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TRUCK UTILIZATION OF THE I-45N CONTRAFLOW LANE

IN HOUSTON

A Feasibility Study

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May 1979

ABSTRACT

This report was to document the gathering of truck movement data on the North Freeway (I-45N) in Houston, Texas, primarily to determine the potential for trucks to use the proposed North Freeway contraflow lane. However, the final result of the study was the compilation of detailed traffic flow data concerning all traffic using the North Freeway.

The data collection methods included interviews with major truck terminal operators, and both a.m. and p.m. peak-period data collection (using time-lapse photography) at two locations on the freeway.

While the data might provide a useful base for evaluating other urban transportation problems such as the need for separate truck lanes, the evaluation concluded that few trucks would choose to utilize the proposed contraflow lane.

Key words: Contraflow Lane, Traffic Characteristics, Time-Lapse Photography, Truck Counts

SUMMARY

This report provides documentation of a special study of traffic on the North Freeway (I-45) in Houston primarily for the purpose of determining the potential use of the contraflow lane by trucks. The evaluation concluded that although capacity in the lane would be available, very few trucks would choose to utilize the lane. Furthermore, improved safety (related to the objective of keeping an oncoming vehicle in view in the lane at all times) can only be achieved if virtually all trucks using the facility during peak hours were to use the contraflow lane. Finally if all trucks were diverted to the contraflow lane, little benefit would accrue to general traffic through their removal from the normal peak-period lanes. The conclusion was, therefore, that trucks not be considered as potential users of the I-45N contraflow lane.

A result of the study was the compilation of detailed traffic flow data concerning all traffic using the North Freeway. These data are included in this report for general information, and those data may form a basis for further studies concerning the need for exclusive truck lanes. Data include traffic volumes, traffic speeds, vehicle occupancy, and classification counts.

IMPLEMENTATION STATEMENT

The thrust of this project has been to assist the Department in the planning and implementation for high-occupancy vehicle improvements. This report is the result of a request for special assistance in evaluating certain aspects of the I-45N contraflow lane.

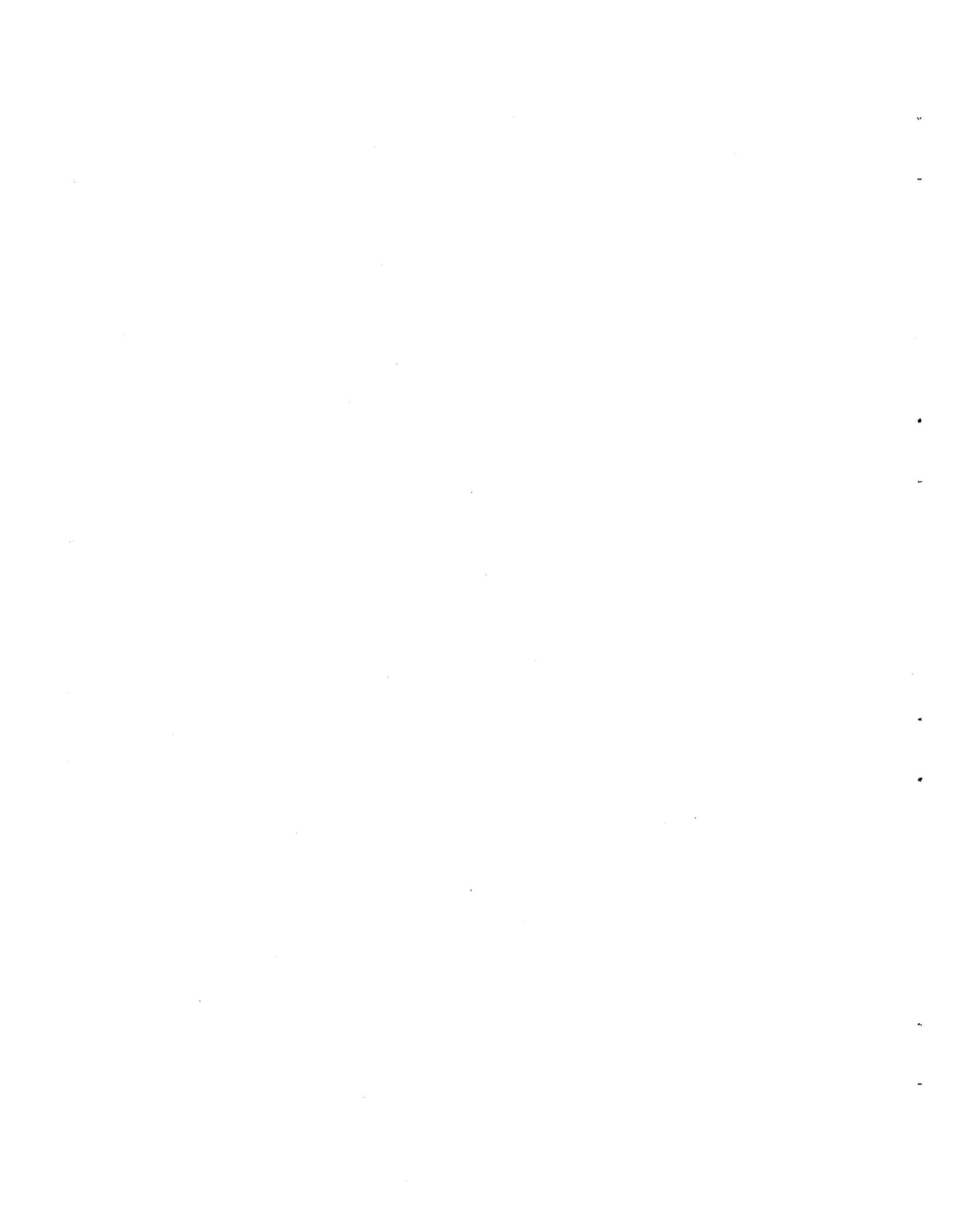
The Department recognized that the capacity of the contraflow lane would not be fully utilized by buses. As a result, the possibility of allowing other users to operate in the lane was considered. This report evaluates the feasibility and desirability of allowing trucks to use the contraflow lane. Data collected have been used in policy decisions concerning the operation of the I-45N contraflow lane.

DISCLAIMER

The contents of this report reflect the views of the authors who are responsible for the opinions, findings, and conclusions presented herein. The contents do not necessarily reflect the official views or policies of the Federal Highway Administration. This report does not constitute a standard, specification, or regulation.

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INTRODUCTION

The feasibility of operating a contraflow lane for buses on the North Freeway (I-45) in Houston has been evaluated by the State Department of Highways and Public Transportation as well as by other concerned agencies. The concept appeared sufficiently attractive to justify implementation, and detailed designs were developed. Although the volume of buses expected to use the contraflow lane (approximately 40 buses per hour) is marginally sufficient to justify implementation from a people-movement standpoint, a flow rate of only 40 vehicles per hour might give the appearance of underutilization of the preferential lane. Concern about possible adverse public reaction to the apparent underutilization of the contraflow lane stimulated an evaluation of other potential users.

A list of possible other users of the contraflow lane was identified which included the following: carpools, vanpools, taxicabs, emergency vehicles, and trucks. Of these, at the outset trucks seemed to be a promising user group because of the following considerations.

1. Truck drivers are professional drivers, and they should be more responsive to the rigid operational controls necessary for the contraflow lane.
2. Trucks and buses have similar acceleration and braking characteristics.
3. Trucks, being large vehicles would be highly visible in the contraflow lane. This is a significant safety consideration--especially if the combined flow rate of trucks and buses would be sufficient to keep an on-coming contraflow vehicle in sight of opposing traffic at all times.
4. Removal of large trucks from the congested mixed-flow lanes might provide a significant improvement to normal operations.

In view of the foregoing considerations, a special study was initiated by Texas Transportation Institute to evaluate the suitability of trucks as

additional users of contraflow lane on the North Freeway in Houston. This report presents the results of that study.

