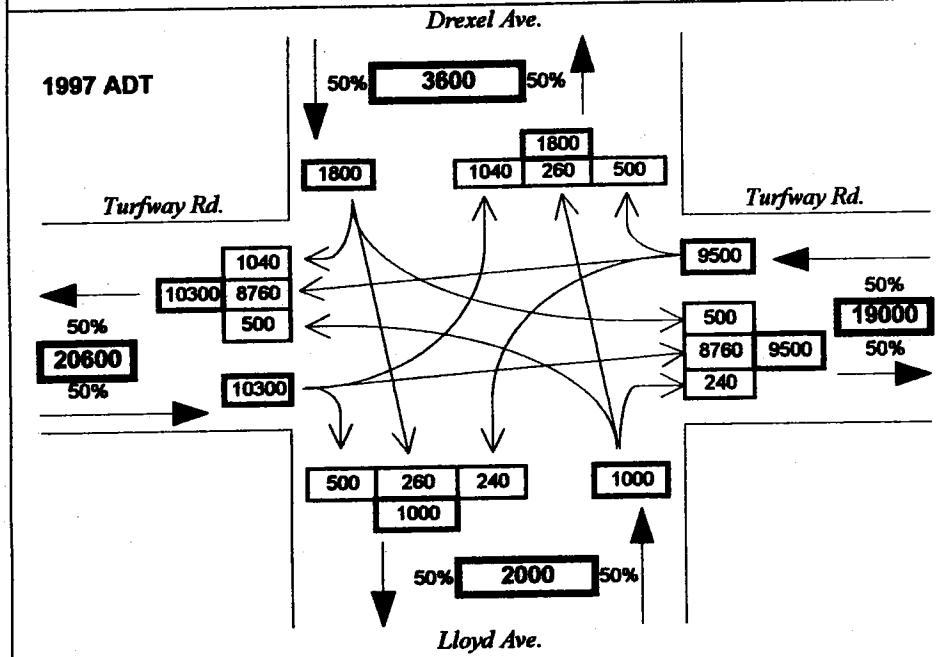
Step 6) In the AM and PM PEAK HOUR MATRIX MANIPULATION SECTIONS of the "Display" worksheet enter the desired % ins and K factors for each movement. Adjust these initial assumptions until the number in the boxes in the center of the AM and PM sections equals zero.

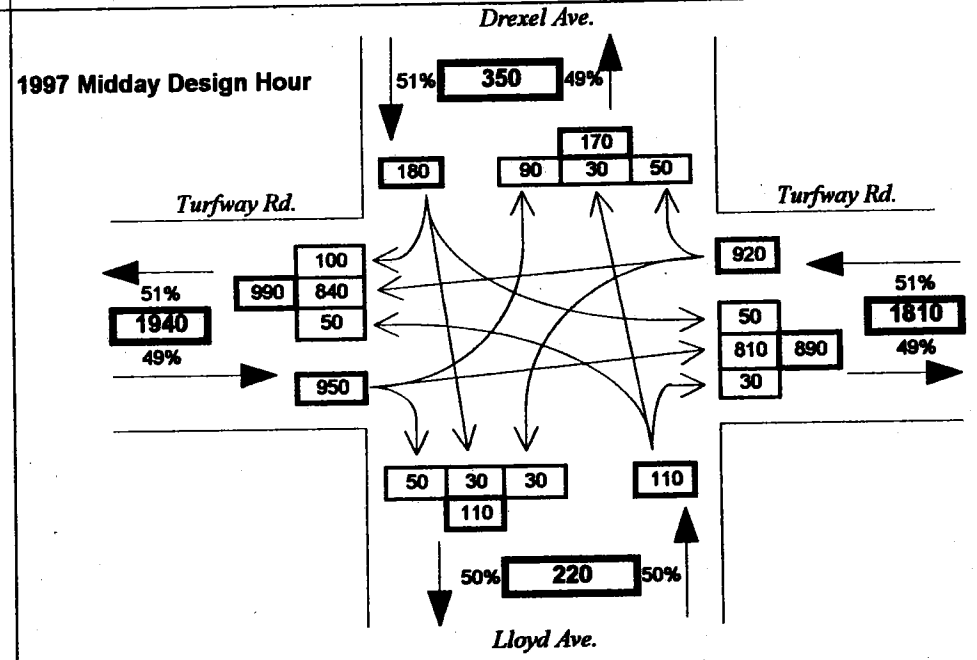
Step 7) Draw a sketch of the study area and project in the far left box labeled LOCATION MAP in the "Display" worksheet.

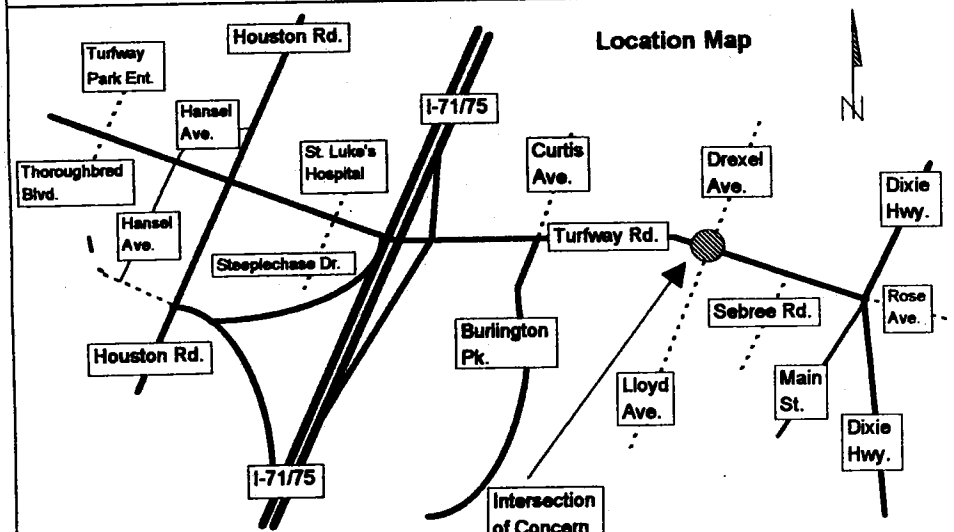
Step 8) Highlight the 6 boxes in the "Display" worksheet containing the project description, notes, ADT, DHVs, and Location maps. Print out what you just highlighted.

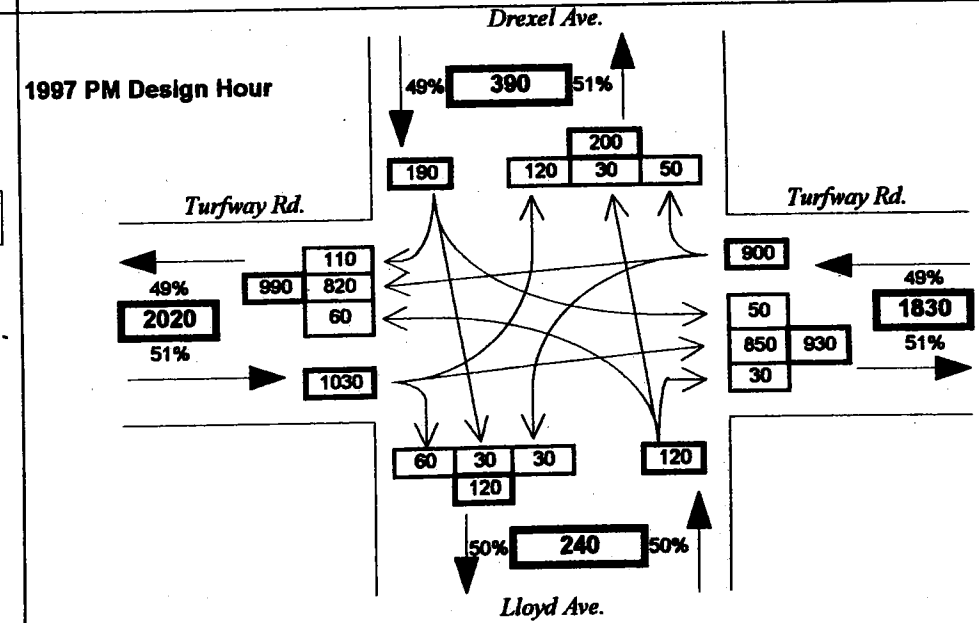
PROJECT: Turn Movement Manual ITEM NUMBER: --
REQUEST DATE: --
ANALYST: Scott Thompson-Graves
SCENARIO: **1997 ADT and Design Hour Volumes**
INTERSECTION: **Lloyd & Drexel Avenues at Turfway Rd. (Int. 2)**

NOTE: ADTs and DHVs based on 1997 traffic counts.



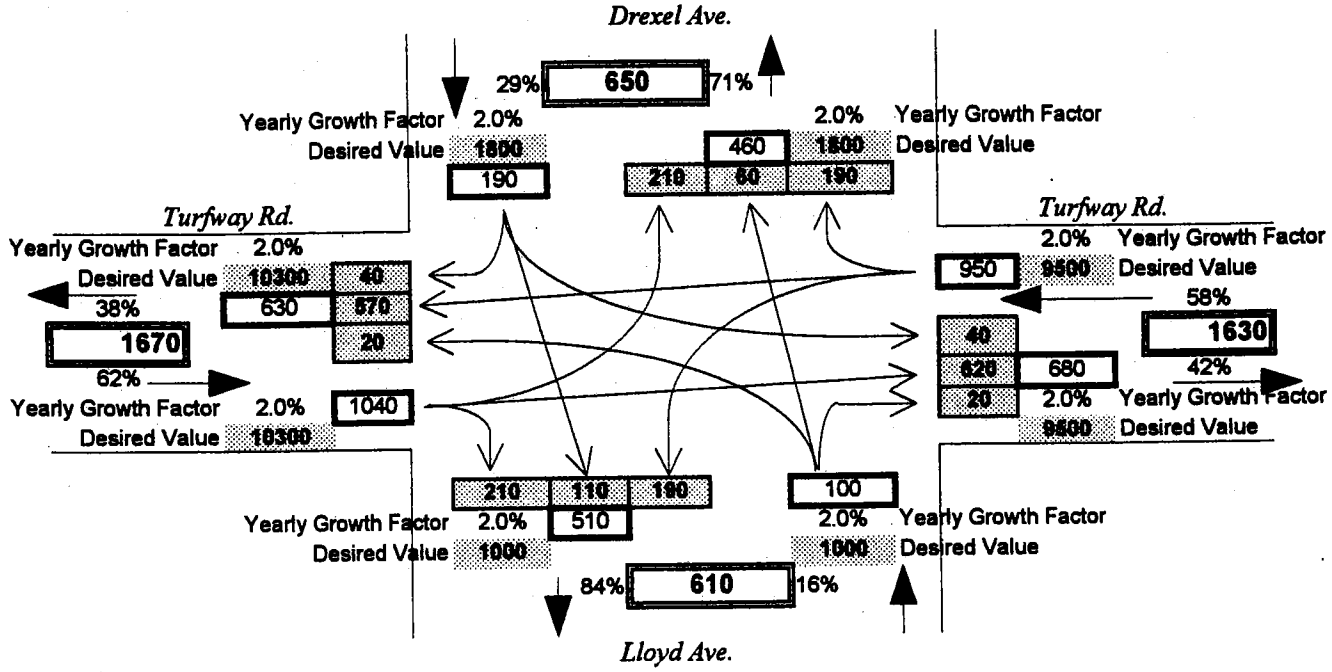




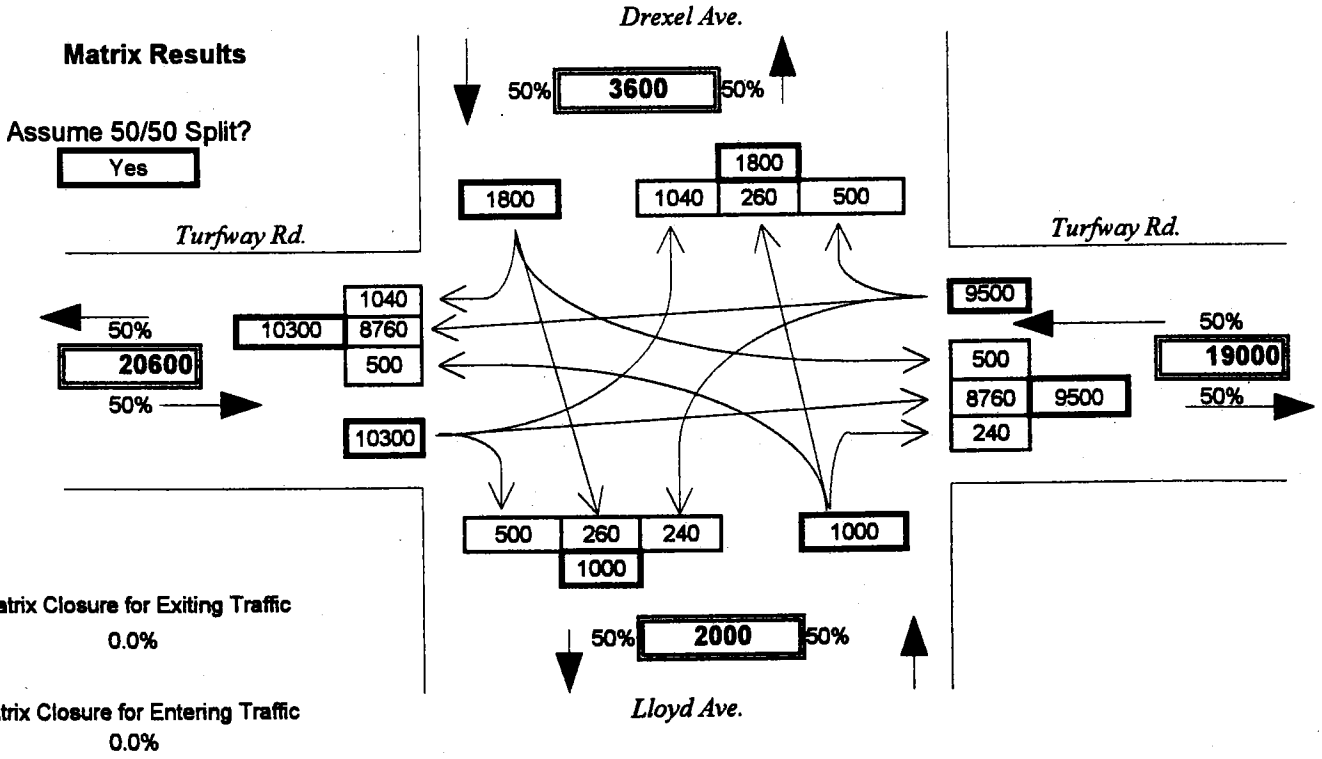


"Display" worksheet, this is the final printout of your results

Current Turn Movements

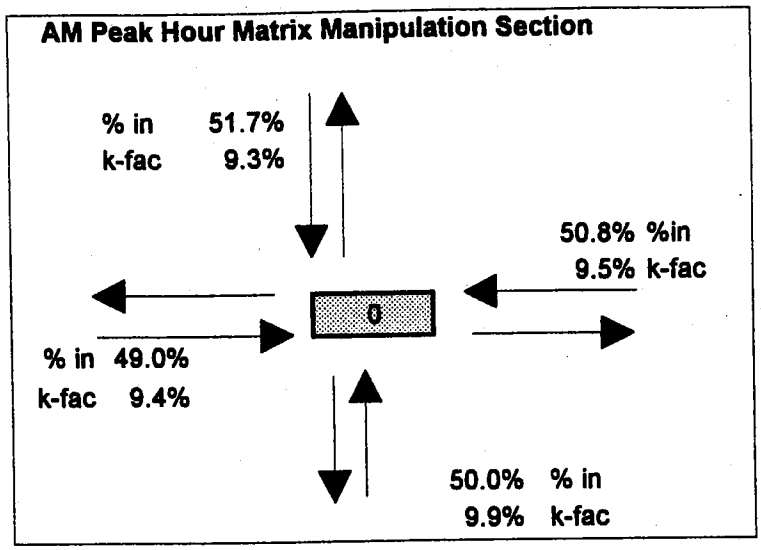


Current Year 1997
Desired Year 1997



"Past to Present" worksheet

In this example estimates were entered into the highlighted boxes in the CURRENT TURN MOVEMENT section.
The directional average daily traffic was entered into the highlighted DESIRED VALUE cells.