The study of trucking activity on the North Freeway included interviews with major truck terminal operators as well as peak-period data collection (using time-lapse photography) at two locations (Figure 1) on the freeway. An evaluation of these data is presented in one section of this report. The data collected using photography provide interesting insights into peak-period freeway operation at the two study locations. These data are presented in another section of this report in order to provide information concerning the "Before" conditions for future contraflow lane analyses. That data might also provide a useful base for evaluating other urban transportation problems such as the need for separate truck lanes.

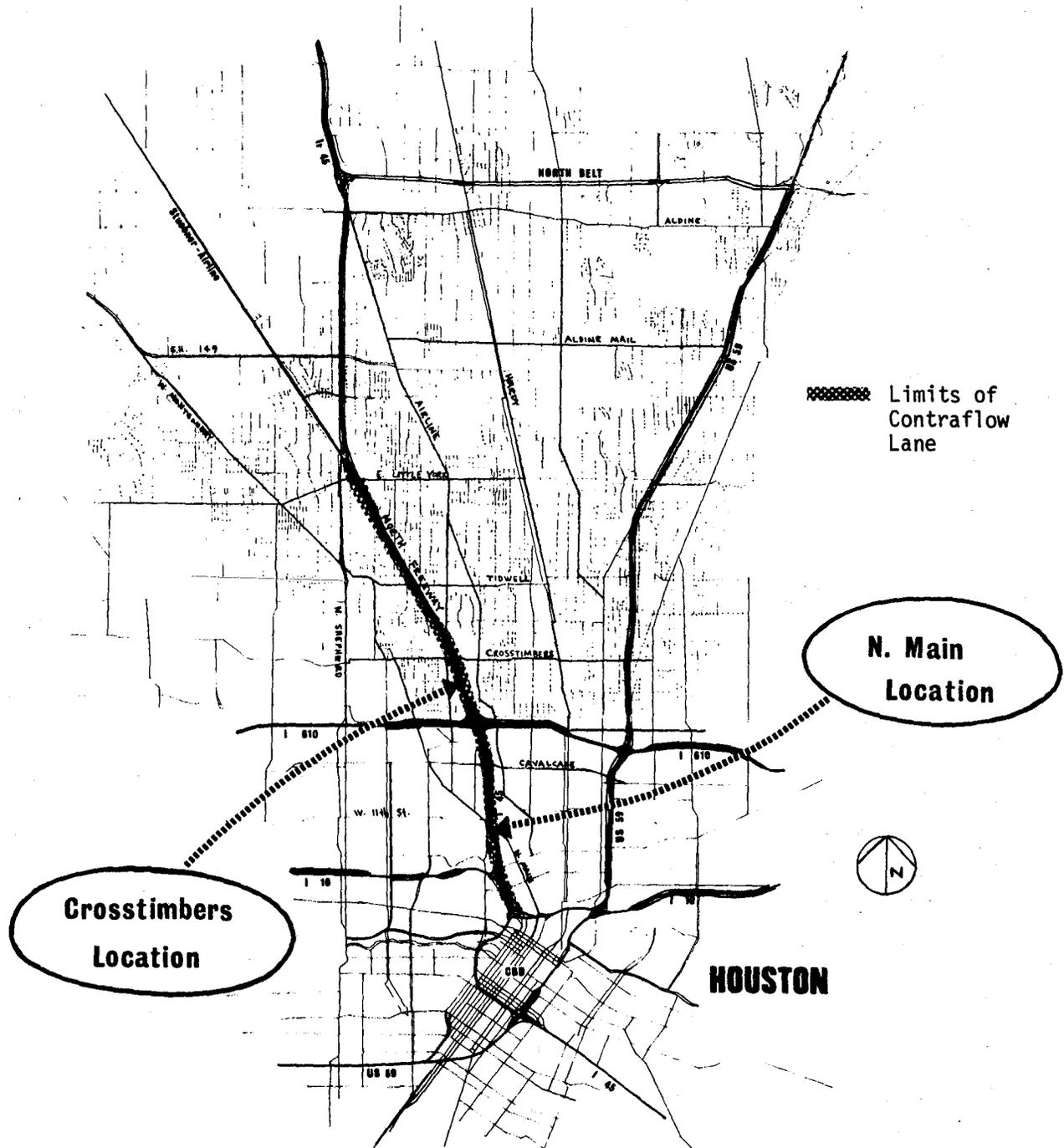


Figure 1: Locations At Which Data Were Collected for this Special Study



EVALUATION OF THE SUITABILITY OF INCLUDING TRUCK OPERATIONS

ON THE I-45N CONTRAFLOW LANE

Interviews With Trucking Firms

The nature of trucking activity and the magnitude of trucking movements were two issues which needed to be studied for assessing potential inclusion of trucks in a contraflow operation. The first step in this study was a series of personal interviews with the managers of nine major truck terminals in Houston. The primary purpose for these interviews was to determine if the contraflow lane would be of significant benefit to the major trucking firms. It was also hoped that data collected at the terminals could provide an indication of the number of trucks operating on the North Freeway.

Interviews were conducted on the basis of the magnitude of the operation and/or the relative proximity of carrier terminals to the North Freeway. The companies interviewed included large common carriers as well as one large private carrier.

The results of these interviews provided basic knowledge of the nature of carrier origins and destinations along the North Freeway. (Note: see Appendix A for more detailed information obtained in these interviews.) Major findings are summarized below.

- Few carriers were found to be operating intercity traffic on I-45 between downtown and the outermost extremities of the corridor during peak hours.
- None of the terminal managers who were contacted used tractor-trailer vehicles for downtown deliveries.
- A significant number of common carriers entered or left I-45N at the I-610 interchange.
- All terminals operating within the corridor were obviously traveling North Freeway only to the extent that it permitted improved accessibility to their terminals. Some rather large common carrier operations, including Yellow and Central Freight Lines, interchanged to and from I-45N at intersections other than I-610.

None of these trucking firms interviewed would be able to effectively utilize the contraflow lanes without additional entry and exit points to/from the lane.

Another significant point that became evident in these interviews was that much of the truck traffic on I-45N occurs at night rather than during peak traffic periods. Those carriers that operate between Houston and Dallas schedule virtually all of those runs between 8 p.m. and 4 a.m. in order to provide overnight delivery of goods. Hence, the volume of truck traffic on I-45N during peak periods may be lower than expected.

Truck Data

The second step in this study was to collect data pertaining to peak-period traffic operations at two locations along the North Freeway (Figure 1). Data gathering techniques during these surveys included time-lapse photography and tape recorded documentation of observed truck traffic. Each of these techniques has its own advantages and disadvantages. Counts of trucks taken from the two sources do not precisely correlate, and no attempt was made in this study to resolve the discrepancies. Rather, when data are presented herein, the source of the data is noted.

A major finding was that the percentage of large vehicles in the peak-period traffic stream is rather low. Data extracted from the time-lapse film, presented in Table 1, show that trucks and buses combined constitute only about 4% of the total traffic. Indeed, the large tractor-trailer trucks that often seem so numerous, constitute only about 2% of the total traffic stream inside Loop I-610 and less than 3% of the total traffic outside the Loop.

Typical hourly flow rates for trucks are shown in Table 2. The distribution of these truck volumes over the peak period appears to be reasonably uniform as indicated in Figures 2 and 3.

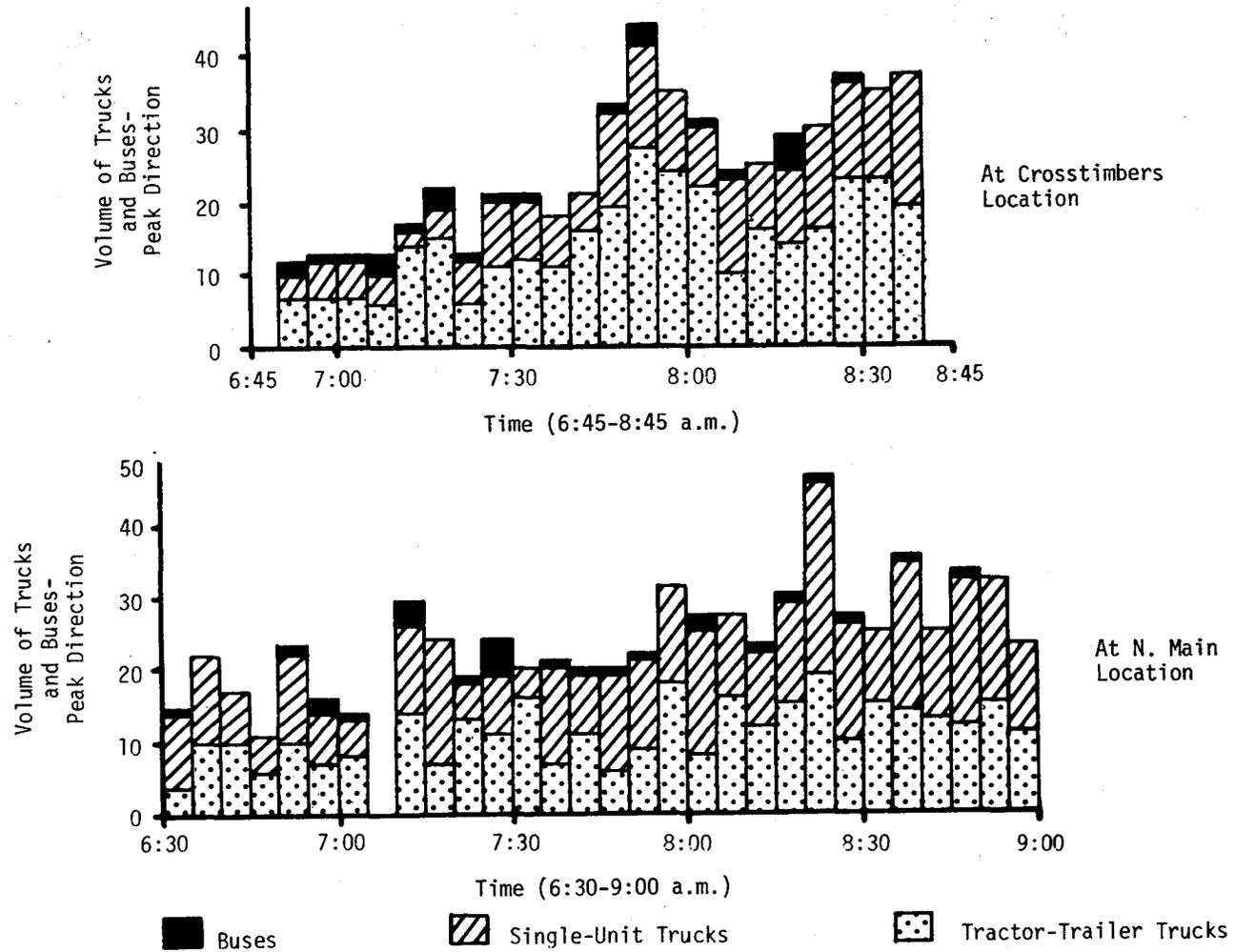
Table 1 - Classification Counts In Peak Direction
On I-45N In Houston
(From Time-Lapse Film)

Classification	Location, Direction and Time			
	North Main		Crosstimbers	
	Northbound 3:30- 6:30 p.m. Tuesday May 31	Southbound 6:30- 9:00 a.m. Wednesday June 1	Northbound 3:30- 6:30 p.m. Wednesday June 1	Southbound 6:45- 8:45 a.m. Thursday June 2
Passenger Vehicles	16,176	17,166	18,270	13,038
Single Unit Trucks	385	350	299	212
Tractor-Trailers	320	344	398	353
Buses	39	28	24	27
Total Vehicles	16,920	17,888	18,991	13,630
Percent Trucks and Buses	4.4	4.0	3.8	4.3

Note: Passenger vehicle volumes are based on expansion of 5-minute counts every 15 minutes.

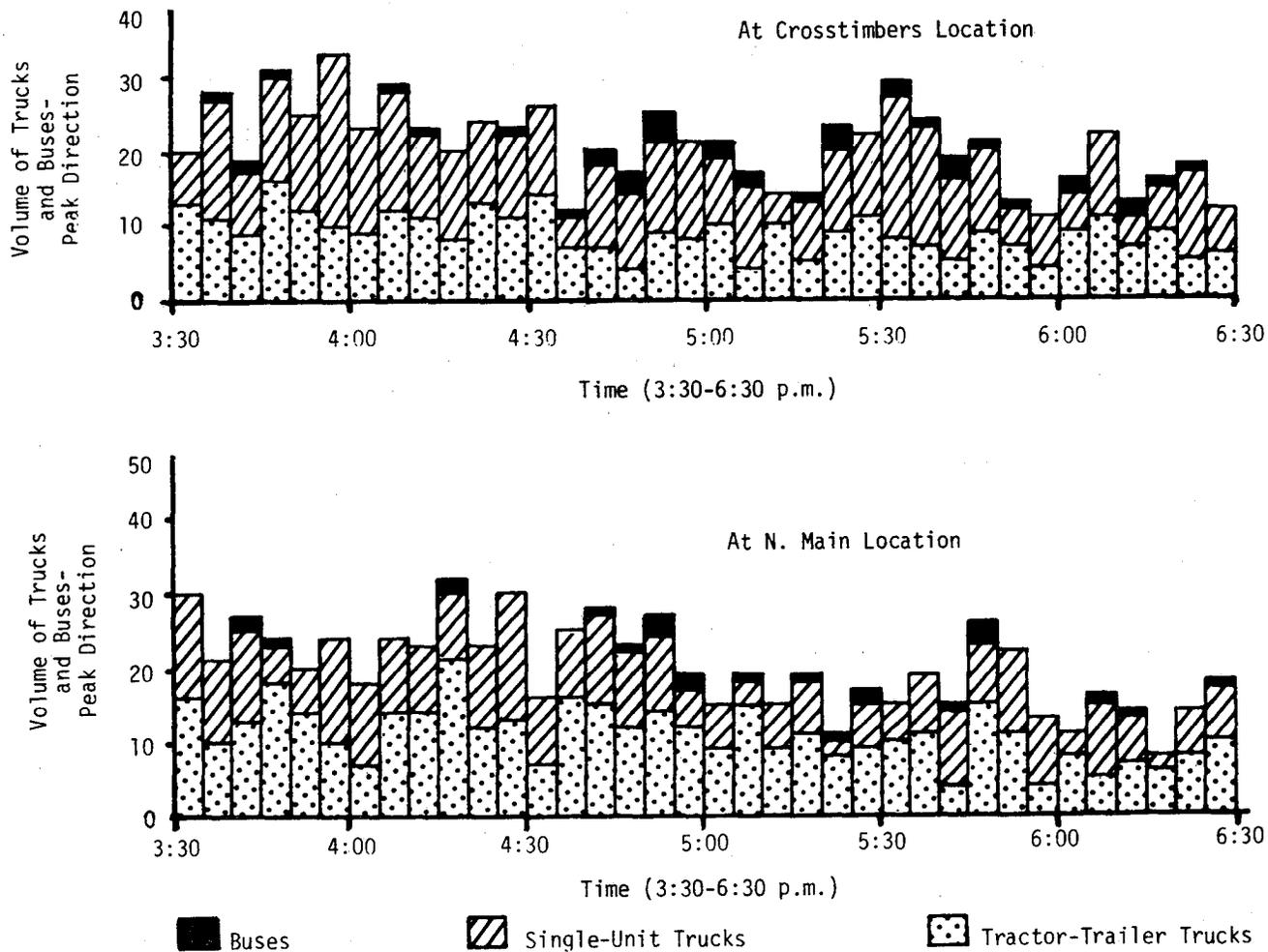
Table 2 - Typical Hourly Flow Rates for Trucks During Peak Periods
(From Time-Lapse Film)

Vehicle Type	North Main		Crosstimbers	
	a.m.	p.m.	a.m.	p.m.
Tractor-Trailers	112	86	146	120
Single-Unit Trucks	154	135	124	120
Total	266	221	270	240



Source: TTI Time-Lapse Photographs

Figure 2: Observed Truck and Bus Flow Rates During Morning Peak Period, 5-Minute Counts



Source: TTI Time-Lapse Photographs

Figure 3: Observed Truck and Bus Flow Rates During Afternoon Peak Period, 5-Minute Counts

The information that was recorded on tape by observers at the survey locations included the number of axles and the type of trucks as well as the firm's name and a description of the cargo (when such information was apparent to the observer). A detailed transcript of the tape recordings from the Crosstimbers location is included in Appendix B. A summary of information recorded concerning truck size, type, and company is presented in Table 3.