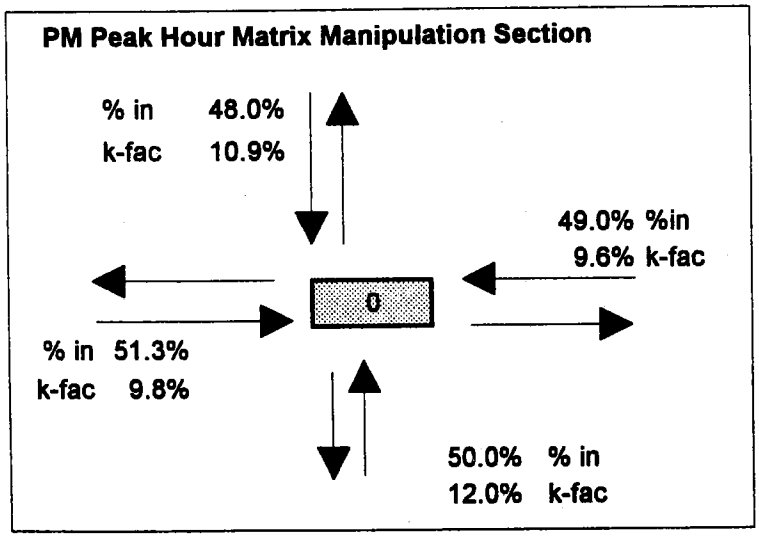


Matrix Closure for Exiting Traffic

0.0%

Matrix Closure for Entering Traffic

0.0%



Matrix Closure for Exiting Traffic

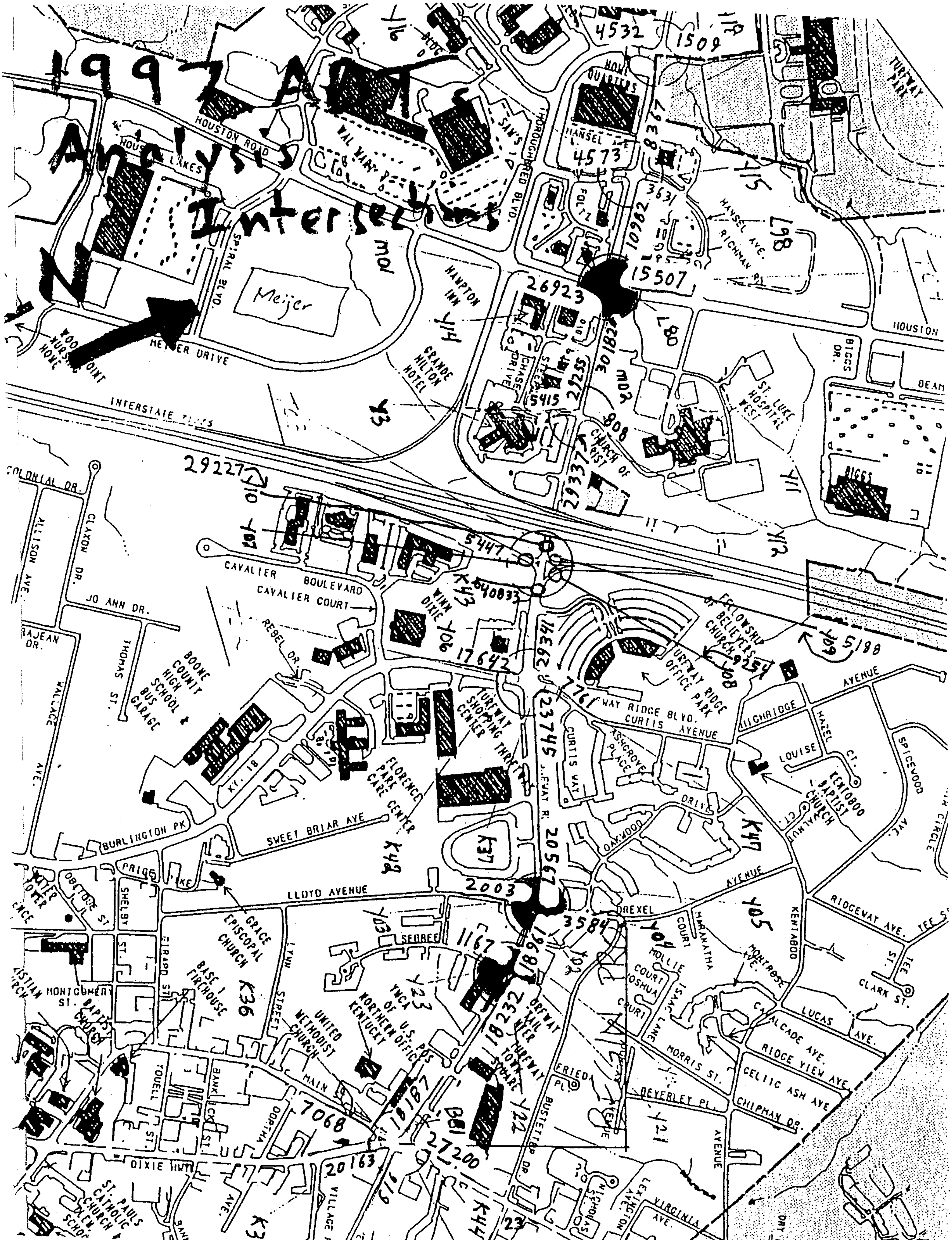
0.0%

Matrix Closure for Entering Traffic

0.0%

"Display" worksheet

As in all of these examples the % in and K factor estimates were entered into the AM and PM PEAK HOUR MATRIX MANIPULATION SECTIONS. These estimates were adjusted until the highlighted boxes equalled zero.


1997 ADT
Analysis
Intersections
HOUSTON ROAD
THOROUGHBRED BLVD.
SPIRAL BLVD.
Meijer
MEIJER DRIVE
HAMPTON INN
GRANDE HILTON HOTEL
INTERSTATE 75
HOME QUARTERS
HANSEL AVE.
RICHMAN PL.
HOUSTON
BIGGS DR.
BIGGS
ST. LUKE HOSPITAL WEST
CHURCH OF CHRIST
TURFWAY PARK
COLONIAL DR.
CLAXON DR.
ALLISON AVE.
CAVALIER BOULEVARD
CAVALIER COURT
JO ANN DR.
REBEL DR.
WINN DIXIE
FELLOWSHIP OF BELIEVERS CHURCH
TURFWAY RIDGE OFFICE PARK
TURFWAY SHOPPING CENTER
BOONE COUNTY HIGH SCHOOL BUS GARAGE
THOMAS ST.
WALLACE AVE.
CURTIS AVENUE
CURTIS WAY
ASHGROVE PLACE
HIGHRIDGE AVENUE
HAZEL CT.
LOUISE CT.
KENTABOO BAPTIST CHURCH
FLORENCE PARK CARE CENTER
KY. 18
BURLINGTON PK
SWEET BRIAR AVE
LLOYD AVENUE
DREXEL AVENUE
OAKWOOD DRIVE
GRACE EPISCOPAL CHURCH
BASE 1 FIREHOUSE
LYNN STREET
SEDREE
YMCA OF NORTHERN KENTUCKY
U.S. POST OFFICE
UNITED METHODIST CHURCH
TURFWAY TOWN SQUARE
MOLLIE COURT
JOSHUA COURT
ISAAC LANE
MARANATHA COURT
KENTABOO AVE.
MONTROSE
RIDGEWAY AVE.
CLARK ST.
LUCAS AVE.
CAVALCADE AVE.
RIDGE VIEW AVE.
CELTIC ASH AVE.
CHIPMAN DR.
MORRIS ST.
BEVERLEY PL.
FRIEDA PL.
BUSTETTER DR.
MAIN
DIXIE HWY.
VILLAGE
GIRARD ST.
SHELBY ST.
MONTGOMERY ST.
BAPTIST CHURCH
ST. PAULS CATHOLIC CHURCH
VIRGINIA AVE.
LEXINGTON AVE.
4532
1509
4573
3631
10982
15507
26923
30182
29255
5415
808
29337
29227
5447
40833
29341
17642
5188
9254
7761
23745
20567
2003
3584
1167
19681
18232
18187
7068
20163
27200

KENTUCKY TRANSPORTATION CABINET-DEPARTMENT OF HIGHWAYS
DIVISION OF TRANSPORTATION PLANNING

PORTABLE TRAFFIC RECORDER REPORT

ROUTE: DREXEL AVE BOONE COUNTY STATION: Y04

WEEK OF MARCH 04 TO MARCH 10 1997

DATE:	04	05	06	07	08	09	10	
DAY:	TUE	WED	THU	FRI	SAT	SUN	MON	TOTALS
12- 1 AM		20	40					60
1- 2 AM		40	20					60
2- 3 AM		20	20					40
3- 4 AM		10	20					30
4- 5 AM		10	10					20
5- 6 AM		40	40					80
6- 7 AM		100	100					200
7- 8 AM		120	140					260
8- 9 AM		150	140					290
9-10 AM		160	170					330
10-11 AM		160	170					330
11-12 AM	210	210						420
12- 1 PM	250	260						510
1- 2 PM	230	250						480
2- 3 PM	270	240						510
3- 4 PM	300	310						610
4- 5 PM	310	310						620
5- 6 PM	320	280						600
6- 7 PM	230	210						440
7- 8 PM	160	150						310
8- 9 PM	130	120						250
9-10 PM	130	100						230
10-11 PM	80	90						170
11-12 PM	60	50						110
TOTALS:	2680	3410	870					6960

AVERAGE DAILY TRAFFIC: 3584

MONTHLY FACTOR: 103
AXLE FACTOR: 100
TOTAL HOURS: 48
AM HIGH HOUR: 210 BETWEEN 11-12 AM ON TUESDAY
PM HIGH HOUR: 320 BETWEEN 5- 6 PM ON TUESDAY

MACHINE NUMBER: T39
MULTIPLE: N
ONE-WAY: N
DATA SOURCE: V

KENTUCKY TRANSPORTATION CABINET-DEPARTMENT OF HIGHWAYS
DIVISION OF TRANSPORTATION PLANNING

PORTABLE TRAFFIC RECORDER REPORT

ROUTE: LLOYD AVE BOONE COUNTY STATION: Y03

WEEK OF MARCH 04 TO MARCH 10 1997

DATE:	04	05	06	07	08	09	10	
DAY:	TUE	WED	THU	FRI	SAT	SUN	MON	TOTALS
12- 1 AM		10	20					30
1- 2 AM		0	10					10
2- 3 AM		10	10					20
3- 4 AM		10	10					20
4- 5 AM		10	10					20
5- 6 AM		10	10					20
6- 7 AM		50	40					90
7- 8 AM		90	60					150
8- 9 AM		100	100					200
9-10 AM		70	100					170
10-11 AM		70	80					150
11-12 AM	110	120						230
12- 1 PM	120	160						280
1- 2 PM	110	120						230
2- 3 PM	120	160						280
3- 4 PM	140	180						320
4- 5 PM	170	200						370
5- 6 PM	170	180						350
6- 7 PM	160	160						320
7- 8 PM	100	90						190
8- 9 PM	100	70						170
9-10 PM	60	60						120
10-11 PM	50	40						90
11-12 PM	30	30						60
TOTALS:	1440	2000	450					3890

AVERAGE DAILY TRAFFIC: 2003

MONTHLY FACTOR: 103
AXLE FACTOR: 100
TOTAL HOURS: 48
AM HIGH HOUR: 120 BETWEEN 11-12 AM ON WEDNESDAY
PM HIGH HOUR: 200 BETWEEN 4- 5 PM ON WEDNESDAY

MACHINE NUMBER: T36
MULTIPLE: N
ONE-WAY: N
DATA SOURCE: V

KENTUCKY TRANSPORTATION CABINET-DEPARTMENT OF HIGHWAYS
DIVISION OF TRANSPORTATION PLANNING

PORTABLE TRAFFIC RECORDER REPORT

ROUTE: KY1017 BOONE COUNTY STATION: Y05

WEEK OF MARCH 04 TO MARCH 10 1997

DATE:	04	05	06	07	08	09	10	
DAY:	TUE	WED	THU	FRI	SAT	SUN	MON	TOTALS
12- 1 AM		230	270					500
1- 2 AM		150	130					280
2- 3 AM		100	110					210
3- 4 AM		80	90					170
4- 5 AM		100	110					210
5- 6 AM		290	270					560
6- 7 AM		590	640					1230
7- 8 AM		920	920					1840
8- 9 AM		890	840					1730
9-10 AM		930	920					1850
10-11 AM	1120	1060						2180
11-12 AM	1280	1220						2500
12- 1 PM	1520	1440						2960
1- 2 PM	1420	1410						2830
2- 3 PM	1470	1380						2850
3- 4 PM	1440	1450						2890
4- 5 PM	1550	1490						3040
5- 6 PM	1600	1500						3100
6- 7 PM	1440	1310						2750
7- 8 PM	1090	990						2080
8- 9 PM	820	790						1610
9-10 PM	690	620						1310
10-11 PM	450	460						910
11-12 PM	370	380						750
TOTALS:	16260	19780	4300					40340

AVERAGE DAILY TRAFFIC: 20567

MONTHLY FACTOR: 103
AXLE FACTOR: 99
TOTAL HOURS: 48
AM HIGH HOUR: 1280 BETWEEN 11-12 AM ON TUESDAY
PM HIGH HOUR: 1600 BETWEEN 5- 6 PM ON TUESDAY

MACHINE NUMBER: P93
MULTIPLE: N
ONE-WAY: N
DATA SOURCE: V

KENTUCKY TRANSPORTATION CABINET-DEPARTMENT OF HIGHWAYS
DIVISION OF TRANSPORTATION PLANNING

PORTABLE TRAFFIC RECORDER REPORT

ROUTE: KY1017 BOONE COUNTY STATION: Y02

WEEK OF MARCH 04 TO MARCH 10 1997

DATE:	04	05	06	07	08	09	10	
DAY:	TUE	WED	THU	FRI	SAT	SUN	MON	TOTALS
12- 1 AM		210	240					450
1- 2 AM		140	120					260
2- 3 AM		90	110					200
3- 4 AM		70	70					140
4- 5 AM		90	110					200
5- 6 AM		280	250					530
6- 7 AM		550	590					1140
7- 8 AM		850	830					1680
8- 9 AM		800	770					1570
9-10 AM		860	880					1740
10-11 AM		990	1010					2000
11-12 AM	1160	1130						2290
12- 1 PM	1410	1310						2720
1- 2 PM	1320	1320						2640
2- 3 PM	1350	1280						2630
3- 4 PM	1320	1280						2600
4- 5 PM	1380	1370						2750
5- 6 PM	1450	1380						2830
6- 7 PM	1350	1230						2580
7- 8 PM	1020	940						1960
8- 9 PM	790	750						1540
9-10 PM	620	580						1200
10-11 PM	420	440						860
11-12 PM	320	360						680
TOTALS:	13910	18300	4980					37190

AVERAGE DAILY TRAFFIC: 18961

MONTHLY FACTOR: 103
AXLE FACTOR: 99
TOTAL HOURS: 48
AM HIGH HOUR: 1160 BETWEEN 11-12 AM ON TUESDAY
PM HIGH HOUR: 1450 BETWEEN 5- 6 PM ON TUESDAY

MACHINE NUMBER: P94
MULTIPLE: N
ONE-WAY: N
DATA SOURCE: V

Drexel Avenue

```
approach 3:
left turns          376
thru moves          423
right turns         1000
exiting             1800
```

Turfway Road

```
approach 1:
left turns      901
thru moves      8961
right turns     437
exiting         10297
```

```
approach 2:
left turns      140
thru moves      8911
right turns     450
exiting         9502
```

Turfway Road

```
approach 4:
left turns          386
thru moves          449
right turns         165
exiting             1000
```

```
Do another intersection (y or n)?
```

Lloyd Avenue

Intersection 2 using Turns.bat

Steps/Assumptions:

- assume Turfway Road is an arterial
- assume Drexel and Lloyd Avenues are collectors

Intersection 3: KY 192 at KY 1006

This four legged intersection is located in Laurel County, Kentucky. The study area is located to the East of Interstate 75. Both hourly machine counts and manual turn movement counts were available for this analysis.

Step by Step Methodology

Step 1) Fill in project information in upper left hand box on the "Display" worksheet.

Step 2) Write street names into the proper cells in the ADT BOX on the "Display" worksheet.

Step 3) Enter your initial turn movement assumptions into the boxes in the CURRENT TURN MOVEMENT SECTION of the "Past to Present" worksheet. In this case the sums of the individual turn movements from the manual turn movement count were entered.

Step 4) Write the directional Average Daily Traffic (ADT) into the DESIRED VALUE cells in the CURRENT TURN MOVEMENT SECTION.

Step 5) Look at the results in the 1997 ADT section of the "Display" worksheet. Manually overwrite the individual turn movement cells to make the TOTAL ADTs equal your desired values. In this case the ADT on the West leg of the intersection needed to be 24,500. The initial spreadsheet prediction was 24,480. To accomplish this the North-West, South-West, and North-South turn movements couplets were adjusted by 10 vehicles.

Step 6) Enter the highest hour volumes of the Midday turn movement count into the Individual turn movement boxes in the "AM Peak Hour" worksheet.

Step 7) Enter the highest hour volumes of the PM turn movement count into the Individual turn movement boxes in the "PM Peak Hour" worksheet.

Step 8) In the AM and PM PEAK HOUR MATRIX MANIPULATION SECTIONS of the "Display" worksheet enter the desired % ins and K factors for each movement. Adjust these initial assumptions until the number in the boxes in the center of the AM and PM sections equals zero.

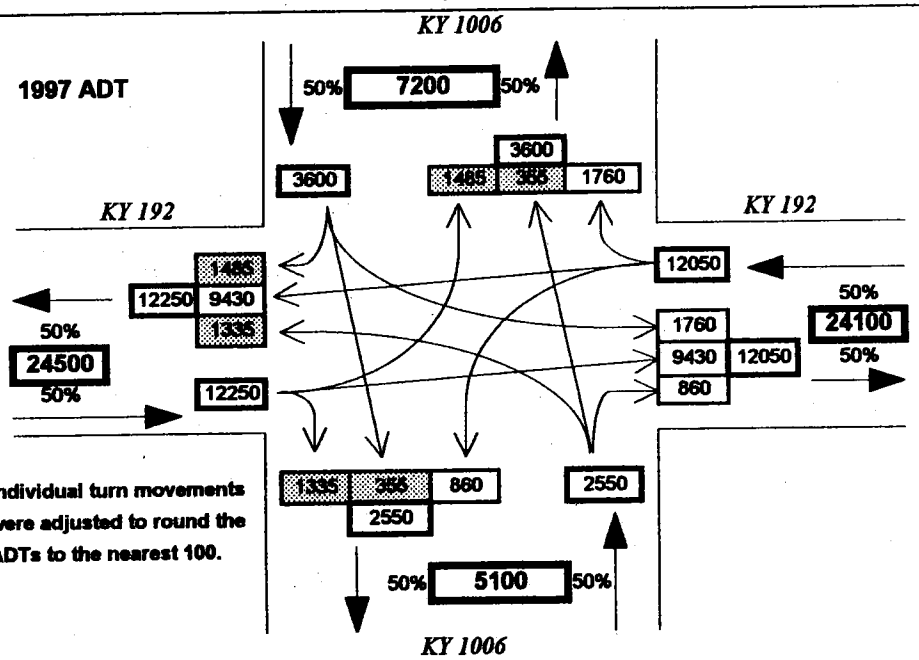
Step 9) Draw a sketch of the study area and project in the far left box labeled LOCATION MAP in the "Display" worksheet.

Step 10) Highlight the 6 boxes in the "Display" worksheet containing the project description, notes, ADT, DHVs, and Location maps. Print out what you just highlighted.

PROJECT: Turn Movement Manual ITEM NUMBER: --
REQUEST DATE: --
ANALYST: Scott Thompson-Graves
SCENARIO: **1997 ADT and Design Hour Volumes**
INTERSECTION: **KY 192 at KY 1006 (Intersection 3)**

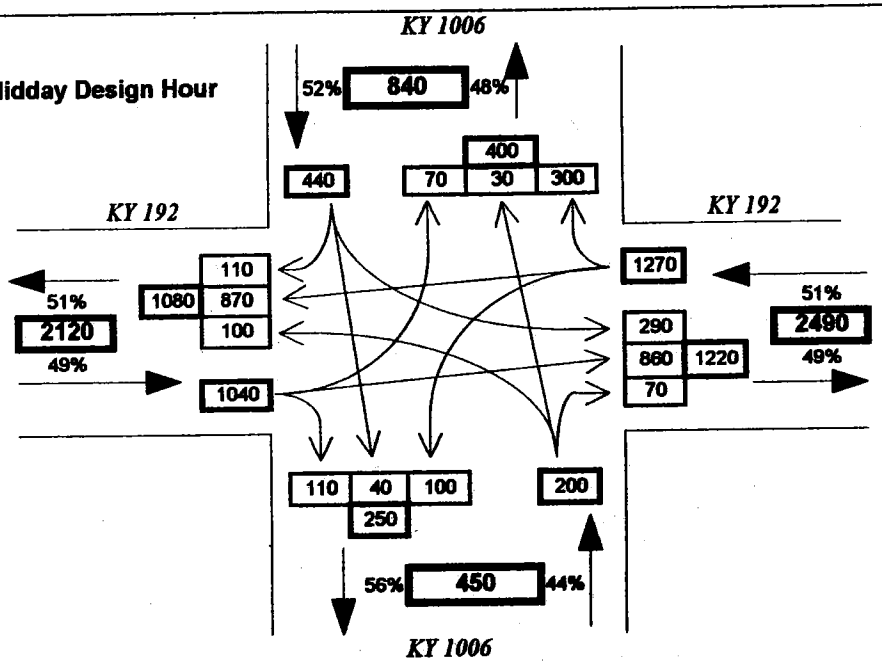
NOTE: ADTs and DHVs based on 1997 and 1995 hourly traffic counts. Turning movements based on 1997 hourly traffic counts and 1995 turn movements supplied by Wilbur Smith Associates.