Approximately half of the trucks observed near Crosstimbers were tractor-trailer units apparently involved in intercity goods movement. The percentage of trucks that appeared to be involved in urban pick-up and delivery was almost twice as high inside the Loop (at N. Main) as outside (at Crosstimbers). Work trucks (tree-trimming trucks, welding trucks, sign trucks, and concrete haulers as well as 2- and 3-axle flatbeds) constituted about one-fourth of the total truck traffic at both locations.

Central Freight Lines' terminal was located very close to the N. Main location during the time of the survey; hence, their vehicles comprised about 20% of the truck traffic at that location. At Crosstimbers location, no one trucking firm accounted for more than 8% of the total truck traffic.

Other special categories of trucks that might be of special interest to the contraflow lane evaluation were counted at the Crosstimbers location (Table 4). All gasoline trucks, liquid carriers, and chemical haulers were assumed to be potential carriers of hazardous cargo which would presumably not be allowed to use the contraflow lane. The other two categories were identified because they represent traffic going to specific areas of Houston--the port on the east side and tree trimming trucks probably destined for the west side. Potential port traffic was assumed to include all grain trucks, auto carriers, and Sea-Land vehicles as well as 25% of all 5-axle flatbeds. It is interesting to note that no one special category accounts for more than 8% of total truck traffic.

Table 3 - Distributions of Trucks by Size and Type
(from tape transcript)

Classification	North Main		Crosstimbers	
	A.M. (2½ hours)	P.M. (3 hours)	A.M. (2 hours)	P.M. (3 hours)
<u>Size</u>				
2 axle	39%	45%	25%	35%
3 axle	17%	15%	19%	17%
4 axle	4%	3%	6%	8%
5 axle	<u>40%</u>	<u>37%</u>	<u>50%</u>	<u>40%</u>
	100%	100%	100%	100%
<u>Type</u>				
City P&D	24%	30%	12%	17%
Work Truck	26%	21%	25%	26%
Dump Truck	4%	7%	5%	5%
Tractor-Trailer Rigs	42%	39%	54%	50%
Tractor Only	<u>4%</u>	<u>3%</u>	<u>4%</u>	<u>2%</u>
	100%	100%	100%	100%
<u>Company</u>				
Central Freight	19%	20%	3%	0%
Yellow Freight	3%	5%	5%	8%
Other	<u>78%</u>	<u>75%</u>	<u>92%</u>	<u>92%</u>
	100%	100%	100%	100%
Total Trucks Recorded	668	666	533	725

Table 4 - Special Categories of Trucks Observed
at the Crosstimbers Location
(from tape transcripts)

Category	Percent of Truck Traffic	
	a.m.	p.m.
Apparent Hazardous Cargo	5	5
Apparent Port Traffic	3	8
Tree Trimming Trucks	8	7

Questions Addressed

As a part of the evaluation process in determining the suitability of trucks using the contraflow lane, the following questions were addressed.

1. Does the contraflow lane have the capacity to accommodate trucks as well as buses?
2. How much effective capacity would be provided to the mixed-flow lanes by the removal of trucks from those lanes?
3. Can the safety related objective of keeping an on-coming contraflow vehicle in sight at all times be achieved through the inclusion of trucks?
4. Will the contraflow lane, as now envisioned, be attractive to truckers? If not, what design changes would be needed to make it attractive?
5. Can truck use of the contraflow lane be managed safely and effectively?

The following paragraphs present information related to each of these questions.

Capacity of the Contraflow Lane

The Highway Capacity Manual (1965, p. 345) cites a value of 940 buses per hour as the capacity of a bus-only lane having a capacity of 1500 passenger cars per hour. The lane capacity reduction is the result of one bus being the equivalent of 1.6 cars. The equivalency for trucks (Highway Capacity Manual, 1965, p. 258) is 2.0 cars per truck, or 750 trucks per hour for a facility with a 1500 passenger car per hour capacity. Truck counts on the North Freeway

showed a typical hourly flow rate of 270 trucks per hour. Hence, all of the trucks currently using the North Freeway could be accommodated in the contraflow lane, and there would still be sufficient capacity for more than 500 buses per hour. Obviously, vehicular capacity of the contraflow lane is not a constraining factor in this evaluation.

Each truck removed from the mixed-flow lanes will make room for 2 automobiles. The removal of all trucks would leave capacity for about 540 more automobiles per hour--less than half of the capacity of a single lane. By way of comparison, if 100 buses per hour were filled with riders, they would replace some 4000 automobiles (assuming 50 persons per bus and 1.25 persons per automobile)--the auto capacity of approximately two freeway lanes.

Safety Objectives

Although contraflow lanes in use elsewhere in the nation have established excellent safety records, it seems that a worthwhile safety objective would be to have enough traffic in the contraflow lane to ensure that an oncoming contraflow vehicle would be in sight of mixed-flow traffic at all times. Assuming an average sight distance for large vehicles of 2000 feet (600 m) and assuming speeds of 50 mph (80 kph) in each lane, then the available sight time for each vehicle is about 14 seconds. If an average variation in headways (time between vehicles) is assumed to be $\pm 25\%$, then the desired average headway for contraflow vehicles would be 11 seconds--a flow rate of 330 vehicles per hour. Thus it appears that this objective could possibly be achieved if all trucks, other than those carrying hazardous cargo, were assigned to the contraflow lane and at least 80 buses per hour also used the lane.

Truck Travel Patterns

The contraflow lane, as presently designed, includes a mid-point crossover opportunity at Loop 610; however, this crossover does not permit contraflow traffic to interchange with I-610. The lane terminates in the CBD and at Stuebner-Airline Road. The composition of truck traffic observed at the two survey locations indicates a strong affinity for Loop I-610. As the contraflow lane is presently designed, it does not appear to be an attractive option for more than 10% of the trucks. A direct interchange opportunity with Loop I-610 as well as access to I-10 on the south end would make it attractive to a much larger share of the trucks; however, an interchange with Loop I-610 would be prohibitively expensive--if it is even possible. Access opportunities to I-10, on the other hand, could be accomplished safely and at reasonable expense. Even if these access opportunities were provided, however, probably fewer than 25% of the trucks would voluntarily use the contraflow lane.

Management Considerations

At the outset of this study, it was hoped that a significant portion of the truck traffic on North Freeway might be represented by a few large trucking firms. If so, then driver training programs concerning use of the contraflow lane could be conducted working through the trucking firms involved. This does not appear to be the case, however, because the top ten firms identified at Crosstimbers represent only a combined total of about 15% of the trucks. Indeed, more than 200 different firm names were identified on the trucks passing Crosstimbers, and about half of the trucks had no name visible to the observer. Hence, information concerning truck-use of the contraflow lane might have to be communicated to truckers through the use of highway signs rather than training programs if a

significant portion of the truck traffic is to use the contraflow lane. In short, it appears questionable whether this operation could be managed safely and effectively.

Conclusions and Recommendation

This evaluation of the suitability of trucks using the contraflow lane led to the following conclusions.

1. Vehicular capacity of the contraflow lane is more than adequate to accommodate trucks.
2. Very few truckers would, however, want to use the contraflow lane unless additional entrance/exit opportunities are provided--at tremendous expense.
3. The safety related objective of keeping an oncoming contraflow vehicle in sight at all times can only be achieved if virtually all trucks are using the contraflow lane.
4. The potential for significant increases in peak-hour direction productivity of the freeway is much greater with buses than with trucks.

Based upon the foregoing conclusions, it is recommended that trucks be eliminated from further consideration as potential users of the contraflow lane.

1977 TRAFFIC CHARACTERISTICS ON
NORTH FREEWAY (I-45N)

Aside from data needed to evaluate the trucking issue on the contraflow project, data were extracted from the time-lapse films that yield a reasonably complete profile of overall traffic operations during the survey periods. Time-lapse film was analysed to determine speeds and volumes for each 15-minute increment throughout the peak periods (See Appendix C for description of analysis methodology). During the filming, some rather sketchy occupancy surveys were taken from vantage points immediately adjacent to the main lanes. The results of these data, while limited, are representative of typical traffic characteristics on the North Freeway prior to implementation of the contraflow project. Thus, it may be used as a measure of "before" conditions for later comparison.

Presentation of traffic characteristics is divided according to survey locations and peak periods. This section also presents a history of peak hour directional distribution that has been recorded for more than ten years prior to implementation of the contraflow project, and compares the information to directional distributions observed in this survey.

N. Main--6:30-9:00 a.m.

The morning survey at N. Main was conducted on Wednesday, June 1, 1977. The weather was warm and clear. No incidents were observed within the immediate vicinity of this site which would have significantly influenced traffic behavior. Traffic operations prior to 6:30 a.m. appeared heavy in the peak direction (about level-of-service C), but without significant speed reductions. Until sunrise at 6:45 a.m., about half of the passing drivers were using headlights.

During the 2.5 hour survey, about 18,000 inbound vehicles were observed representing an hourly flow rate of 1800 vehicles per lane. In Table 5, trucks

are shown to be about 4 percent of the total vehicular volume; buses represented less than 0.2 percent.

Table 5: Peak Direction Traffic Volumes at N. Main (6:30 - 9:00 a.m.)

Start Time	Cumulative Counts for Each 15 Minutes				
	Estimated Passenger Vehicles ¹	Single Unit Trucks	Tractor-Trailer Trucks	Buses	Total Vehicles
6:30	1962	29	24	1	2016
6:45	1959	24	23	3	2009
7:00	1863	25 ²	33 ²	6 ²	1927
7:15	1875	30	31	6	1942
7:30	1716	19	40	2	1777
7:45	1698	38	33	2	1771
8:00	1773	38	36	3	1850
8:15	1776	56	44	3	1879
8:30	1254	42	42	1	1339
8:45	<u>1290</u>	<u>49</u>	<u>38</u>	<u>1</u>	<u>1378</u>
Total	17,166	350	344	28	17,888

¹Based upon 5-minute count expanded for 15-minutes

²Volumes estimated from 10-minute count

While a major interchange at I-10 involving left- and right-hand exit ramps is located only one mile (1.6 km) downstream of this point, weaving maneuvers did not seem to influence traffic flow. Trucks of all types appeared equally distributed in travel lanes. Buses, apparently destined to the CBD via the Louisiana Street left-hand exit, were most often observed in the inner-most two lanes. A detailed distribution of the types of buses which passed the survey site is included in Table 6.

Travel speeds for each direction freeway lane at N. Main were calculated from analysis of the time-lapse film (see Appendix C for a description of the analytical technique). These calculated speeds are shown in Table 7. This

Table 6: Bus Counts at N. Main
(6:30 - 9:00 a.m.)

Start Time	Cumulative counts for each 15-minute period				
	Houtran-City Bus	Air Coach-Airport Shuttle	Commuter	Other	Total
6:30	1	-	-	-	1
6:45	1	1	-	1	3
7:00*	1	-	3	2	6
7:15	1	3	2	-	6
7:30	1	-	1	-	2
7:45	-	1	-	1	2
8:00	1	1	-	1	3
8:15	1	-	1	1	3
8:30	-	-	-	1	1
8:45	<u>1</u>	<u>-</u>	<u>-</u>	<u>-</u>	<u>1</u>
Total	8	6	7	7	28

*Three minute gap in film; tape recording documents only one Houtran bus in the gap.

location appeared to experience a minimal amount of speed reductions. During the 2.5 hour peak period, travel speeds seldom dropped below 45 mph (72 kph). After 8:15 a.m. restricted flow that had been noticed periodically before 8 a.m. improved, and speeds remained above 50 mph (80 kph). Speed differentials between lanes do not appear to follow any definite pattern.

A single 25-minute survey of auto occupancy in the right-hand lane was taken between 8:05 and 8:30 a.m. This count showed 589 one-occupant vehicles, 99 two-occupant vehicles, and 14 three-or-more occupant vehicles. These three categories reflect 84% one-occupant, 14% two-occupant and 2% three-or-more occupant vehicles. If an assumption is made that three-or-more vehicles carry an average of 3.5 persons, the average automobile occupancy noted at this point was 1.2. This average, however, may not be a valid reflection of CBD-bound commuters, since the right lane further south becomes an exit for traffic westbound on I-10.

Table 7: Calculated Traffic Speeds at N. Main
(Inbound 6:30 - 9:00 a.m.)

Start Time	Outside Lane 1	Lane 2	Lane 3	Inside Lane 4	Average for All Lanes
6:30	66	57	62	58	61
6:35	51	57	52	48	52
6:40	56	52	48	48	51
6:45	56	57	52	48	53
6:50	56	52	48	48	51
6:55	56	57	52	52	54
7:00	48	48	52	58	52
7:05*	--	--	--	--	--
7:10	48	48	44	48	47
7:15	51	52	48	44	49
7:20	42	48	48	52	48
7:25	42	40	52	48	46
7:30	40	48	52	44	46
7:35	40	45	41	38	41
7:40	33	38	41	41	38
7:45	38	28	19	23	27
7:50	42	52	44	48	47
7:55	34	42	39	44	40
8:00	27	25	31	32	29
8:05	38	39	36	44	39
8:10	56	52	48	64	55
8:15	48	45	48	58	50
8:20	48	52	52	48	50
8:25	51	48	44	64	52
8:30	56	62	52	58	57
8:35	51	62	56	64	58
8:40	55	62	62	58	59
8:45	51	57	69	64	60
8:50	60	62	56	64	60
8:55	<u>55</u>	<u>48</u>	<u>69</u>	<u>72</u>	<u>61</u>
Average for Peak Period	48	49	49	51	49

*Inadequate data attributable to film gap

Note: Speeds listed are in mph; to convert to kph, multiple by 1.6.

N. Main--3:30-6:30 p.m.

Afternoon peak-period traffic was monitored on Tuesday, May 31, from the earthen embankment overlooking the outbound traffic lanes. The weather was hot and clear. No accidents or unusual occurrences were noted which might have influenced traffic operations. At 3:30 p.m., traffic volumes were varying from levels-of-service A through C.

The highest outbound traffic volumes were recorded between 3:30 and 4:00 p.m. (Table 8). Hourly flows were commonly 1,600 vehicles per lane, but most averages were lower than volumes recorded in the morning peak at this location. The total number of single-unit and tractor-trailer trucks counted constituted four percent of the total flow. Many trucks observed at this location were destined for the Central Freight Lines regional terminal on Patton Street, less than a mile farther north. A total of 39 buses passed the survey point, representing 0.2 percent of the total estimated vehicle flow. Table 9 presents cumulative 15-minute counts of various types of buses observed.