1997 ADT

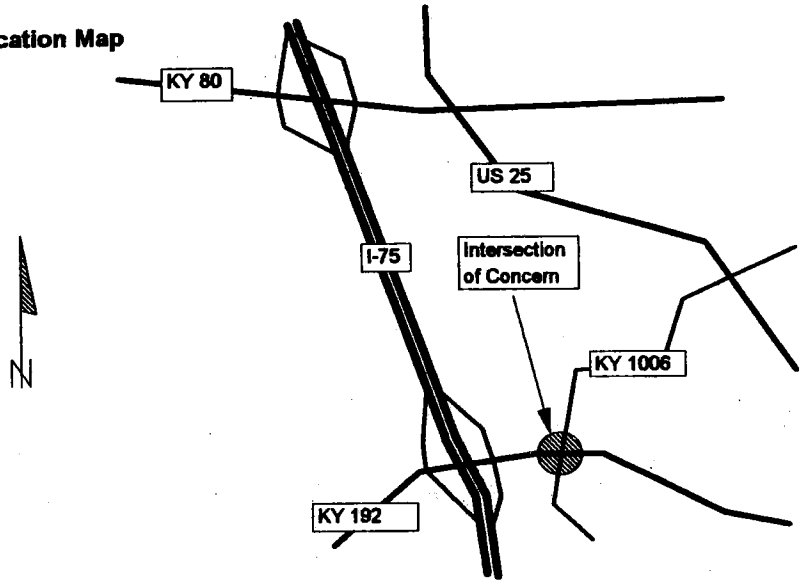


Individual turn movements were adjusted to round the ADTs to the nearest 100.

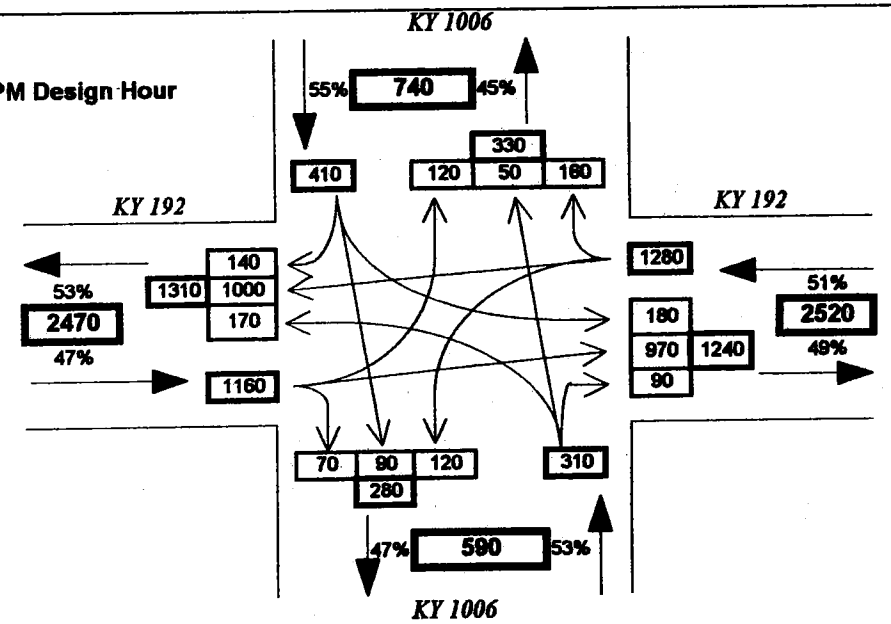
1997 Midday Design Hour



Location Map

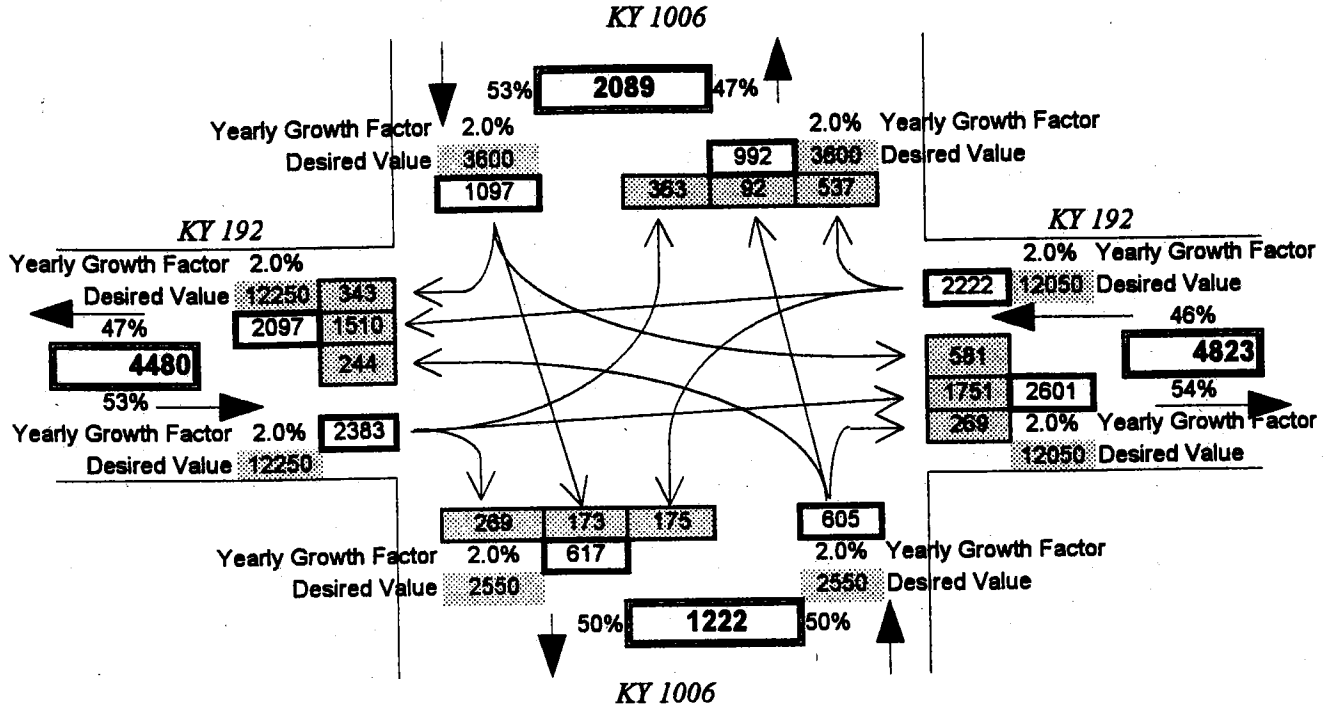


1997 PM Design Hour

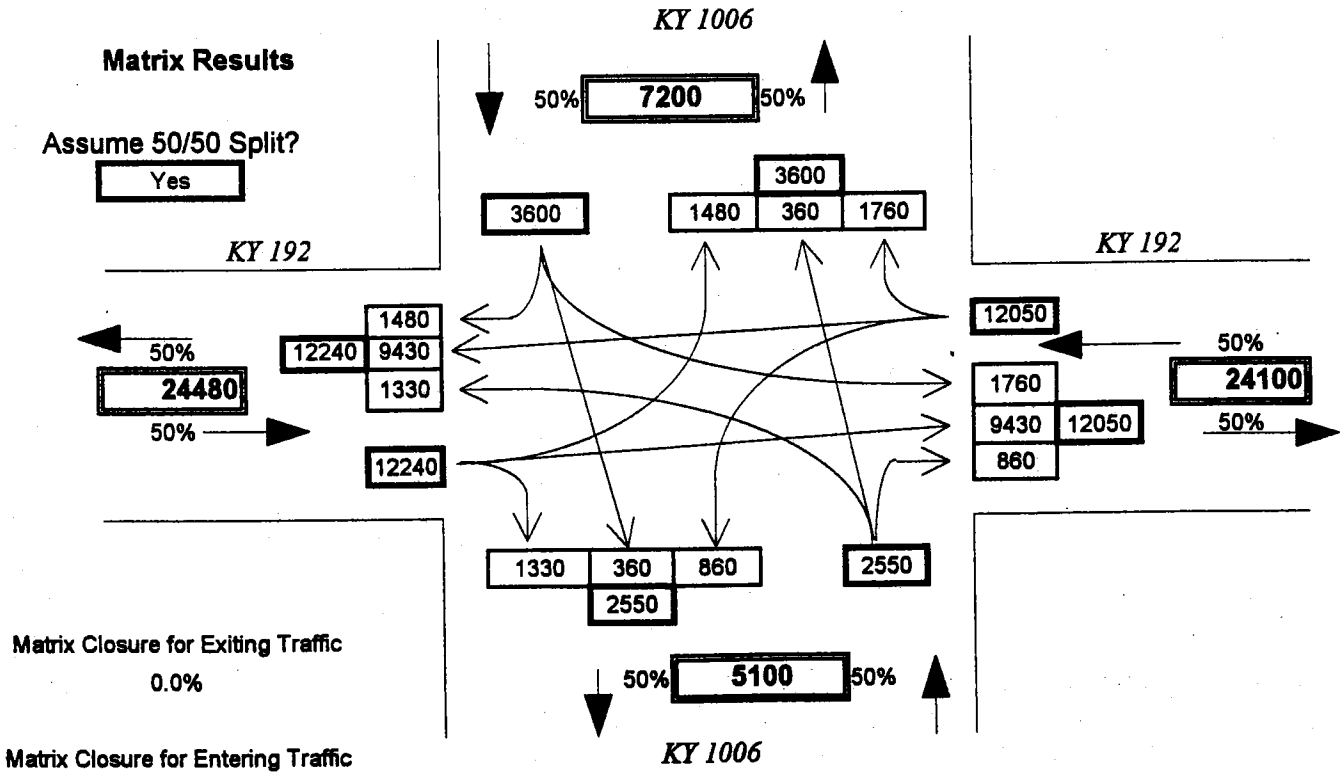


"Display" worksheet, this is the final printout of your results (minus the highlights and comments in the ADT section)

Current Turn Movements



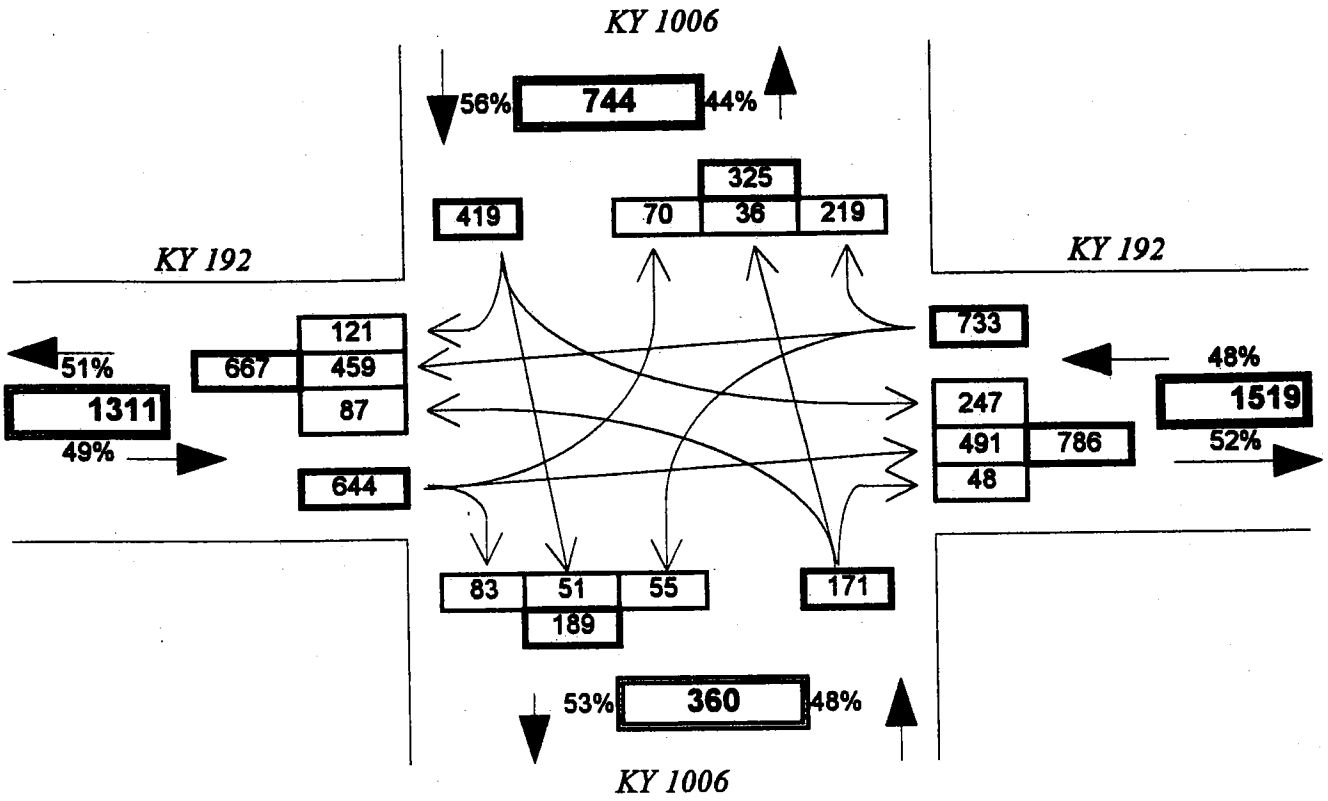
Current Year 1997
Desired Year 1997



"Past to Present" worksheet

In this example the sums of an actual turn movement count were entered into the highlighted boxes in the CURRENT TURN MOVEMENTS section. The directional average daily traffic (ADT) was entered into the highlighted DESIRED VALUE cells.

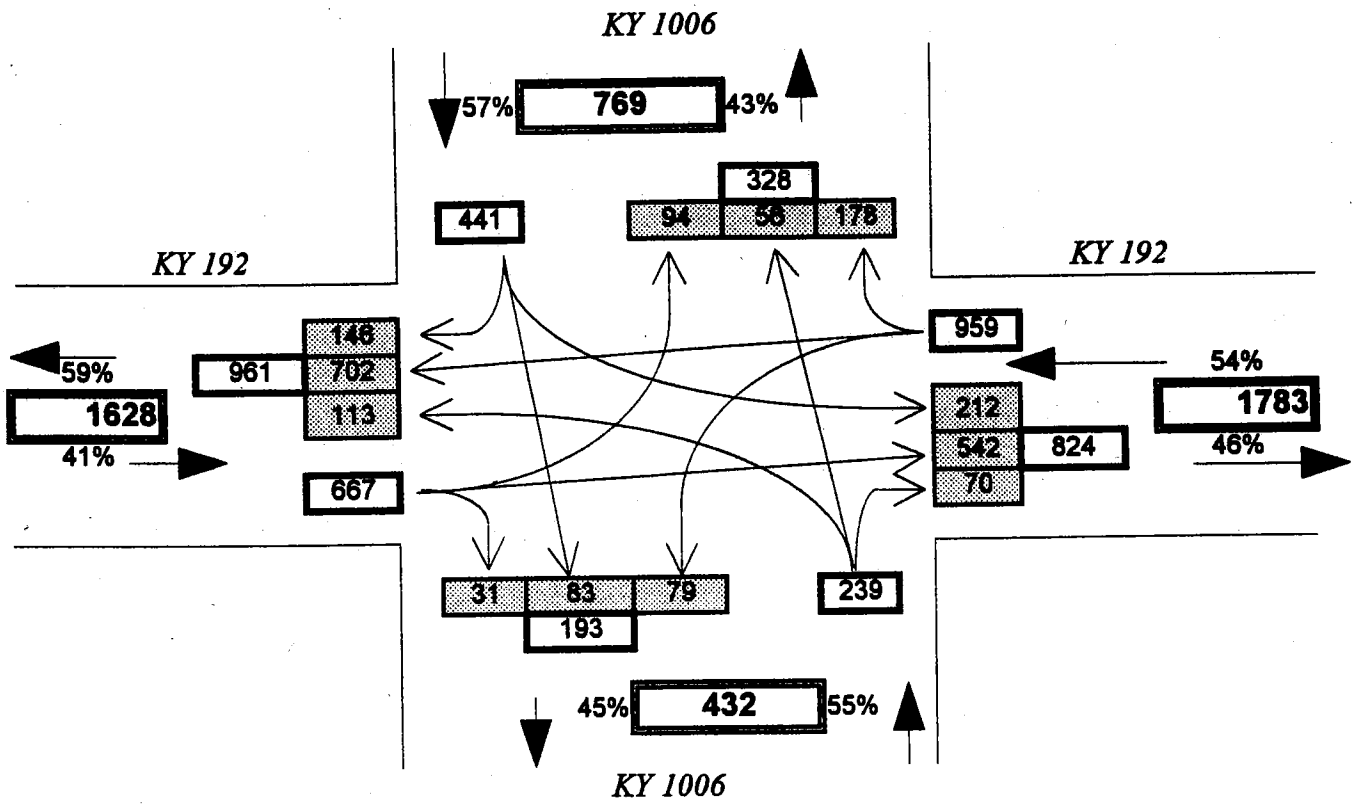
AM Initial Data Entry



"AM Peak Hour" worksheet

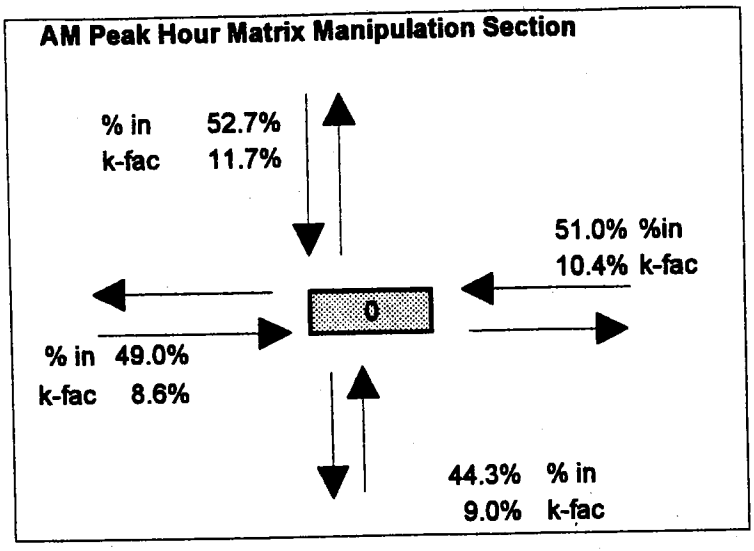
In this example the highest hour volumes of the Midday turn movement count were entered into the highlighted boxes.

PM Initial Data Entry



"PM Peak Hour" worksheet

In this example the highest hour volumes of the PM turn movement count were entered into the highlighted boxes.

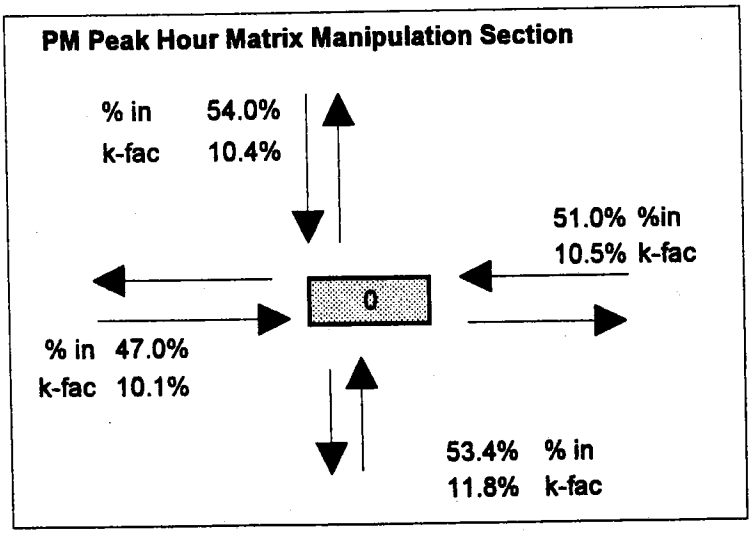


Matrix Closure for Exiting Traffic

0.0%

Matrix Closure for Entering Traffic

0.0%



Matrix Closure for Exiting Traffic

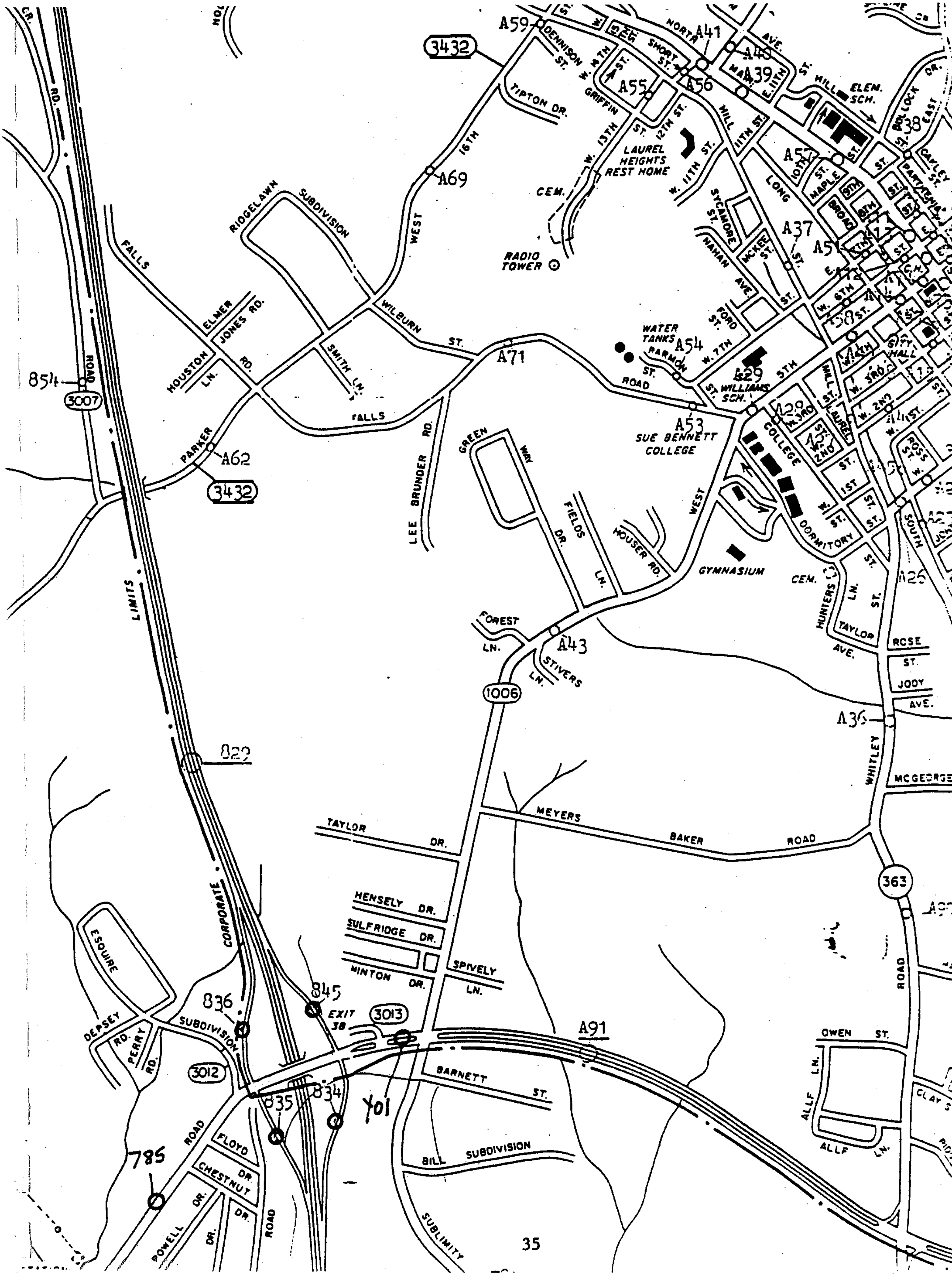
0.0%

Matrix Closure for Entering Traffic

0.0%

"Display" worksheet

As in all of these examples the % in and K factor estimates were entered into the AM and PM PEAK HOUR MATRIX MANIPULATION SECTIONS. These estimates were adjusted until the highlighted boxes equalled zero.



3432
DENNISON ST.
W. 14TH
SHORT ST.
NORTH
AVE.
MAIN
E. 11TH
HILL ELEM. SCH.
BULLOCK
TIPTON DR.
GRIFFIN ST.
12TH ST.
W. 13TH
HILL
11TH ST.
LAUREL HEIGHTS REST HOME
W. 11TH ST.
10TH
MAPLE ST.
LONG
SYCAMORE ST.
CEM.
16TH
WEST
RIDGELAWN
SUBDIVISION
RADIO TOWER
NAHAN AVE.
MCKEE ST.
FALLS
ELMER
JONES RD.
WILBURN ST.
SMITH LN.
HOUSTON LN.
RD.
WATER TANKS
PARMON ST.
FORD ST.
W. 7TH
5TH
WILLIAMS SCH.
CITY HALL
W. 3RD
W. 2ND
ROAD
FALLS
PARKER
3432
3007
ROAD
SUE BENNETT COLLEGE
COLLEGE
GREEN WAY
LEE BRUNDER RD.
FIELDS DR.
LN.
HOUSER RD.
WEST
DORMITORY
GYMNASIUM
CEM.
HUNTERS LN.
TAYLOR AVE.
ROSE ST.
JODY AVE.
SOUTH
FOREST LN.
STIVERS LN.
1006
LIMITS
WHITLEY
MCGEORGE
TAYLOR DR.
MEYERS
BAKER
ROAD
363
CORPORATE
HENSELY DR.
SULFRIDGE DR.
SPIVELY LN.
MINTON DR.
ESQUIRE
DEPSEY RD.
PERRY RD.
SUBDIVISION
EXIT 38
3013
3012
BARNETT ST.
OWEN ST.
ALLF LN.
CLAY
FLOYD DR.
CHESTNUT DR.
ROAD
BILL SUBDIVISION
POWELL DR.
SUBLIMITY
A59
A41
A39
A55
A56
A69
A37
A71
A54
A29
A53
A62
A43
A36
A91
854
829
836
845
835
834
Y01
785

DIVISION OF TRANSPORTATION PLANNING

PORTABLE TRAFFIC RECORDER REPORT

ROUTE: KY192 LONDON STATION: Y01 E

WEEK OF AUGUST 26 TO SEPTEMBER 01 1997

DATE:	26	27	28	29	30	31	01	
DAY:	TUE	WED	THU	FRI	SAT	SUN	MON	TOTALS
12- 1 AM		110	130					240
1- 2 AM		100	90					190
2- 3 AM		60	100					160
3- 4 AM		110	70					180
4- 5 AM		110	130					240
5- 6 AM		200	200					400
6- 7 AM		410	460					870
7- 8 AM		960	990					1950
8- 9 AM		950	920					1870
9-10 AM		680	670					1350
10-11 AM	650	640						1290
11-12 AM	730	720						1450
12- 1 PM	790	720						1510
1- 2 PM	740	740						1480
2- 3 PM	750	750						1500
3- 4 PM	780	830						1610
4- 5 PM	880	820						1700
5- 6 PM	940	800						1740
6- 7 PM	870	750						1620
7- 8 PM	640	650						1290
8- 9 PM	570	570						1140
9-10 PM	390	450						840
10-11 PM	240	310						550
11-12 PM	180	200						380
TOTALS:	9150	12640	3760					25550

AVERAGE DAILY TRAFFIC: 12268

MONTHLY FACTOR: 97
AXLE FACTOR: 99
TOTAL HOURS: 48
AM HIGH HOUR: 990 BETWEEN 7- 8 AM ON THURSDAY
PM HIGH HOUR: 940 BETWEEN 5- 6 PM ON TUESDAY

MACHINE NUMBER: M38
MULTIPLE: N
ONE-WAY: N
DATA SOURCE: V

DIVISION OF TRANSPORTATION PLANNING

PORTABLE TRAFFIC RECORDER REPORT

ROUTE: KY192 LONDON STATION: Y01 W

WEEK OF AUGUST 26 TO SEPTEMBER 01 1997

DATE:	26	27	28	29	30	31	01	
DAY:	TUE	WED	THU	FRI	SAT	SUN	MON	TOTALS
12- 1 AM		140	180					320
1- 2 AM		130	90					220
2- 3 AM		70	90					160
3- 4 AM		120	60					180
4- 5 AM		110	140					250
5- 6 AM		220	210					430
6- 7 AM		360	440					800
7- 8 AM		610	640					1250
8- 9 AM		680	690					1370
9-10 AM	600	690						1290
10-11 AM	670	620						1290
11-12 AM	700	650						1350
12- 1 PM	830	770						1600
1- 2 PM	770	730						1500
2- 3 PM	780	740						1520
3- 4 PM	920	930						1850
4- 5 PM	960	890						1850
5- 6 PM	1030	1050						2080
6- 7 PM	770	810						1580
7- 8 PM	650	610						1260
8- 9 PM	720	610						1330
9-10 PM	490	460						950
10-11 PM	300	350						650
11-12 PM	240	210						450
TOTALS:	10430	12560	2540					25530

AVERAGE DAILY TRAFFIC: 12258

MONTHLY FACTOR: 97
AXLE FACTOR: 99
TOTAL HOURS: 48
AM HIGH HOUR: 700 BETWEEN 11-12 AM ON TUESDAY
PM HIGH HOUR: 1050 BETWEEN 5- 6 PM ON WEDNESDAY

MACHINE NUMBER: T39
MULTIPLE: N
ONE-WAY: N
DATA SOURCE: V

KENTUCKY TRANSPORTATION CABINET-DEPARTMENT OF HIGHWAYS
DIVISION OF TRANSPORTATION PLANNING

PORTABLE TRAFFIC RECORDER REPORT

ROUTE: KY192 LONDON STATION: A91 E

WEEK OF JULY 19 TO JULY 25 1995

DATE:	19	20	21	22	23	24	25	
DAY:	WED	THU	FRI	SAT	SUN	MON	TUE	TOTALS
12- 1 AM		150	150					300
1- 2 AM		110	110					220
2- 3 AM		60	80					140
3- 4 AM		50	50					100
4- 5 AM		60	80					140
5- 6 AM		130	90					220
6- 7 AM		280	300					580
7- 8 AM		510	530					1040
8- 9 AM		610	560					1170
9-10 AM		560	620					1180
10-11 AM	630	620						1250
11-12 AM	730	710						1440
12- 1 PM	930	910						1840
1- 2 PM	860	870						1730
2- 3 PM	820	870						1690
3- 4 PM	850	930						1780
4- 5 PM	850	950						1800
5- 6 PM	860	940						1800
6- 7 PM	740	830						1570
7- 8 PM	590	690						1280
8- 9 PM	660	680						1340
9-10 PM	550	600						1150
10-11 PM	400	410						810
11-12 PM	300	290						590
TOTALS:	9770	12820	2570					25160

AVERAGE DAILY TRAFFIC: 11234

† 11511
22,745

MONTHLY FACTOR: 95
AXLE FACTOR: 94
TOTAL HOURS: 48
AM HIGH HOUR: 730 BETWEEN 11-12 AM ON WEDNESDAY
PM HIGH HOUR: 950 BETWEEN 4- 5 PM ON THURSDAY

MACHINE NUMBER: T14
MULTIPLE: N
ONE-WAY: N
DATA SOURCE: V

KENTUCKY TRANSPORTATION CABINET-DEPARTMENT OF HIGHWAYS
DIVISION OF TRANSPORTATION PLANNING

PORTABLE TRAFFIC RECORDER REPORT

ROUTE: KY192 LONDON STATION: A81 W

WEEK OF JULY 19 TO JULY 25 1995

DATE:	19	20	21	22	23	24	25	
DAY:	WED	THU	FRI	SAT	SUN	MON	TUE	TOTALS
12- 1 AM		140	170					310
1- 2 AM		100	90					190
2- 3 AM		50	80					130
3- 4 AM		60	60					120
4- 5 AM		70	70					140
5- 6 AM		170	130					300
6- 7 AM		340	320					660
7- 8 AM		490	480					970
8- 9 AM		560	620					1180
9-10 AM		650	720					1370
10-11 AM	890	710						1400
11-12 AM	920	830						1750
12- 1 PM	980	970						1950
1- 2 PM	850	940						1790
2- 3 PM	810	800						1610
3- 4 PM	790	930						1720
4- 5 PM	900	980						1880
5- 6 PM	810	870						1680
6- 7 PM	720	800						1520
7- 8 PM	610	620						1230
8- 9 PM	700	680						1380
9-10 PM	510	590						1100
10-11 PM	350	360						710
11-12 PM	240	250						490
TOTALS:	9980	13060	2740					25780

AVERAGE DAILY TRAFFIC: 11511

+ 11234
22745

MONTHLY FACTOR: 95
AXLE FACTOR: 94
TOTAL HOURS: 48
AM HIGH HOUR: 920 BETWEEN 11-12 AM ON WEDNESDAY
PM HIGH HOUR: 980 BETWEEN 12- 1 PM ON WEDNESDAY

MACHINE NUMBER: P46
MULTIPLE: N
ONE-WAY: N
DATA SOURCE: V

39

KENTUCKY TRANSPORTATION CABINET-DEPARTMENT OF HIGHWAYS
DIVISION OF TRANSPORTATION PLANNING

PORTABLE TRAFFIC RECORDER REPORT

ROUTE: KY1006 LAUREL COUNTY STATION: 780

WEEK OF JULY 17 TO JULY 23 1995

DATE:	17	18	19	20	21	22	23	
DAY:	MON	TUE	WED	THU	FRI	SAT	SUN	TOTALS
12- 1 AM		50	50					100
1- 2 AM		20	30					50
2- 3 AM		20	20					40
3- 4 AM		10	20					30
4- 5 AM		30	30					60
5- 6 AM		50	60					110
6- 7 AM		200	200					400
7- 8 AM		280	280					560
8- 9 AM		350	290					640
9-10 AM		210	200					410
10-11 AM	230	280						510
11-12 AM	280	340						620
12- 1 PM	340	330						670
1- 2 PM	290	330						620
2- 3 PM	330	280						610
3- 4 PM	280	360						640
4- 5 PM	360	410						770
5- 6 PM	460	480						940
6- 7 PM	350	400						750
7- 8 PM	330	330						660
8- 9 PM	280	310						590
9-10 PM	200	260						460
10-11 PM	140	160						300
11-12 PM	110	110						220
TOTALS:	3980	5600	1180					10760

AVERAGE DAILY TRAFFIC: 4906

MONTHLY FACTOR: 95
AXLE FACTOR: 96
TOTAL HOURS: 48
AM HIGH HOUR: 350 BETWEEN 8- 9 AM ON TUESDAY
PM HIGH HOUR: 480 BETWEEN 5- 6 PM ON TUESDAY

MACHINE NUMBER: M37
MULTIPLE: N
ONE-WAY: N
DATA SOURCE: V

KENTUCKY TRANSPORTATION CABINET-DEPARTMENT OF HIGHWAYS
DIVISION OF TRANSPORTATION PLANNING

PORTABLE TRAFFIC RECORDER REPORT

ROUTE: KY1006 LONDON STATION: A43

WEEK OF JULY 26 TO AUGUST 01 1995

DATE:	26	27	28	29	30	31	01	
DAY:	WED	THU	FRI	SAT	SUN	MON	TUE	TOTALS
12- 1 AM		50	40					90
1- 2 AM		30	40					70
2- 3 AM		20	20					40
3- 4 AM		10	10					20
4- 5 AM		20	20					40
5- 6 AM		40	50					90
6- 7 AM		120	120					240
7- 8 AM		320	360					680
8- 9 AM		460	450					910
9-10 AM		380	470					850
10-11 AM		440	510					950
11-12 AM		560	590					1150
12- 1 PM	610	670						1280
1- 2 PM	580	540						1120
2- 3 PM	500	540						1040
3- 4 PM	540	530						1070
4- 5 PM	510	580						1090
5- 6 PM	470	550						1020
6- 7 PM	460	420						880
7- 8 PM	340	350						690
8- 9 PM	370	360						730
9-10 PM	280	290						570
10-11 PM	160	170						330
11-12 PM	110	100						210
TOTALS:	4930	7550	2680					15160