A listing of calculated travel speeds by lane is shown in Table 10 for this site. Average speeds ranged between 50 and 64 mph (80-103 kph) throughout the three hours except for the 30-minute period following 5 p.m. Traffic congestion during this time had backed up from the I-610 interchange, several miles north into the survey vicinity, causing speeds to sharply decline to an average of 18 mph at 5:15 p.m. The right-hand lane apparently experienced the most significant speed reductions. No auto occupancy surveys were recorded.

Crosstimbers--6:45-8:45 a.m.

A vantage point from a motel balcony located about 1800 feet (540 m) south of Crosstimbers was employed to record morning peak-period operation on Thursday, June 2. The weather was clear and warm. One major incident upstream, however, apparently altered traffic flow between 7:15 and 7:45 a.m. Immediately north

Table 8: Peak Direction Traffic Volumes at N. Main
(3:30 - 6:30 p.m.)

Start Time	Estimated* Passenger Vehicles	Single Unit Trucks	Tractor-Trailer Trucks	Buses	Total Vehicles
3:30	1584	31	33	3	1651
3:45	1563	50	38	1	1652
4:00	1509	41	32	2	1584
4:15	1449	34	32	1	1516
4:30	1464	27	28	3	1522
4:45	1467	35	21	7	1530
5:00	1467	24	24	4	1519
5:15	1296	30	25	4	1355
5:30	1245	46	20	6	1317
5:45	1077	23	20	2	1122
6:00	1008	20	27	4	1059
6:15	1047	24	20	2	1093
	<u>16,176</u>	<u>385</u>	<u>320</u>	<u>39</u>	<u>16,920</u>

*Based upon 5-minute count expanded to 15 minutes

Table 9: Bus Counts at N. Main
(3:30 - 6:30 p.m.)

Start Time	Cumulative Counts for Each 15-Minute Period				
	HouTran-City Bus	Air Coach-Airport Shuttle	Commuter	Other	Total
3:30	-	2	-	1	3
3:45	1	-	-	-	1
4:00	1	1	-	-	2
4:15	1	-	-	-	1
4:30	-	2	-	1	3
4:45	2	1	3	1	7
5:00	2	-	1	1	4
5:15	1	1	2	-	4
5:30	2	2	-	2	6
5:45	1	-	1	-	2
6:00	1	1	1	1	4
6:15	1	1	-	-	2
	<u>13</u>	<u>11</u>	<u>8</u>	<u>7</u>	<u>39</u>

Table 10: Calculated Traffic Speeds at N. Main
(outbound, 3:30 - 6:30 p.m.)

Start Time	Outside Lane 1	Lane 2	Lane 3	Inside Lane 4	Average for All Lanes
3:30	52	58	63	77	63
3:35	47	65	63	68	61
3:40	52	65	63	77	64
3:45	52	58	63	68	60
3:50	52	58	70	68	62
3:55	52	65	56	68	60
4:00	47	58	56	56	54
4:05	47	43	56	56	51
4:10	51	47	70	56	56
4:15	59	58	70	56	61
4:20	59	58	63	77	64
4:25	52	58	63	61	59
4:30	52	47	70	61	58
4:35	52	58	63	77	63
4:40	59	58	70	68	64
4:45	52	52	63	77	61
4:50	47	47	51	56	50
4:55	47	58	70	61	59
5:00	47	47	51	68	53
5:05	36	52	51	56	49
5:10	23	27	40	38	32
5:15	13	14	22	24	18
5:20	15	26	35	44	30
5:25	19	29	31	34	28
5:30	36	47	47	56	47
5:35	47	52	56	61	54
5:40	59	65	63	56	61
5:45	52	58	63	56	57
5:50	59	52	63	51	56
5:55	47	47	56	61	53
6:00	59	65	56	61	60
6:05	59	58	63	61	60
6:10	59	58	70	61	62
6:15	59	65	56	61	60
6:20	59	65	56	68	62
6:25	<u>59</u>	<u>52</u>	<u>63</u>	<u>56</u>	<u>58</u>
Average	48	52	58	60	55

Note: Speeds listed are in mph; to convert to kph, multiply by 1.6.

of the Airline Road intersection, a tree trimming truck, either stalled or involved in an accident, resulted in the blockage of at least one of the three main inbound lanes. Some vehicles diverted to a continuous frontage road and bypassed the segment of through lanes being monitored near Crosstimbers. Thus, some fluctuations appearing on volume and speed records are attributable to this event.

Prior to 6:45 a.m., travel conditions just south of this vantage point were going into forced-flow approaching the I-610 interchange. Just to the north, levels-of-service C and D were observed. A fourth main lane is added just upstream of the survey site, and it is not continuous through the I-610 interchange. Thus, the outside lane was subject to extensive weaving and lower volume.

The camera vantage point at this location allowed the extraction of the traffic volume data for both directions. Morning peak direction flow was highest at the beginning of the survey, as evidenced in Table 11, when a flow rate equivalent to 1900 vehicles per hour in each direction was recorded. As levels-of-service deteriorated, volumes also experienced some reductions. Off-peak flows began climbing at the start of the survey period and continued to increase through 7:45 a.m. Directional splits varied from 61 percent during the period of restricted flow to 67 percent on either end of the peak period. Trucks and buses were 4.5 percent of peak-direct on traffic. A distribution of buses seen at this site is included in Table 12.

Calculated travel speeds for each lane, as the vehicles crossed the Crosstimbers overpass, are shown in Table 13. At 6:05 a.m., average speeds were 36 mph (50 kph), but by 7:15 a.m. had dropped below 20 mph (32 kph). Restricted flow upstream apparently increased travel speeds temporarily between 7:30 and 7:45 a.m. Speeds following this incident again declined and remained below 25 mph (40 kph) until about 8:15 a.m.

Table 11: Traffic Volumes at Crosstimbers
(6:45 - 8:45 a.m.)

Start Time	PEAK DIRECTION (southbound)						OFF-PEAK DIRECTION (northbound)			
	Cumulative Counts Each 15-Minutes						Cumulative Counts Each 15 minutes ¹			
	Estimated ¹ Passenger Vehicles	Single- Unit Trucks	Tractor- Trailer Trucks	Buses	Total Vehicles	Percent Distribution in Peak Direction	Passengers Vehicles	Single- Unit Trucks	Tractor- Trailer Trucks or Buses	Total Vehicles
6:45	1,863	12 ²	21 ²	4 ²	1,900	67	870	27 ²	21 ²	918
7:00	1,785	11	27	5	1,828	66	873	30	36	939
7:15	1,590	19	32	5	1,646	63	927	36	24	987
7:30	1,476	20	39	1	1,536	61	909	39	27	975
7:45	1,650	38	70	4	1,762	63	1,008	27	9	1,044
8:00	1,464	30	48	2	1,544	66	723	60	30	813
8:15	1,662	37	53	6	1,758	67	777	36	57	870
8:30	<u>1,548</u>	<u>45²</u>	<u>63²</u>	<u>0²</u>	<u>1,656</u>	67	<u>744</u>	<u>54</u>	<u>36</u>	<u>834</u>
Totals	13,038	212	353	27	13,630	N/A	6,831	309	240	7,380

¹Based upon 5-minute count expanded to 15 minutes.

²Volumes estimated from 10-minute count.

Table 12: Bus Counts at Crosstimbers
(6:45 - 8:45 a.m.)

Start Time	Cumulative Counts for Each 15-minute Period				
	Houtran-City Bus	Air Coach-Airport Shuttle	Commuter	Other	Total
6:45*	-	1	1	2	4
7:00	1	2	1	1	5
7:15	-	1	3	1	5
7:30	-	-	1	-	1
7:45	-	2	1	1	4
8:00	-	-	-	2	2
8:15	-	2	1	3	6
8:30*	-	-	-	-	-
	<u>1</u>	<u>8</u>	<u>8</u>	<u>10</u>	<u>27</u>

*Incomplete count periods.