AVERAGE DAILY TRAFFIC: 6913

MONTHLY FACTOR: 95
AXLE FACTOR: 96
TOTAL HOURS: 48

AM HIGH HOUR: 590 BETWEEN 11-12 AM ON FRIDAY
PM HIGH HOUR: 670 BETWEEN 12- 1 PM ON THURSDAY

MACHINE NUMBER: T39
MULTIPLE: N
ONE-WAY: N
DATA SOURCE: V

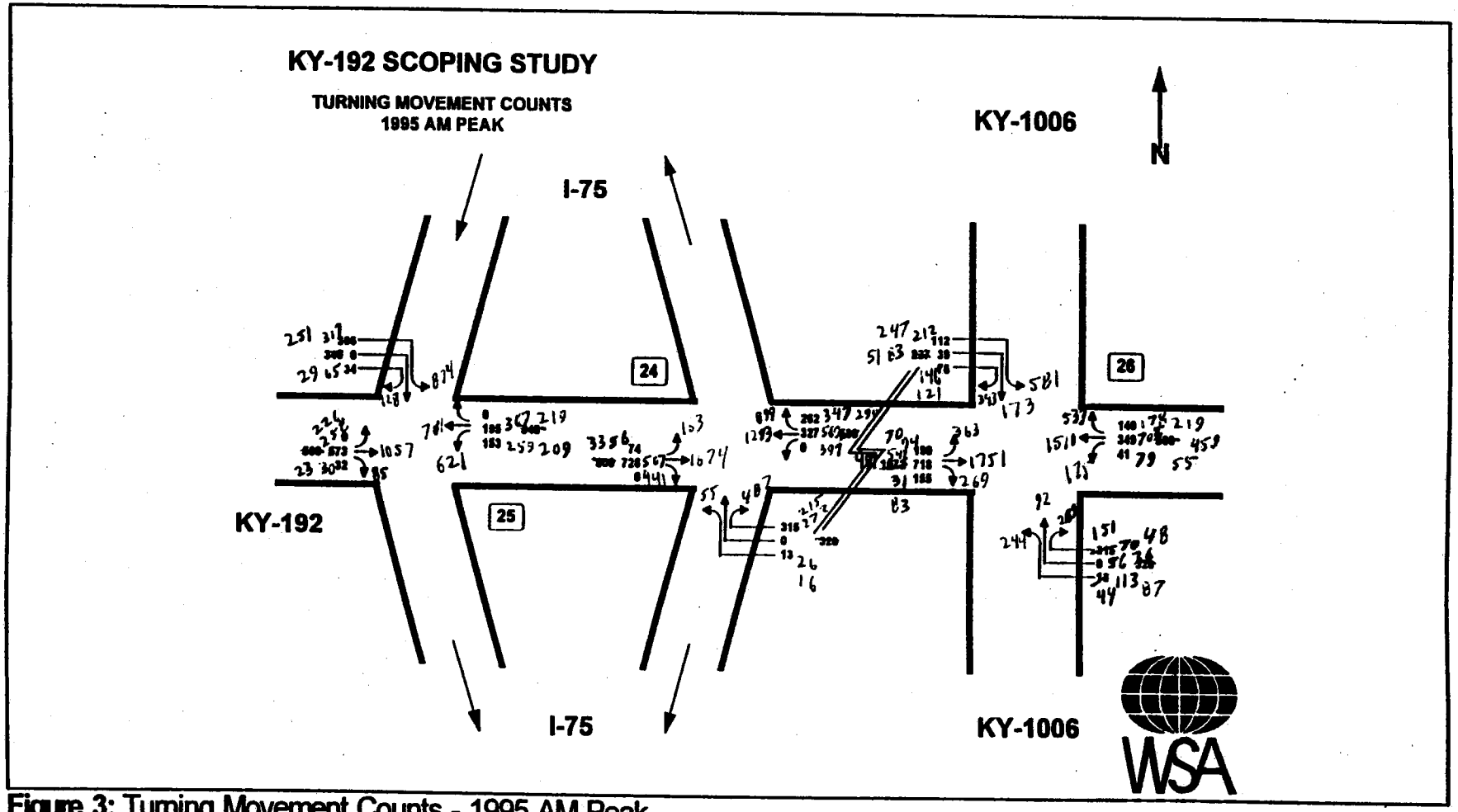


Figure 3: Turning Movement Counts - 1995 AM Peak

~ p.m
~ NOON
N sum For movement
(used as seed counts in
TM program)

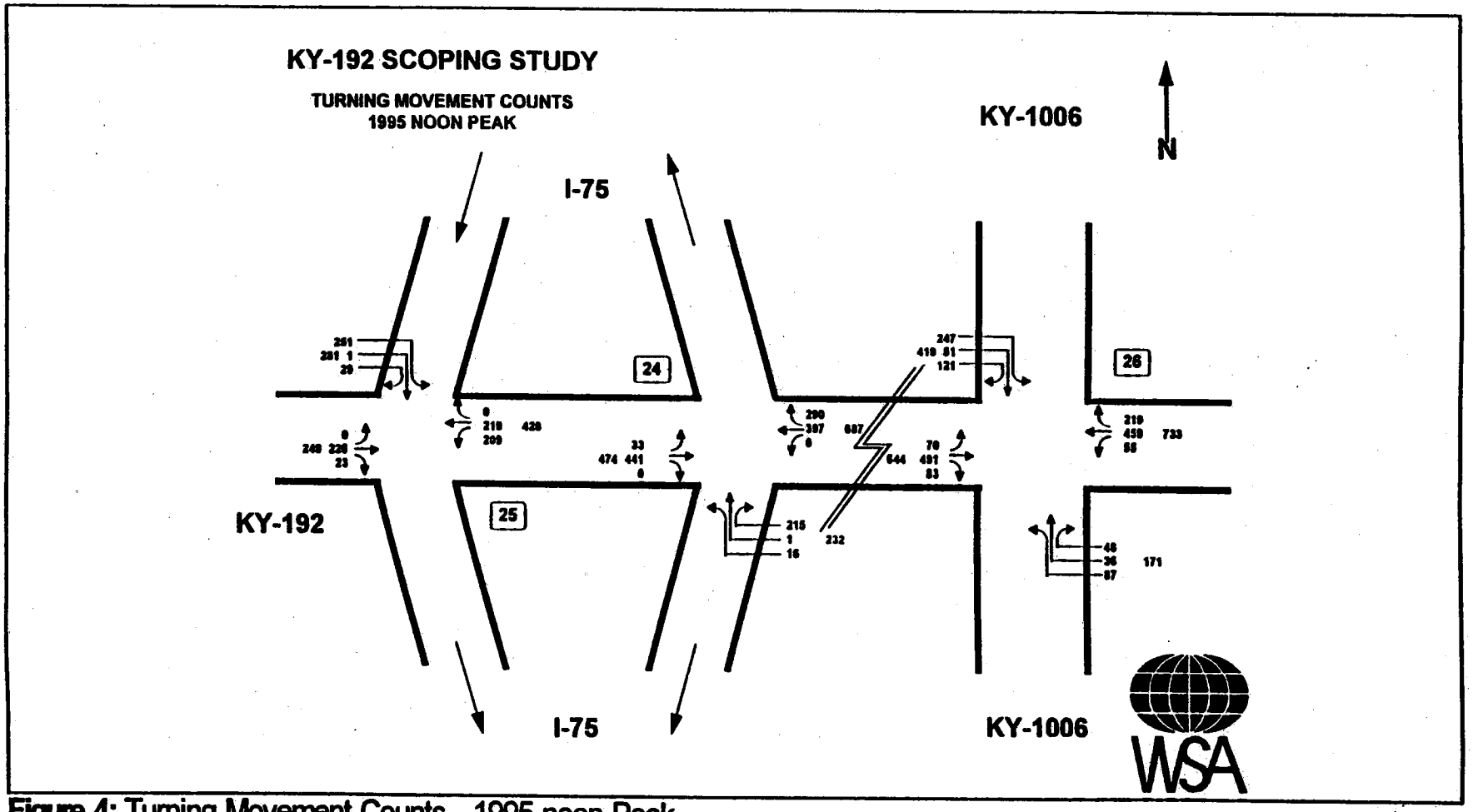


Figure 4: Turning Movement Counts - 1995 noon Peak

Intersection 4: Turfway Rd. at Houston Rd.

This four legged intersection is located in Boone County, Kentucky. The study area is a highly developed commercial area south of Interstate 275 and Cincinnati, Ohio. Turfway Road is currently a 2 and 3 lane road beginning at US 25 (the Dixie Highway) and heading northwest through the study area. This intersection exhibits directionality on two legs. The end product had to be adjusted to force movements that should not have been directional to balance. Both hourly machine counts and manual turn movement counts were available for this analysis.

Step by Step Methodology

Step 1) Fill in project information in upper left hand box on the "Display" worksheet.

Step 2) Write street names into the proper cells in the ADT BOX on the "Display" worksheet.

Step 3) Enter your initial turn movement assumptions into the boxes in the CURRENT TURN MOVEMENT SECTION of the "Past to Present" worksheet. In this case the sums of the individual turn movements from the manual turn movement count were entered.

Step 4) Write the directional Average Daily Traffic (ADT) into the DESIRED VALUE cells in the CURRENT TURN MOVEMENT SECTION.

Step 5) Write "No" into the ASSUME 50/50 SPLIT? Box in the MATRIX RESULTS section of the "Past to Present" worksheet.

Step 6) Look at the results in the 1997 ADT section of the "Display" worksheet. Manually overwrite the individual turn movement cells to make the TOTAL ADTs equal your desired values. In this case the most of the turn movement couplets should not be balanced, but some should be. The individual turn movements were adjusted to accomplish this goal.

Step 7) Enter the highest hour volumes of the PM turn movement count into the Individual turn movement boxes in the "PM Peak Hour" worksheet.

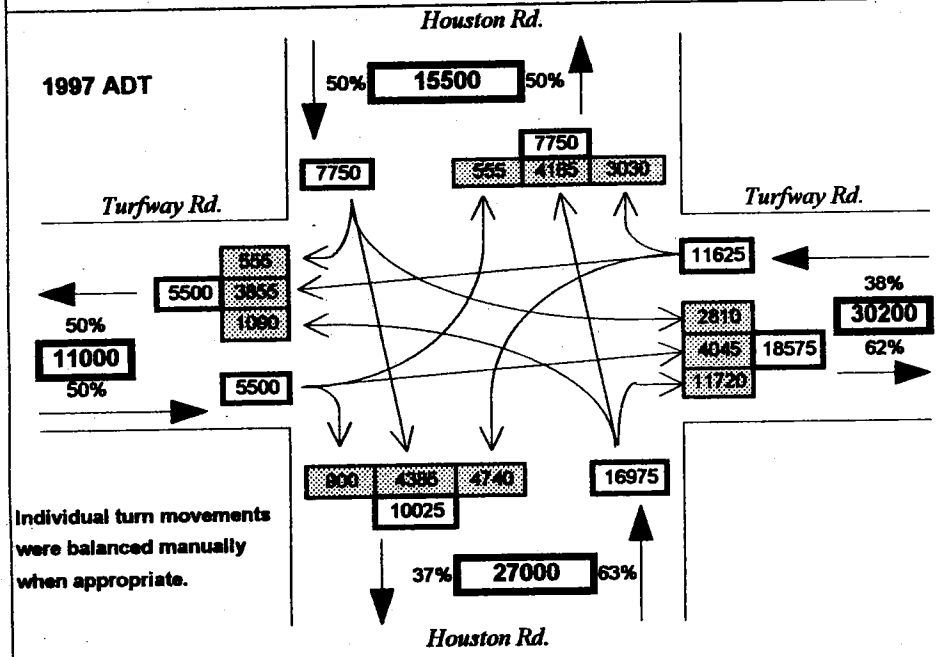
Step 8) In the AM and PM PEAK HOUR MATRIX MANIPULATION SECTIONS of the "Display" worksheet enter the desired % ins and K factors for each movement. Adjust these initial assumptions until the number in the boxes in the center of the AM and PM sections equals zero.

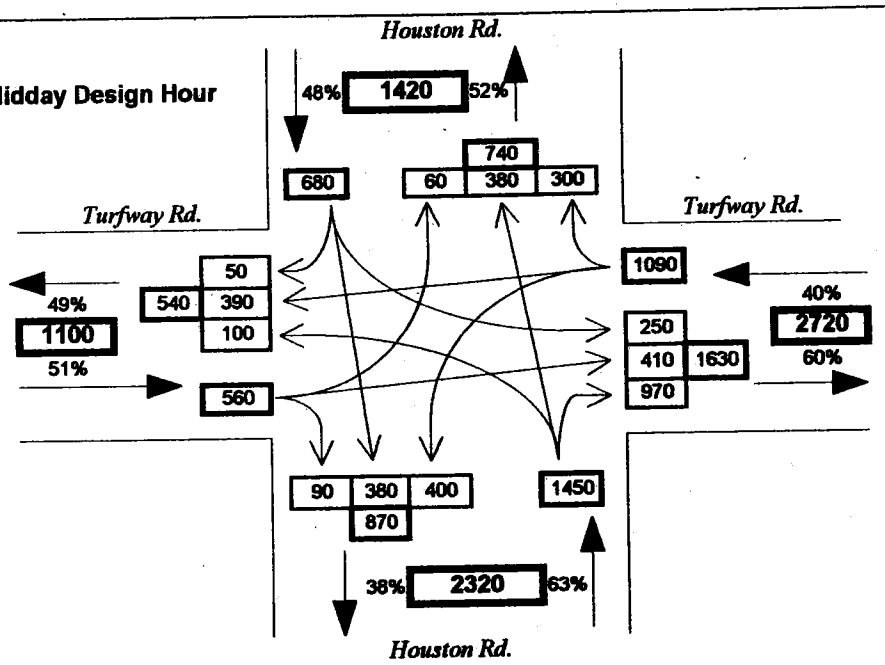
Step 9) Draw a sketch of the study area and project in the far left box labeled LOCATION MAP in the "Display" worksheet.

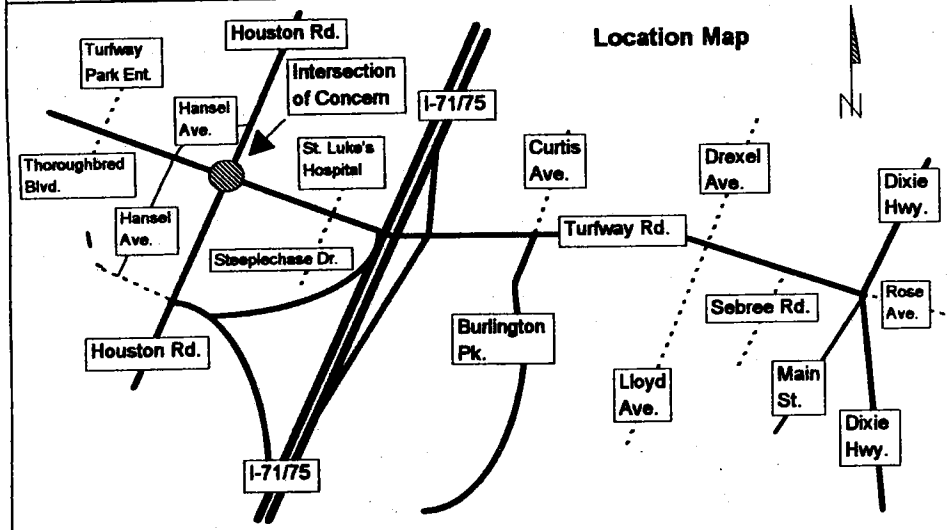
Step 10) Highlight the 6 boxes in the "Display" worksheet containing the project description, notes, ADT, DHVs, and Location maps. Print out what you just highlighted.

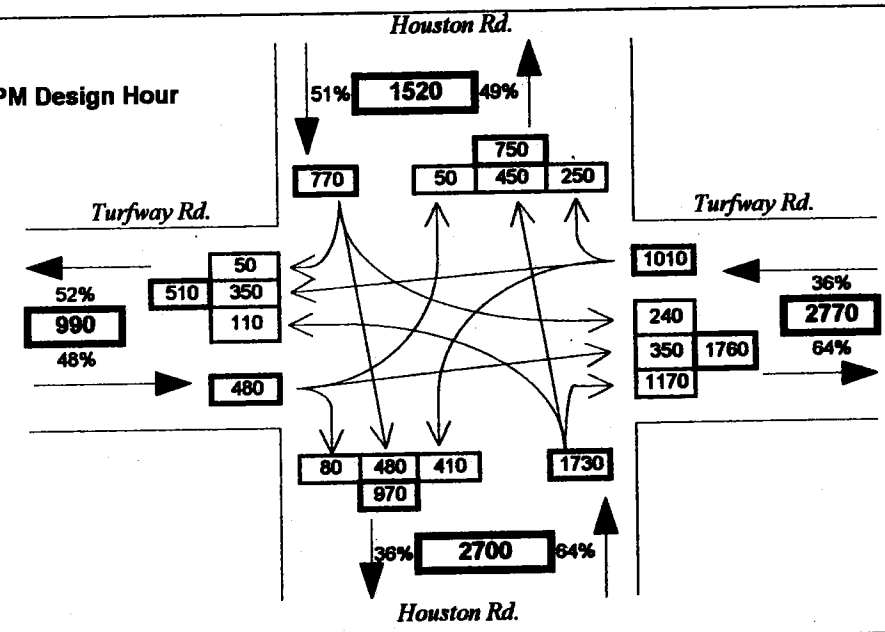
PROJECT: Turn Movement Manual ITEM NUMBER: --
REQUEST DATE: --
ANALYST: Scott Thompson-Graves
SCENARIO: **1997 ADT and Design Hour Volumes**
INTERSECTION: **Houston Rd. at Turfway Rd. (Int. 4)**

NOTE: ADTs and DHVs based on 1997 traffic counts. Turn movement data was used when available.



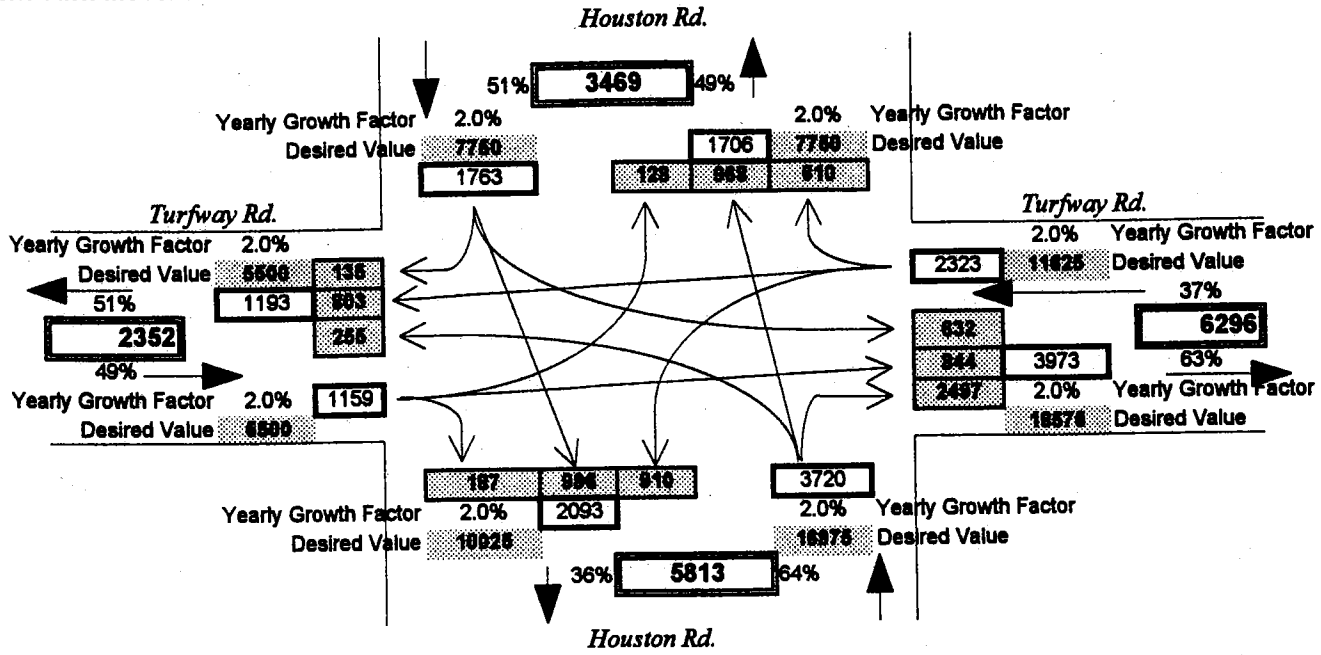






"Display" worksheet, this is the final printout of your results (minus the highlights and comments in the ADT section)

Current Turn Movements

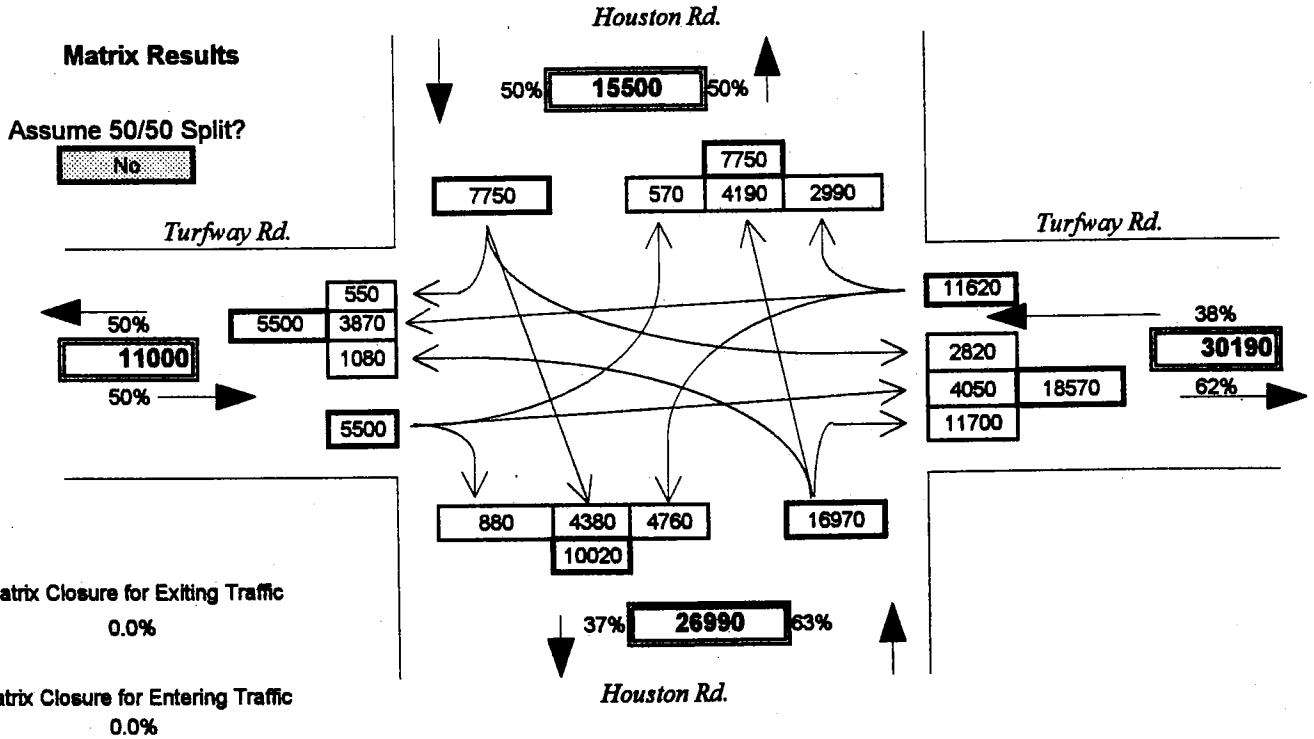


Current Year 1997
Desired Year 1997

Matrix Results

Assume 50/50 Split?

No



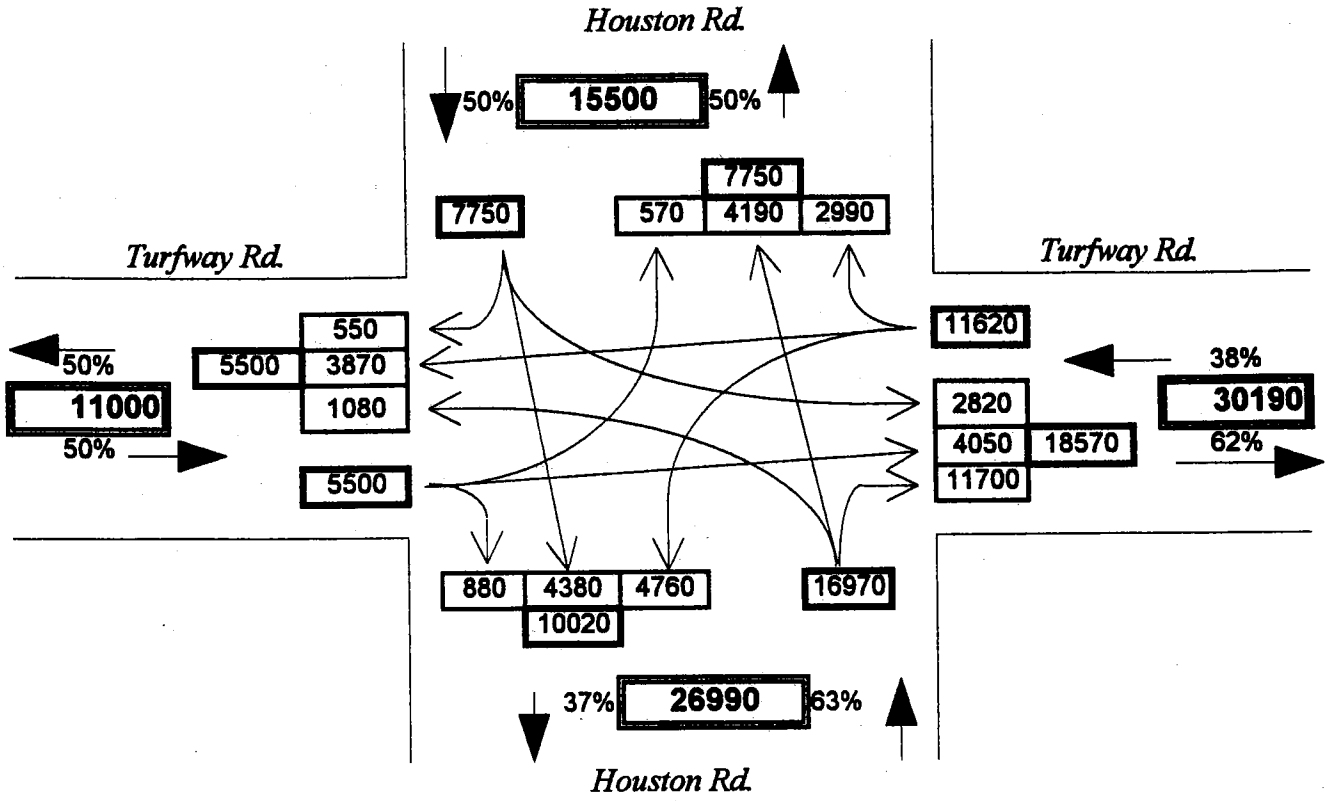
Matrix Closure for Exiting Traffic
0.0%

Matrix Closure for Entering Traffic
0.0%

"Past to Present" worksheet

In this example the sums of an actual turn movement count were entered into the highlighted boxes in the CURRENT TURN MOVEMENTS section. The directional average daily traffic (ADT) was entered into the highlighted DESIRED VALUE cells. In the MATRIX RESULTS section, "No" was written into the ASSUME 50/50 SPLIT box.

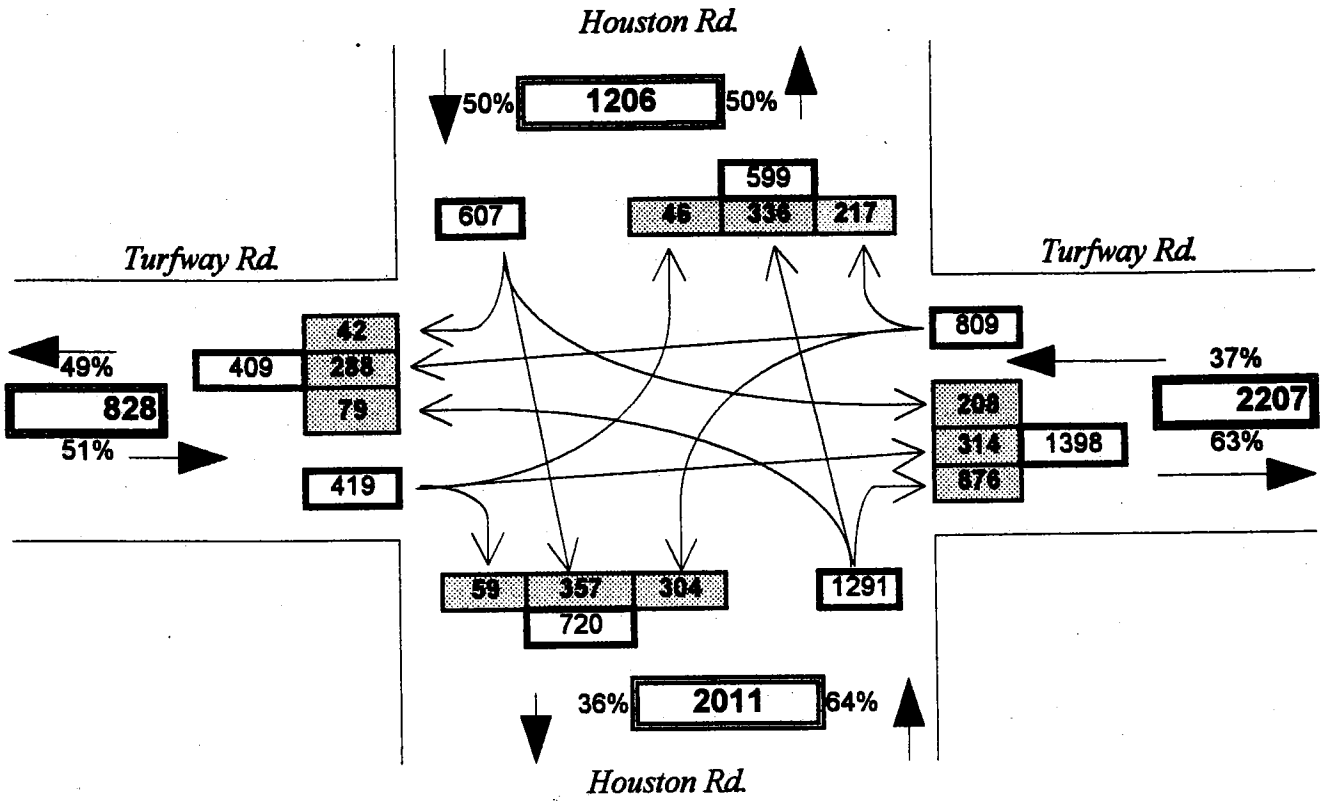
AM Initial Data Entry



"AM Peak Hour" worksheet

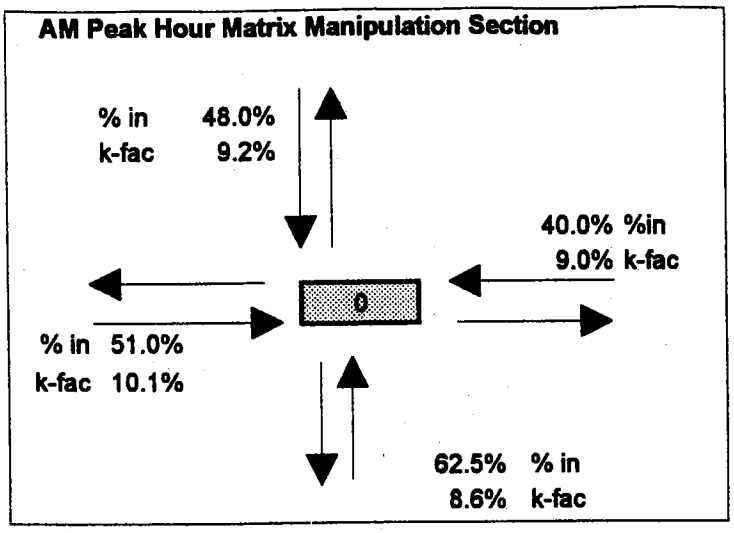
No AM peak hour turn movement counts were available so nothing was entered into this worksheet.

PM Initial Data Entry



"PM Peak Hour" worksheet

In this example the highest hour of the PM turn movement count were entered into the highlighted boxes.

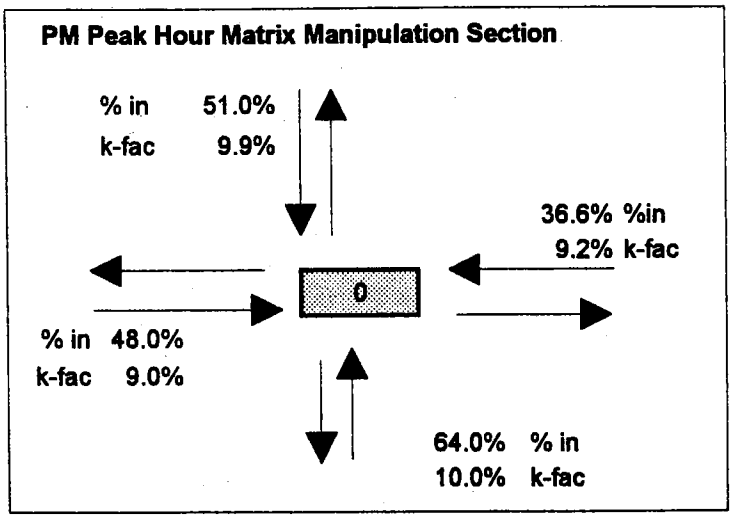


Matrix Closure for Exiting Traffic

0.0%

Matrix Closure for Entering Traffic

0.0%



Matrix Closure for Exiting Traffic

0.0%

Matrix Closure for Entering Traffic

0.0%

"Display" worksheet

As in all of these examples the % in and K factor estimates were entered into the AM and PM PEAK HOUR MATRIX MANIPULATION SECTIONS. These estimates were adjusted until the highlighted boxes equalled zero.

KENTUCKY TRANSPORTATION CABINET-DEPARTMENT OF HIGHWAYS
DIVISION OF TRANSPORTATION PLANNING

PORTABLE TRAFFIC RECORDER REPORT

ROUTE: KY1017 BOONE COUNTY STATION: Y14 N

WEEK OF FEBRUARY 24 TO MARCH 02 1997

DATE:	24	25	26	27	28	01	02	
DAY:	MON	TUE	WED	THU	FRI	SAT	SUN	TOTALS
12- 1 AM		190	180					370
1- 2 AM		90	110					200
2- 3 AM		90	80					170
3- 4 AM		70	60					130
4- 5 AM		80	70					150
5- 6 AM		190	170					360
6- 7 AM		410	420					830
7- 8 AM		850	840					1690
8- 9 AM	750	750						1500
9-10 AM	700	720						1420
10-11 AM	810	830						1640
11-12 AM	1040	1050						2090
12- 1 PM	1240	1220						2460
1- 2 PM	1170	1100						2270
2- 3 PM	1200	1120						2320
3- 4 PM	1220	1290						2510
4- 5 PM	1320	1260						2580
5- 6 PM	1390	1350						2740
6- 7 PM	1160	1210						2370
7- 8 PM	1000	970						1970
8- 9 PM	810	820						1630
9-10 PM	690	700						1390
10-11 PM	450	410						860
11-12 PM	340	360						700
TOTALS:	15290	17130	1930					34350

AVERAGE DAILY TRAFFIC: 18533

MONTHLY FACTOR: 109
AXLE FACTOR: 99
TOTAL HOURS: 48
AM HIGH HOUR: 1050 BETWEEN 11-12 AM ON TUESDAY
PM HIGH HOUR: 1390 BETWEEN 5- 6 PM ON MONDAY

MACHINE NUMBER: M26
MULTIPLE: N
ONE-WAY: N
DATA SOURCE: V

KENTUCKY TRANSPORTATION CABINET-DEPARTMENT OF HIGHWAYS
DIVISION OF TRANSPORTATION PLANNING

PORTABLE TRAFFIC RECORDER REPORT

ROUTE: KY1017 BOONE COUNTY STATION: Y14 S

WEEK OF FEBRUARY 24 TO MARCH 02 1997

DATE:	24	25	26	27	28	01	02	
DAY:	MON	TUE	WED	THU	FRI	SAT	SUN	TOTALS
12- 1 AM		100	90					190
1- 2 AM		30	30					60
2- 3 AM		50	30					80
3- 4 AM		40	30					70
4- 5 AM		60	70					130
5- 6 AM		190	180					370
6- 7 AM		480	480					960
7- 8 AM		810	650					1460
8- 9 AM	480	580						1060
9-10 AM	470	440						910
10-11 AM	540	580						1120
11-12 AM	730	710						1440
12- 1 PM	870	840						1710
1- 2 PM	760	750						1510
2- 3 PM	730	670						1400
3- 4 PM	770	760						1530
4- 5 PM	770	730						1500
5- 6 PM	790	770						1560
6- 7 PM	680	700						1380
7- 8 PM	550	540						1090
8- 9 PM	390	390						780
9-10 PM	260	290						550
10-11 PM	200	220						420
11-12 PM	160	150						310
TOTALS:	9150	10880	1560					21590

AVERAGE DAILY TRAFFIC: 11649

MONTHLY FACTOR: 109
AXLE FACTOR: 99
TOTAL HOURS: 48
AM HIGH HOUR: 810 BETWEEN 7- 8 AM ON TUESDAY
PM HIGH HOUR: 870 BETWEEN 12- 1 PM ON MONDAY