A random sampling of inbound vehicles in the two right-hand lanes at the HB&T railroad overpass yielded the occupancy counts shown in Table 14. In the total canvass of over 1500 vehicles, (excluding large tractor-trailer trucks), 78 percent of the total were one-occupant, 18 percent were two-occupant, and 4 percent carried 3-or-more occupants. No buses were observed during any of the counts. Again, an assumption regarding 3-or-more vehicles is made that they carried an average 3.5 persons, the resulting average occupancy observed would be about 1.3 persons per vehicle.

Crosstimbers--3:30-6:30 p.m.

From the same vantage point on Wednesday, June 1, afternoon documentation was undertaken. Both peak and off-peak directions were again recorded on film. The weather was partly cloudy and hot. No unusual traffic incidents were observed.

Peak and off-peak traffic volumes are presented in Table 15. Vehicle counts in both directions are highest immediately following the 3:30 p.m.

Table 13: Calculated Traffic Speeds at Crosstimbers
(6:50 - 8:45 a.m.)

Start Time	Outside Lane 1	Lane 2	Lane 3	Inside Lane 4	Average for All Lanes
6:50	38	36	30	39	36
6:55	31	26	26	27	28
7:00	29	25	21	18	23
7:05	27	23	19	19	22
7:10	20	18	20	21	20
7:15	23	14	18	25	20
7:20	19	11	11	14	14
7:25	14	10	17	18	15
7:30	19	18	29	35	25
7:35	47	45	43	51	47
7:40	49	56	60	59	56
7:45	41	41	40	53	44
7:50	40	40	43	51	44
7:55	41	38	43	46	42
8:00	36	27	28	25	29
8:05	23	19	19	22	21
8:10	18	16	17	24	19
8:15	28	30	22	19	25
8:20	38	34	37	39	37
8:25	42	38	42	40	41
8:30	47	47	49	48	48
8:35	47	41	47	53	47
8:40	<u>44</u>	<u>47</u>	<u>49</u>	<u>63</u>	<u>51</u>
Average for Peak Period	33	30	32	35	32

Note: Speeds listed in mph, to covert to kph, multiply by 1.6.

Table 14: Inbound A.M. Peak-Period Occupancy Counts
at the HB&T Railroad Overpass
(June 2, 1977)

Time/Vehicles	Two Right Lanes			
	Number of Occupants Per Vehicle			
	1	2	3+	Total
7:00 - 7:05 a.m.				
Number of Vehicles	211	47	19	277
Percentage	76	17	7	100
7:15 - 7:20 a.m.				
Number of Vehicles	203	42	11	256
Percentage	79	17	4	100
7:50 - 7:55 a.m.				
Number of Vehicles	174	40	5	219
Percentage	79	19	2	100
8:00 - 8:05 a.m.				
Number of Vehicles	216	43	11	270
Percentage	80	16	4	100
8:20 - 8:25 a.m.				
Number of Vehicles	218	54	13	285
Percentage	76	19	5	100
8:30 - 8:35				
Number of Vehicles	178	44	9	231
Percentage	77	19	4	100
Total Count	1200	270	68	1538
Average Percentage	78	18	4	100

Table 15: Traffic Volumes at Crosstimbers
(3:30 - 6:30 p.m.)

Start Time	PEAK DIRECTION (northbound)						OFF-PEAK DIRECTION (southbound)			
	Cumulative Counts Each 15-Minutes						Cumulative Counts Each 15 minutes			
	Estimated Passenger Vehicles*	Single-Unit Trucks	Tractor-Trailer Trucks	Buses	Total Vehicles	Percent Distribution in Peak Direction	Passengers Vehicles	Single-Unit Trucks	Tractor-Trailer Trucks or Buses	Total Vehicles
3:30	1,653	37	39	2	1,731	56	1,230	66	39	1,335
3:45	1,548	25	42	1	1,615	54	1,290	42	51	1,383
4:00	1,632	30	35	0	1,697	58	1,167	24	39	1,230
4:15	1,530	37	46	2	1,615	57	1,122	24	57	1,203
4:30	1,629	30	38	1	1,698	61	1,014	33	30	1,077
4:45	1,446	25	38	7	1,515	57	1,044	57	36	1,137
5:00	1,524	15	33	1	1,573	58	1,056	18	42	1,116
5:15	1,587	15	28	3	1,634	59	1,035	30	54	1,119
5:30	1,554	23	25	1	1,603	60	996	27	39	1,062
5:45	1,949	28	30	3	1,555	58	1,092	21	18	1,131
6:00	1,281	19	20	2	1,322	56	975	30	48	1,053
6:15	<u>1,392</u>	<u>15</u>	<u>24</u>	<u>1</u>	<u>1,432</u>	56	<u>1,098</u>	<u>18</u>	<u>27</u>	<u>1,143</u>
Totals	18,270	299	398	24	18,991	N/A	13,119	390	480	13,989

*Based upon 5-minute count expanded for 15 minutes.

starting time. Peak-direction flow remained relatively constant, even with observed level-of-service reductions, until about 5:45 p.m. For the remainder of the survey period, demand apparently reduced, as observed levels-of-service rose to A and B. The off-peak direction portrayed a rather continuous, though gradual, decline throughout most of the peak period. Directional distributions fluctuated during the peak period, but overall distributions were not as extreme as those noted during the morning peak.

There were 870 trucks in the off-peak flow and 697 trucks in the peak flow. In the off-peak, trucks accounted for 6.2 percent of the flow; while in the peak direction, trucks accounted for only 3.7 percent of the flow.

Bus distributions are shown in Table 16. Although no Houtran routes operated over this portion of the freeway in a.m. or p.m. peak periods, three Houtran minibuses did pass this location during the survey period.

Table 16: Bus Counts at Crosstimbers
(3:30 - 6:30 p.m.)

Start Time	Cumulative Counts for Each 15-Minute Period				
	Houtran-City Bus	Air Coach-Airport Shuttle	Commuter	Other	Total
3:30	-	1	-	1	2
3:45	-	1	-	-	1
4:00	-	-	-	-	-
4:15	-	2	-	-	2
4:30	1	-	-	-	1
4:45	1	1	3	2	7
5:00	-	1	-	-	1
5:15	-	1	2	-	3
5:30	-	-	-	1	1
5:45	-	2	-	1	3
6:00	-	1	1	-	2
6:15	$\frac{1}{3}$	$\frac{-}{10}$	$\frac{-}{6}$	$\frac{-}{5}$	$\frac{1}{24}$

Table 17 lists calculated outbound travel speeds observed over the three-hour period. Considerable fluctuation was noted throughout the observation period, with forced-flow conditions bringing traffic to a standstill numerous times. During level-of-service reductions, inside lanes appeared most frequently to succumb to stop-and-go conditions. The duration often lasted several minutes. After 6 p.m. speeds generally recovered to above 55 mph (88 kph).

In the outbound direction, four random, five-minute records were made of vehicle occupancy in the outer two main lanes. This information is presented in Table 18. Almost 100 vehicles were surveyed, reflecting 70 percent one-occupant, 23 percent two-occupant, and 7 percent three-or-more occupant. Using the same earlier assumption on three-or-more occupant vehicles (3.5 persons per vehicle), an average vehicle occupancy reflected in these spot surveys would be 1.4 persons per vehicle.

Trends in Directional Distribution

Since it was possible to record peak and off-peak activity at the Crosstimbers location, a.m. and p.m. peak-hour directional distribution previously presented in Tables 11 and 15 were obtained. This information indicated a peak-hour average of 63 percent in the a.m. and 59 percent in the p.m.* Similar a.m. and p.m. directional data have been recorded for a number of years at a permanent traffic recorder located near Cavalcade, 1.5 miles south of the Crosstimbers survey site.