MACHINE NUMBER: P96
MULTIPLE: N
ONE-WAY: N
DATA SOURCE: V

KENTUCKY TRANSPORTATION CABINET-DEPARTMENT OF HIGHWAYS
DIVISION OF TRANSPORTATION PLANNING

PORTABLE TRAFFIC RECORDER REPORT

ROUTE: KY1017 BOONE COUNTY STATION: L98

WEEK OF FEBRUARY 24 TO MARCH 02 1997

DATE:	24	25	26	27	28	01	02	
DAY:	MON	TUE	WED	THU	FRI	SAT	SUN	TOTALS
12- 1 AM		100	100					200
1- 2 AM		40	30					70
2- 3 AM		30	30					60
3- 4 AM		50	50					100
4- 5 AM		80	90					170
5- 6 AM		220	200					420
6- 7 AM		470	460					930
7- 8 AM		610	540					1150
8- 9 AM	450	460						910
9-10 AM	410	380						790
10-11 AM	450	450						900
11-12 AM	660	680						1340
12- 1 PM	840	870						1710
1- 2 PM	720	680						1400
2- 3 PM	640	650						1290
3- 4 PM	720	700						1420
4- 5 PM	680	700						1380
5- 6 PM	720	720						1440
6- 7 PM	600	650						1250
7- 8 PM	510	540						1050
8- 9 PM	410	380						790
9-10 PM	340	320						660
10-11 PM	180	200						380
11-12 PM	170	170						340
TOTALS:	8500	10150	1500					20150

AVERAGE DAILY TRAFFIC: 10982

MONTHLY FACTOR: 109
AXLE FACTOR: 100
TOTAL HOURS: 48
AM HIGH HOUR: 680 BETWEEN 11-12 AM ON TUESDAY
PM HIGH HOUR: 870 BETWEEN 12- 1 PM ON TUESDAY

MACHINE NUMBER: M26
MULTIPLE: N
ONE-WAY: N
DATA SOURCE: V

KENTUCKY TRANSPORTATION CABINET DEPARTMENT OF HIGHWAYS
DIVISION OF TRANSPORTATION PLANNING

PORTABLE TRAFFIC RECORDER REPORT

ROUTE: KY1017 BOONE COUNTY STATION: K37 S

WEEK OF FEBRUARY 24 TO MARCH 02 1997

DATE:	24	25	26	27	28	01	02	
DAY:	MON	TUE	WED	THU	FRI	SAT	SUN	TOTALS
12- 1 AM		110	130					240
1- 2 AM		60	60					120
2- 3 AM		50	40					90
3- 4 AM		50	40					90
4- 5 AM		70	80					150
5- 6 AM		200	200					400
6- 7 AM		470	500					970
7- 8 AM		720	670					1390
8- 9 AM		470	520					990
9-10 AM		550	550					1100
10-11 AM	580	640						1220
11-12 AM	710	730						1440
12- 1 PM	860	840						1700
1- 2 PM	780	730						1510
2- 3 PM	810	690						1500
3- 4 PM	780	740						1520
4- 5 PM	850	810						1660
5- 6 PM	830	820						1650
6- 7 PM	750	760						1510
7- 8 PM	550	520						1070
8- 9 PM	400	380						780
9-10 PM	270	300						570
10-11 PM	210	220						430
11-12 PM	160	170						330
TOTALS:	8540	11100	2790					22430

AVERAGE DAILY TRAFFIC: 12102

MONTHLY FACTOR: 109
AXLE FACTOR: 99
TOTAL HOURS: 48
AM HIGH HOUR: 730 BETWEEN 11-12 AM ON TUESDAY
PM HIGH HOUR: 860 BETWEEN 12- 1 PM ON MONDAY

MACHINE NUMBER: P93
MULTIPLE: N
ONE-WAY: N
DATA SOURCE: V

KENTUCKY TRANSPORTATION CABINET-DEPARTMENT OF HIGHWAYS
DIVISION OF TRANSPORTATION PLANNING

PORTABLE TRAFFIC RECORDER REPORT

ROUTE: KY1017 BOONE COUNTY STATION: K37 N

WEEK OF FEBRUARY 24 TO MARCH 02 1997

DATE:	24	25	26	27	28	01	02	
DAY:	MON	TUE	WED	THU	FRI	SAT	SUN	TOTALS
12- 1 AM		140	160					300
1- 2 AM		60	70					130
2- 3 AM		40	50					90
3- 4 AM		50	40					90
4- 5 AM		50	50					100
5- 6 AM		120	80					200
6- 7 AM		170	180					350
7- 8 AM		540	380					920
8- 9 AM		470	450					920
9-10 AM	530	550						1080
10-11 AM	580	550						1130
11-12 AM	700	720						1420
12- 1 PM	740	800						1540
1- 2 PM	780	720						1500
2- 3 PM	810	700						1510
3- 4 PM	730	780						1510
4- 5 PM	840	790						1630
5- 6 PM	880	820						1700
6- 7 PM	710	730						1440
7- 8 PM	620	600						1220
8- 9 PM	460	500						960
9-10 PM	380	430						810
10-11 PM	280	260						540
11-12 PM	240	250						490
TOTALS:	9280	10840	1460					21580

AVERAGE DAILY TRAFFIC: 11643

MONTHLY FACTOR: 109
AXLE FACTOR: 99
TOTAL HOURS: 48
AM HIGH HOUR: 720 BETWEEN 11-12 AM ON TUESDAY
PM HIGH HOUR: 880 BETWEEN 5- 6 PM ON MONDAY

MACHINE NUMBER: P94
MULTIPLE: N
ONE-WAY: N
DATA SOURCE: V

KENTUCKY TRANSPORTATION CABINET DEPARTMENT OF HIGHWAYS
DIVISION OF TRANSPORTATION PLANNING

PORTABLE TRAFFIC RECORDER REPORT

ROUTE: KY842 BOONE COUNTY STATION: L80 E

WEEK OF FEBRUARY 24 TO MARCH 02 1997

DATE:	24	25	26	27	28	01	02	
DAY:	MON	TUE	WED	THU	FRI	SAT	SUN	TOTALS
12- 1 AM		80	70					150
1- 2 AM		20	20					40
2- 3 AM		20	20					40
3- 4 AM		10	10					20
4- 5 AM		20	30					50
5- 6 AM		50	50					100
6- 7 AM		180	180					360
7- 8 AM		460	340					800
8- 9 AM	290	340						630
9-10 AM	280	260						540
10-11 AM	350	330						680
11-12 AM	460	400						860
12- 1 PM	570	560						1130
1- 2 PM	540	500						1040
2- 3 PM	510	510						1020
3- 4 PM	530	510						1040
4- 5 PM	500	510						1010
5- 6 PM	580	560						1140
6- 7 PM	520	510						1030
7- 8 PM	430	410						840
8- 9 PM	300	310						610
9-10 PM	220	230						450
10-11 PM	150	140						290
11-12 PM	100	110						210
TOTALS:	6330	7030	720					14080

AVERAGE DAILY TRAFFIC: 7597

MONTHLY FACTOR: 109
AXLE FACTOR: 99
TOTAL HOURS: 48
AM HIGH HOUR: 460 BETWEEN 11-12 AM ON MONDAY
PM HIGH HOUR: 580 BETWEEN 5- 6 PM ON MONDAY

MACHINE NUMBER: P91
MULTIPLE: N
ONE-WAY: N
DATA SOURCE: V

KENTUCKY TRANSPORTATION CABINET DEPARTMENT OF HIGHWAYS
DIVISION OF TRANSPORTATION PLANNING

PORTABLE TRAFFIC RECORDER REPORT

ROUTE: KY842 BOONE COUNTY STATION: L80 W

WEEK OF FEBRUARY 24 TO MARCH 02 1997

DATE:	24	25	26	27	28	01	02	
DAY:	MON	TUE	WED	THU	FRI	SAT	SUN	TOTALS
12- 1 AM		120	100					220
1- 2 AM		50	50					100
2- 3 AM		40	30					70
3- 4 AM		20	20					40
4- 5 AM		30	20					50
5- 6 AM		50	50					100
6- 7 AM		110	110					220
7- 8 AM		280	270					550
8- 9 AM	230	250						480
9-10 AM	310	290						600
10-11 AM	360	350						710
11-12 AM	470	420						890
12- 1 PM	550	530						1080
1- 2 PM	550	520						1070
2- 3 PM	580	490						1070
3- 4 PM	560	550						1110
4- 5 PM	600	570						1170
5- 6 PM	650	620						1270
6- 7 PM	550	550						1100
7- 8 PM	450	460						910
8- 9 PM	320	340						660
9-10 PM	260	260						520
10-11 PM	190	190						380
11-12 PM	150	140						290
TOTALS:	6780	7230	650					14660

AVERAGE DAILY TRAFFIC: 7910

MONTHLY FACTOR: 109
AXLE FACTOR: 99
TOTAL HOURS: 48
AM HIGH HOUR: 470 BETWEEN 11-12 AM ON MONDAY
PM HIGH HOUR: 650 BETWEEN 5- 6 PM ON MONDAY

MACHINE NUMBER: T60
MULTIPLE: N
ONE-WAY: N
DATA SOURCE: V

Turning Movement Estimation Guidelines

Appendix 2

Factors

Appendix 2
Contents

This appendix contains information concerning k-factors, directional factors, growth factors, and peak hour factors. This information is primarily derived from the Cabinet's 65 automatic traffic recorder (ATRs) which gather traffic information continuously.

The first section is an excerpt of a memorandum transmitting data for the Cabinet's annual Highway Performance Monitoring System submittal to the Federal Highway Administration which goes through the Highway Information Systems Section of the Division of Transportation Planning. The excerpt contains:

Functional class k-factors
Functional class directional factors
Functional class growth rates

It should be noted that these are averages and should be used only in the absence of more site specific data.

The second section is an excerpt from the 1996 Traffic Characteristics Report which was published by the Division of Transportation Planning. The excerpt contains:

ATR k-factors
ATR peak hour factors

This data is an excellent source of data to be used for traffic forecasting since ATR data contains the only true traffic volumes. Traffic volumes from other sources are only estimates of traffic.

JAMES C. CODELL, III
SECRETARY OF TRANSPORTATION

T. KEVIN FLANERY
DEPUTY SECRETARY

COMMONWEALTH OF KENTUCKY
TRANSPORTATION CABINET
FRANKFORT, KENTUCKY 40622

PAUL E. PATTON
GOVERNOR

INTRA-DEPARTMENTAL MEMO

TO: Greg Witt, Manager
Highway Information Systems Section

FROM: Rob Bostrom, Manager Rob Bostrom
Traffic Section

DATE: April 17, 1997

SUBJECT: 1997 HPMS Traffic Data Submittal

This is to document the data submitted to you via computer files and written reports. We are providing the following data to you:

1. 1996 ADTs: This data was collected at 1,543 non-local HPMS stations and 431 local HPMS stations. This includes 142 directional interstate stations (includes rest areas) and 66 ATRs. Some data smoothing and estimating was necessary and is explained on the attached interstate adjustment summary. All of the finalized ADTs are present on the mainframe computer in the April 17, 1997 version of the TVS file and are also shown in the Interstate Database Summary 1992 -1996. The ATR monthly summary is provided in the attached "Blackbook" printout.

2. 1996 Classification Counts: This data was collected at 116 HPMS stations. Included in this total are 25 interstate stations, 43 ATRs, and 30 WIM stations. The finalized VCR data is available on the mainframe computer in the April 17, 1997 version of the VCR file. We are also providing you with the annual Travel Activity by Vehicle Type and Functional Classes.

3. Traffic Factors: Directional factors are provided by functional class which should be used for all of the sample sections excepting the 345 classification stations. K-factors are provided by functional class in the attached list. Twenty-year (1996-2016) growth rates are provided by functional class.

If you have any questions or comments. let me know.

NRB

Attachments:
(1) K-Factor Summary
(2) Directional Factor Summary
(3) 20-year Growth Factors
(4) Travel Activity Summary
(5) Interstates 1996 - Adjustments and Comments
(6) Interstate Database Summary 1992-1996
(7) ATR Blackbook

c: Barry House
Bruce Siria

1996 K-FACTORS FOR ATR FUNCTIONAL CLASSES

FC = 1	Rural Interstate	11.2
FC = 2	Rural Principal Arterial	11.6
FC = 6	Rural Minor Arterial	12.5
FC = 7	Rural Major Collector	12.3
FC = 8	Rural Minor Collector	11.2
FC = 11	Urban Interstate	10.7
FC = 12	Urban Other Freeway	11.2
FC = 14	Urban Principal Arterial	10.2
FC = 16	Urban Minor Arterial	9.9
FC = 17	Urban Collector	13.2

1996 ATR DIRECTIONAL PERCENTAGES

FC=1	Rural Interstate	41.7% 58.3%	100.0%
FC=2	Rural Principal Arterial	42.3% 57.7%	100.0%
FC=6	Rural Minor Arterial	42.5% 57.5%	100.0%
FC=7	Rural Major Collector	42.0% 58.0%	100.0%
FC=8	Rural Minor Collector	45.9% 54.1%	100.0%
FC=11	Urban Interstate	41.4% 58.6%	100.0%
FC=12	Urban Other Freeway	41.6% 58.4%	100.0%
FC=14	Urban Principal Arterial	40.1% 59.9%	100.0%
FC=16	Urban Minor Arterial	41.4% 58.6%	100.0%
FC=17	Urban Collector	38.9% 61.1%	100.0%

Statewide Growth Rates (20-year Multipliers)
by
Functional Class

Functional Class	*20-year Multiplier*	*Source*
1	1.529	CTS/ATR
2	1.554	CTS/ATR
6	1.332	CTS/ATR
7	1.523	CTS/ATR
8	1.651	CTS/ATR
9	1.390	CTS/Everything
11	1.604	TLA/ATR
12	1.488	CTS/HPMS
14	1.370	CTS/HPMS
16	1.372	CTS/HPMS
17	1.451	CTS/HPMS
19	1.598	CTS/HPMS

Notes:

1. CTS/ATR is based on ATR stations with the growth rates calculated by the CTS 20-year extrapolation program. This is the preferred source of growth rates but is not used where the ATR data is sparse.

2. CTS/Everything is based on all local count stations in the state of Kentucky with the growth rates calculated by the CTS 20-year extrapolation program.

3. TLA/ATR is based on ATR stations with the growth rates calculated by trend line analysis program run on each ATR and averaged. This seemed to be more reliable than the CTS extrapolation in some instances due to its sensitivity to recent growth as exhibited by urban interstates.

4. CTS/HPMS is based on HPMS count stations with the growth rates calculated by the CTS 20-year extrapolation program.

5. In general, the growth rates were chosen that minimized the change from the 1994 20-year growth rates. For example the multiplier used for functional class 11 in 1994 was 1.830 and the CTS/HPMS yielded an average value of 1.488. The TLA estimate of 1.604 was used since it was a more moderate change from the 1994 estimate.

6. All growth rates represent the average of the multipliers calculated for individual stations within a functional class.

TABLE 2A
KENTUCKY TRANSPORTATION CABINET - DIVISION OF TRANSPORTATION PLANNING
AUTOMATIC TRAFFIC RECORDER INVENTORY

STATION NUMBER	COUNTY	ROUTE NUMBER OR NAME	MILEPOINT	DESCRIPTION	FC	TYPE_DATA
1	FRANKLIN	US 60	0.000	AT SHELBY COUNTY LINE AND 0.5 MILES SOUTH OF KY 151	07	VOLUME/CLASS
2	JEFFERSON	KY 1699	1.510	IN LOUISVILLE URBAN AREA 0.4 MILES SOUTH OF KY 146	17	VOLUME/CLASS
3	FRANKLIN	COLLINS LANE	0.000	IN FRANKFORT JUST WEST OF KY 676 (EAST-WEST CONNECTOR)	17	VOLUME
5	ROCKCASTLE	US 25	11.727	SOUTH OF MT. VERNON, 0.1 MI SOUTH OF SOUTHERN I 75 INTERCHANGE	07	VOLUME
6	WOLFE	KY 15	11.680	WEST OF CAMPTON AND 2 MILES WEST OF KY 15 SPUR	07	VOLUME
7	HARDIN	US 31W	29.589	IN RADCLIFF AND 2.4 MILES NORTH OF KY 144	14	VOLUME/CLASS
8	GRAYSON	US 62	12.096	EAST OF CANEYVILLE AND 3.4 MILES EAST OF KY 79	07	VOLUME/CLASS
10	GRAVES	US 45	6.200	SOUTH OF WINGO AND 1.2 MILES SOUTH OF KY 339	07	VOLUME
12	PIKE	US 23	38.140	NORTH OF PIKEVILLE, 2.4 MILES SOUTH OF FLOYD COUNTY LINE	02	VOLUME
13	CARTER	US 60	20.029	WEST OF GRAYSON AND 4.1 MILES WEST OF KY 7	07	VOLUME
14	JEFFERSON	KY 1142	1.400	IN LOUISVILLE URBAN AREA JUST WEST OF NEW CUT ROAD	16	VOLUME
15	UNION	US 60	4.188	SOUTH OF STURGIS AND 1.4 MILES SOUTH OF KY 365	06	VOLUME
16	GRANT	US 25	17.464	NORTH OF DRY RIDGE AND 2.2 MILES NORTH OF KY 22	07	VOLUME
17	DAVIESS	BYPASS 60	6.083	.2 MI. W. OF US231	12	VOLUME/CLASS
18	HARLAN	US 119	10.026	WEST OF HARLAN AND 4.2 MILES OF US 421	02	VOLUME/CLASS
19	SHELBY	OLD ZARING ROAD	0.000	SOUTH OF SHELBYVILLE AND 2.7 MILES SOUTH OF US 60	08	VOLUME
21	JEFFERSON	US 31E	14.635	IN LOUISVILLE AND 0.1 MILES NORTH OF US 60S (EASTERN PARKWAY)	14	VOLUME
22	SHELBY	I 64	36.000	EAST OF SHELBYVILLE AND 0.9 MILES EAST OF KY 53 INTERCHANGE	01	VOLUME/CLASS
23	GRANT	I 75	164.193	SOUTH OF CRITTENDEN AND 1.8 MILES SOUTH OF KY 491	01	VOLUME/CLASS
24	MARION	US 68	9.744	IN LEBANON AND 1.0 MILES EAST OF KY 55	14	VOLUME
25	MERCER	US 127	2.236	SOUTH OF HARRODSBURG AND 2.1 MILES SOUTH OF US 68	02	VOLUME
26	BOURBON	US 68	4.183	NORTH OF PARIS AND 1.4 MILES NORTH OF US 68 BYPASS	02	VOLUME
27	PENDLETON	US 27	5.731	SOUTH OF FALMOUTH AND 2.4 MILES SOUTH OF KY 72	06	VOLUME
28	TRIMBLE	US 42	10.049	EAST OF BEDFORD AND 1.8 MILES EAST OF US 421	07	VOLUME
29	MENIFEE	US 460	4.955	WEST OF FRENCHBURG AND 3.8 MILES WEST OF KY 36	06	VOLUME
30	ESTILL	KY 52	19.081	EAST OF RAVENNA AND 0.4 MILES SOUTH OF KY 1571	07	VOLUME
31	BELL	US 25E	19.035	NORTH OF PINEVILLE AND 1.0 MILES NORTH OF KY 92	02	VOLUME
32	PULASKI	US 27	5.734	SOUTH OF BURNSIDE AND 4.0 MILES SOUTH OF KY 90	02	VOLUME/CLASS
33	RUSSELL	US 127	6.429	SOUTH OF JAMESTOWN AND 1.7 MILES SOUTH OF KY 55	06	VOLUME
34	ADAIR	KY 80	20.058	EAST OF COLUMBIA AND 7.7 MILES EAST OF KY 55	07	VOLUME
35	HANCOCK	US 60	12.578	EAST OF HAWESVILLE AND 1.1 MILES EAST OF KY 69	02	VOLUME
36	OHIO	KY 54	9.558	EAST OF FORDSVILLE AND 1.0 MILES EAST OF KY 261	07	VOLUME
37	BUTLER	US 231	16.086	NORTH OF MORGANTOWN AND 2.8 MILES NORTH OF KY 79	07	VOLUME
38	LOGAN	US 68	2.574	WEST OF RUSSELLVILLE AND 0.2 MILES WEST OF KY 1151	02	VOLUME
39	MARSHALL	US 641	18.236	1.2 MILES SOUTH OF US 62	06	VOLUME
41	ELLIOTT	KY 7	11.373	NORTH OF SANDY HOOK 0.1 MILES SOUTH OF KY 32	06	VOLUME
42	BOYD	US 23	0.100	SOUTH OF ASHLAND AND 0.1 MILES NORTH OF LAWRENCE COUNTY LINE	02	VOLUME
43	FLOYD	KY 1428	10.600	EAST OF PRESTONSBURG AND 2.1 MILES EAST OF KY 3	08	VOLUME
45	WARREN	12TH AVENUE	0.000	12TH AVE IN BOWLING GREEN BETWEEN KENTON ST & FAIRGROUNDS ALLEY	16	VOLUME
46	ROCKCASTLE	I 75	50.770	SOUTH OF MT. VERNON AND 8.2 MILES SOUTH OF KY 25 AT LAUREL CO.	01	VOLUME/CLASS
47	CARTER	I 64	170.857	WEST OF GRAYSON AND 0.2 MILES WEST OF KY 1	01	VOLUME/CLASS
48	HENRY	I 71	34.560	IN HENRY COUNTY AND 0.7 MILES NORTH OF US 421	01	VOLUME/CLASS
49	KENTON	KY 371	3.170	IN COVINGTON-NEWPORT URBAN AREA, 0.2 MILES NORTH OF I 75	16	VOLUME
50	HARDIN	I 65	89.178	SOUTH OF ELIZABETHTOWN AND 2.0 MILES SOUTH OF WEST KY PKWY	01	VOLUME
51	LYON	I 24	37.300	WEST OF EDDYVILLE AND 2.2 MILES WEST OF US 62	01	VOLUME/CLASS

STATION NUMBER	COUNTY	ROUTE NUMBER OR NAME	MILEPOINT	DESCRIPTION	FC	TYPE_DATA
52	LEWIS	KY 546	15.100	BETWEEN VANCEBURG AND CLARKSBURG (2.53 MI. EAST OF KY 989)	02	VOLUME/CLASS
53	WOODFORD	TR 9002	69.600	1.5 MILES WEST OF US 60 IN WOODFORD COUNTY	02	VOLUME/CLASS
60	WOODFORD	US 60	0.000	WOODFORD/FRANKLIN COUNTY LINE	02	VOLUME/CLASS
70	PIKE	US 119	2.300	US 119 IN PIKE COUNTY, EAST OF US 23	02	VOLUME/CLASS
71	BARREN	TR 9008	10.100	CUMBERLAND PARKWAY IN BARREN CO., WEST OF GLASGOW	02	VOLUME/CLASS
72	BULLITT	I 65	106.500	I 65 IN BULLITT CO., NORTH OF LEBANON JUNCTION	01	VOLUME/CLASS/PERMANENT WEIGHT
73	OWSLEY	KY 11	13.300	NORTHWEST OF BOONEVILLE	07	VOLUME/CLASS
74	FAYETTE	I 64	73.800	I 64 IN FAYETTE COUNTY, WEST OF LEXINGTON	11	VOLUME/CLASS/PERMANENT WEIGHT
75	FAYETTE	KY 4	3.500	BETWEEN US 60 AND US 68	12	VOLUME
76	LAUREL	DB PARKWAY	9.200	DANIEL BOONE PARKWAY IN LAUREL COUNTY, UNDER KY 1305 OVERPASS	02	VOLUME/CLASS/PERMANENT WEIGHT
77	LAWRENCE	US 23	5.600	US 23 IN LAWRENCE COUNTY, 0.5 MILE NORTH OF KY 645	02	VOLUME/CLASS/PERMANENT WEIGHT
84	JEFFERSON	KY 61	0.100	AT BULLITT COUNTY LINE AND 0.2 MILES SOUTH OF MUD LANE	14	VOLUME
90	FAYETTE	I 75	100.500	NEAR CLAY'S FERRY EXIT	01	VOLUME
91	SIMPSON	I 65	2.048	BETWEEN US31W AND KY100	01	VOLUME
92	JEFFERSON	I 64	2.600	BETWEEN US150 AND I 264	11	VOLUME
93	KENTON	I 75	188.000	NEAR KYLES LANE	11	VOLUME
94	JEFFERSON	I 264	15.000	BETWEEN NEWBURG AND BARDSTOWN ROAD	11	VOLUME
96	CAMPBELL	I 471	1.900	BETWEEN US 127 AND I 275	11	VOLUME
97	CAMPBELL	I 275	76.400	AT KY 1996 OVERPASS BETWEEN KY 546 AND I 471	11	VOLUME
98	JEFFERSON	I 265	16.134	IN LOUISVILLE URBAN AREA AT THE JOHNSON SCHOOL RD OVERPASS	11	VOLUME/CLASS
99	JEFFERSON	I 65	133.414	IN LOUISVILLE URBAN AREA JUST NORTH OF BRANDIES OVERPASS	11	VOLUME/CLASS

TABLE 2B
AUTOMATIC TRAFFIC RECORDER INVENTORY
ADTs, GROWTH RATES, 30TH HIGHEST HOURS, AND PEAK HOUR FACTORS

STATION NUMBER	COUNTY	ROUTE	1995 AADT	1996 AADT	ANNUAL % GROWTH '95 - '96	1995 % 30TH HIGHEST HOUR	1996 % 30TH HIGHEST HOUR	AM PEAK HOUR FACTOR	PM PEAK HOUR FACTOR
1	FRANKLIN	US 60	4102	4226	3.02	12.7	12.5	0.85	0.85
2	JEFFERSON	KY 1699	5202	5483	5.40	12.1	12.6	0.82	0.78
3	FRANKLIN	COLLINS LANE	5075	4733	-6.74	13.0	12.9	0.73	0.89
5	ROCKCASTLE	US 25	3815	3819	0.10	10.2	10.5	0.68	0.93
6	WOLFE	KY 15	1286	1194	-7.15	11.1	10.9	0.83	0.83
7	HARDIN	US 31W	24615	23138	-6.00	10.1	10.3	0.91	0.90
8	GRAYSON	US 62	2058	2086	1.36	11.1	11.2	0.90	0.79
10	GRAVES	US 45	1674	1652	-1.31	10.6	10.6	0.78	0.80
12	PIKE	US 23	19732	19562	-0.86	10.1	10.2	0.87	0.97
13	CARTER	US 60	2487	2555	2.73	11.0	10.7	0.78	0.85
14	JEFFERSON	KY 1142	12232	12174	-0.47	9.6	9.6	0.98	0.93
15	UNION	US 60	3104	3068	-1.16	10.2	10.3	0.85	0.74
16	GRANT	US 25	5756	5780	0.42	11.5	10.6	0.78	0.85
17	DAVIESS	BYPASS 60	24925	24570	-1.42	10.3	10.4	0.78	0.87
18	HARLAN	US 119	9727	9355	-3.82	11.9	9.9	0.91	0.92
19	SHELBY	OLD ZARING ROAD	999	1064	6.51	11.2	11.5	0.73	0.75
21	JEFFERSON	US 31E	23698	23721	0.10	8.5	8.5	0.93	0.89
22	SHELBY	I 64	31658	31950	0.92	10.6	10.7	0.96	0.92
23	GRANT	I 75	37745	38500	2.00	11.5	11.6	0.91	0.99
24	MARION	US 68	10006	9814	-1.92	11.2	11.3	0.81	0.88
25	MERCER	US 127	14786	14856	0.47	10.6	10.6	0.91	0.94
26	BOURBON	US 68	7430	7535	1.41	11.1	10.8	0.89	0.86
27	PENDLETON	US 27	3982	3776	-5.17	9.9	10.0	0.85	0.75
28	TRIMBLE	US 42	1532	1663	8.55	12.7	11.5	0.85	0.87
29	MENIFEE	US 460	2884	3067	6.35	10.2	10.0	0.91	0.92
30	ESTILL	KY 52	1246	1248	0.16	12.0	12.2	0.87	0.78
31	BELL	US 25E	8411	8908	5.91	11.0	10.6	0.91	0.84
32	PULASKI	US 27	6405	6277	-2.00	14.7	13.7	0.92	0.93
33	RUSSELL	US 127	2473	2497	0.97	16.4	17.4	0.72	0.59
34	ADAIR	KY 80	3243	3285	1.30	10.9	10.7	0.90	0.80
35	HANCOCK	US 60	4283	4430	3.43	11.5	15.7	0.86	0.68
36	OHIO	KY 54	1189	1166	-1.93	12.2	12.3	0.84	0.67
37	BUTLER	US 231	2537	2464	-2.88	14.7	13.6	0.80	0.75
38	LOGAN	US 68	2735	2777	1.54	11.4	11.6	0.86	0.90
39	MARSHALL	US 641	5546	5284	-4.72	15.4	14.9	0.91	0.69
41	ELLIOTT	KY 7	2515	2503	-0.48	10.5	10.3	0.68	0.86
42	BOYD	US 23	9077	8805	-3.00	12.0	10.2	0.90	0.92
43	FLOYD	KY 1428	2717	2740	0.85	10.4	10.4	0.75	0.86
45	WARREN	12TH AVENUE	11905	11941	0.30	9.4	9.3	0.99	0.95
46	ROCKCASTLE	I 75	31531	31216	-1.00	12.5	12.1	0.96	0.97

STATION NUMBER	COUNTY	ROUTE	1995 AADT	1996 AADT	ANNUAL % GROWTH '95 - '96	1995 % 30TH HIGHEST HOUR	1996 % 30TH HIGHEST HOUR	AM PEAK HOUR FACTOR	PM PEAK HOUR FACTOR
47	CARTER	I 64	13039	13999	7.36	10.9	10.7	0.91	0.96
48	HENRY	I 71	22309	23424	5.00	10.5	9.8	0.94	0.96
49	KENTON	KY 371	31921	32498	1.81	10.2	10.4	0.94	0.96
50	HARDIN	I 65	35234	37520	6.49	10.7	10.4	0.95	0.98
51	LYON	I 24	20234	20028	-1.02	11.3	11.0	0.93	0.95
52	LEWIS	KY 546	4133	4545	9.97	10.9	10.3	0.71	0.69
53	WOODFORD	TR 9002	14153	14085	-0.48	11.6	11.4	0.92	0.90
60	WOODFORD	US 60	14857	15451	4.00		12.0	0.87	0.91
70	PIKE	US 119	5180	5286	2.05	12.9	11.1	0.90	0.96
71	BARREN	TR 9008	6320	5550	-12.18	12.4	18.1	0.86	0.86
72	BULLITT	I 65	39606	40800	3.01	10.8	8.7	0.00	0.00
73	OWSLEY	KY 11	3170	3320	4.73	14.9	5.9	0.61	0.85
74	FAYETTE	I 64	26500	26900	1.51	12.3			
75	FAYETTE	KY 4	47142	49499	5.00	11.6	11.5	0.83	0.93
76 *	LAUREL	DB PARKWAY	7310	7010	-4.10				
77 **	LAWRENCE	US 23	7940	8250	3.90				
84	JEFFERSON	KY 61	18578	19693	6.00	10.0	9.8	0.78	0.89
90	FAYETTE	I 75	48704	51280	5.29	10.2	10.1	0.91	0.96
91	SIMPSON	I 65	32458	32322	-0.42	10.5	10.8	0.96	0.89
92	JEFFERSON	I 64	54427	57266	5.22	10.6	11.2	0.80	0.85
93	KENTON	I 75	123318	135650	10.00	8.9	9.3	0.95	0.92
94	JEFFERSON	I 264	132697	139332	5.00	10.4	10.1	0.77	0.90
96	CAMPBELL	I 471	82445	83269	1.00	17.9	10.3	0.92	0.96
97	CAMPBELL	I 275	59848	60446	1.00	10.8	10.6	0.95	0.91
98	JEFFERSON	I 265	48563	47592	-2.00	10.9	11.3	0.90	0.90
99	JEFFERSON	I 65	121410	125052	3.00	9.1	9.3	0.93	0.92

* High Hours and Peak Factors are not available for this site.

** This station was installed as an ATR in 1996; therefore, we are using an estimate for the 1995 ADT for comparison purposes. High Hours and Peak Factors are not available for this site.

Turning Movement Estimation Guidelines

Appendix 3

Manual Turning Movement Estimation Techniques

Appendix 3
Contents

This appendix contains methods for calculating turning movements at three leg and four leg intersections respectively. This information comes from the Florida Department of Transportation Design Traffic Manual.

Calculating three leg turning movements can be done precisely if three accurate traffic volume counts are available at each leg of the intersection. This method is widely used since it is so simple.

Calculating four leg turning movements is more difficult. As mentioned in the Tools section of the report, four leg turning movements can be derived if traffic volume counts are available at six of the twelve movements. The Florida method uses an approximation method of determining the turning movements.

Appendix E

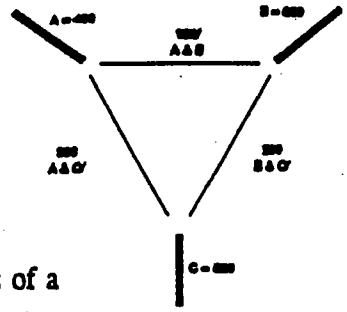
EXAMPLE OF DISTRICT TWO MANUAL METHOD

A simple calculation technique for obtaining balanced turning movement volumes from approach volumes at three-legged and four-legged intersections.

E.1 Calculation of Turns at "T" or "Y" Intersection from End Volumes

Given: Two-way ADT on each leg of a "T" of "Y" intersection

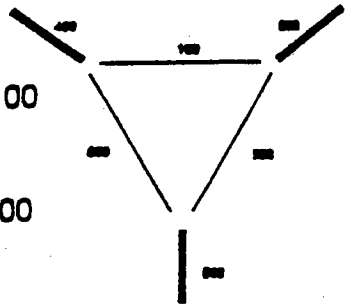
A=400, B=300, C=500



Round all volumes: Current years to nearest 20, future years to nearest 200
(This example assumes current year)

Rule: To find the two-way volume moving between two legs of a three-legged intersection, add the two-way volumes on the two legs concerned and subtract the two-way volume on the third leg, then divide by 2.

Find: Two-way turning volumes



$$\text{between A \& B} = \frac{A + B - C}{2} = \frac{400 + 300 - 500}{2} = 100$$

$$\text{between B \& C} = \frac{B + C - A}{2} = \frac{300 + 500 - 400}{2} = 200$$

$$\text{between A \& C} = \frac{A + C - B}{2} = \frac{400 + 500 - 300}{2} = 300$$

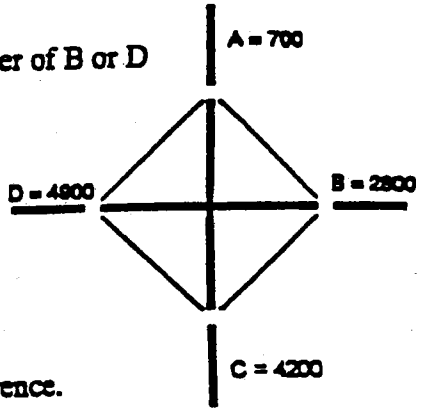
E.2 Approximation of Turns from End Volumes

Given: Two-way ADT on each leg of a four-legged intersection

Find: The two-way turn and through ADT between A&B, A&C, A&D, B&C, B&D, C&D

Round all volumes: Current years to nearest 20, future years to nearest 200
(This example assumes current year)

1. From the larger of A or C subtract the smaller of A or C
   4200 – 700 = 3500
2. From the larger of B or D subtract the smaller of B or D
   4900 – 2800 = 2100
3. From the larger difference subtract the smaller difference, Divide the remainder by 2;
   3500 – 2100 = 1400
   1400 / 2 = 700
   This is the first diagonal-turn-volume-difference.



4. From the larger difference subtract the last calculated value.

   3500 – 700 = 2800

   This remainder is the second diagonal-turn-volume-difference.

5. Position the last two calculated diagonal-turn-volume-differences so that the original end volumes are satisfied if the two other turning movements are zero.

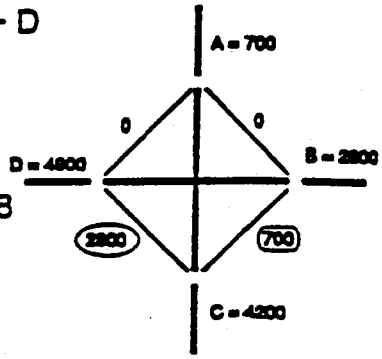
6. Approximate the turns which were above taken as zero by prorating the smaller end volume to the other three legs.

   A is smallest = 700, so base = B + C + D

   = 2800 + 4200 + 4900 = 11900

   Proration constant for "A"

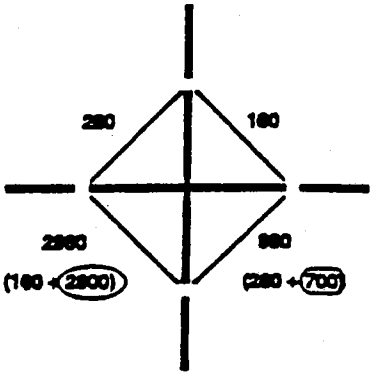
   $$K_A = \frac{A}{B + C + D} = \frac{700}{11{,}900} = 0.0588$$



   Turns between A & B = K_A x B
   = 0.0588 x 2800 = 164
   (20 round) → 160

   Turns between A & D = K_A x D
   = 0.0588 x 4900 = 288
   (20 round) → 280

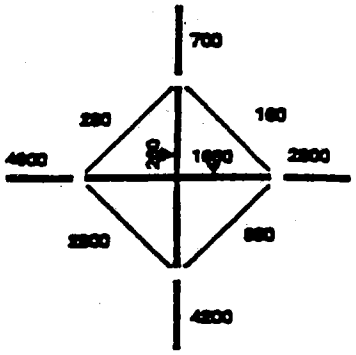
7. To the approximated minor turns add the opposite diagonal-turn-volume-difference to obtain the remaining turn volumes.



   280 + 700 = 980

   160 + 2800 = 2960

8. From the end volumes subtract the turn volumes to obtain the through volumes.



   700 – 280 – 160 = 260

   2800 – 160 – 980 = 1660