A profile of peak hour directional distributions at Cavalcade is plotted in Figure 4 from 1967 to 1978. The Crosstimbers data are also plotted, as a comparison, for 1977 as determined in the TTI study. It appears that both peaks

*Peak hours at Crosstimbers were defined as 7-8 a.m. and 5-6 p.m.

Table 17: Calculated Traffic Speeds at Crosstimbbers
(3:30 - 6:30 p.m.)

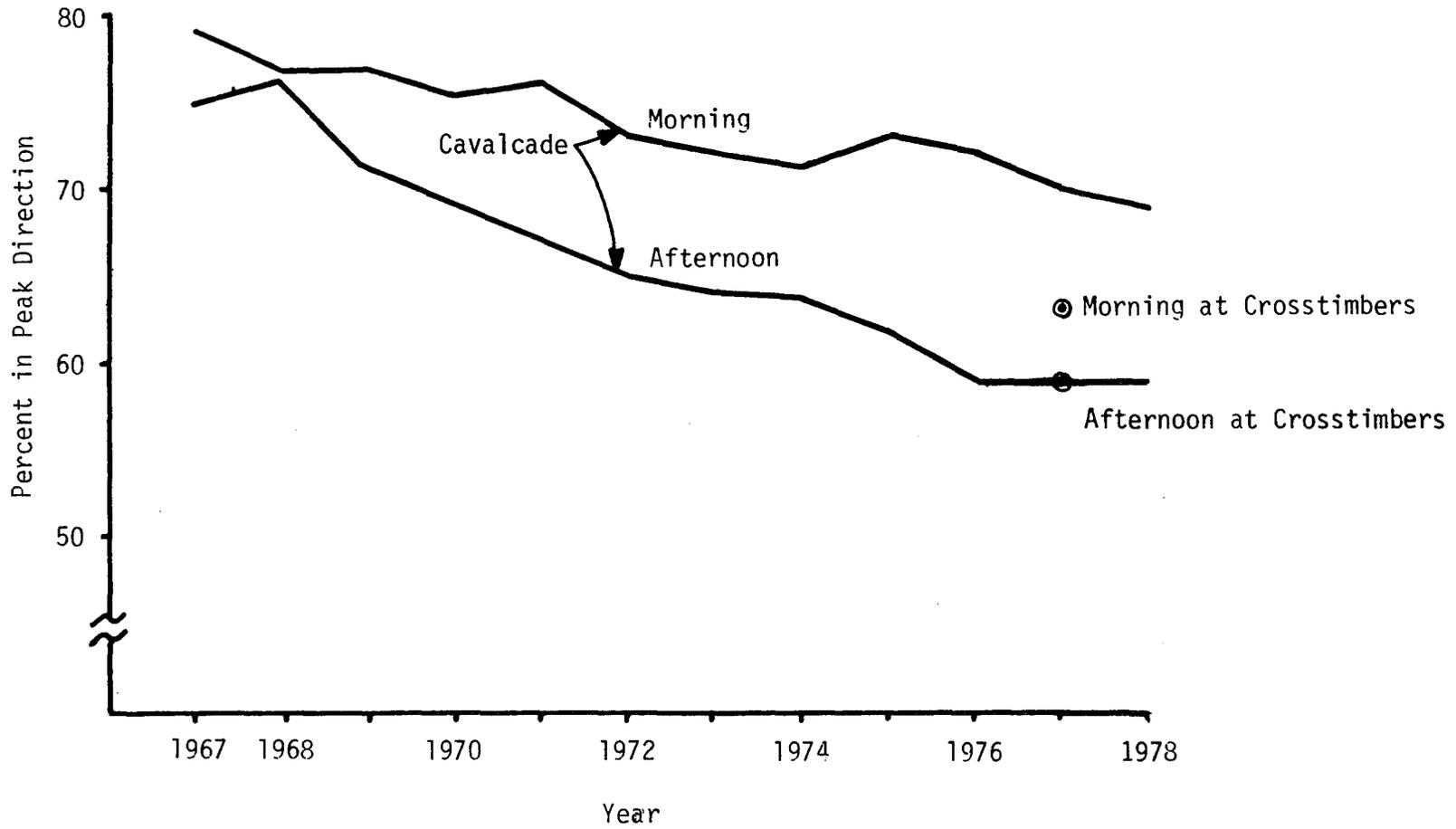
Start Time	Outside Lane 1	Lane 2	Lane 3	Inside Lane 4	Average for All Lanes
3:30	44	43	54	57	49
3:35	40	43	47	54	46
3:40	34	41	45	42	40
3:45	40	41	39	47	42
3:50	32	37	36	43	37
3:55	36	39	43	43	40
4:00	33	43	45	47	42
4:05	33	47	41	45	39
4:10	38	39	43	45	41
4:15	36	39	43	45	41
4:20	34	37	32	21	31
4:25	40	39	41	42	40
4:30	30	31	35	42	34
4:35	33	36	30	36	34
4:40	33	34	27	27	30
4:45	29	21	13	11	18
4:50	30	27	20	16	23
4:55	30	34	36	39	35
5:00	36	33	35	36	35
5:05	29	23	21	21	23
5:10	23	17	18	14	18
5:15	32	26	24	18	25
5:20	26	26	25	20	24
5:25	26	22	21	13	20
5:30	28	26	30	28	28
5:35	26	23	20	13	20
5:40	28	32	21	21	25
5:45	30	31	27	25	28
5:50	26	26	19	20	23
5:55	34	34	34	22	31
6:00	42	47	52	54	49
6:05	42	50	49	54	49
6:10	47	53	58	60	54
6:15	47	47	58	60	53
6:20	50	50	58	57	54
6:25	<u>44</u>	<u>43</u>	<u>49</u>	<u>60</u>	<u>49</u>
Average	34	36	36	36	35

Note: Speeds listed are mph, to convert to kph, multiple by 1.6.

Table 18: Outbound P.M. Peak Period Occupancy Counts
at the HB&T Railroad Overpass
(June 1, 1977)

Two Right Lanes				
	Number of Occupants Per Vehicle			
	1	2	3+	Total
5:20 - 5:25 p.m.				
Number of Vehicles	158	49	17	224
Percentage	70	22	8	100
5:35 - 5:40 p.m.				
Number of Vehicles	162	47	14	223
Percentage	73	21	6	100
5:45 - 5:50 p.m.				
Number of Vehicles	181	66	13	260
Percentage	70	25	5	100
5:55 - 6:00 p.m.				
Number of Vehicles	170	57	19	246
Percentage	69	23	8	100
Total Count	671	219	63	953
Average Percentage	70	23	7	100

have experienced downward trending differentials since 1967. The 80 percent morning peak direction split has declined to 70 percent in ten years. The 75 percent afternoon split has more sharply declined to below 60 percent in that same period. These one-time TTI surveys at Crosstimbers, while not representing a comparable degree of accuracy as does the yearly averaged data, are important because they are taken in the critical section just North of Loop I-610. Trends



NOTE: ATR peak-hour data from counter S-142 at Cavalcade averaged from available listings for 1st-200th ordinal hour.

Figure 4: History of North Freeway Peak-Hour Directional Distribution

in directional data over an eleven-year period substantiate a concern that unrestricted off-peak traffic may experience an unacceptable level-of-service near Crosstimbers when the contraflow lane is implemented.

Overview of Major Findings

Pertinent traffic data for the peak direction are summarized in Table 19.

Table 19: Pertinent Peak Direction Travel Data as Determined in the TTI Study, I-45N

Traffic Data	Count Location			
	N. Main		Crosstimbers	
	A.M.	P.M.	A.M.	P.M.
Duration of Traffic Count	6:30-9	3:30-6:30	6:45-8:45	3:30-6:30
VPH/Lane	1,800	1,600	1,700	1,600
Truck Percentage	4	4	4	4
Bus Percentage	0.2	0.2	0.2	0.1
Avg. Travel Speed, mph	49	55	32	35
% of Traffic in Peak Direction In Peak-Hour	-	-	63	59
Vehicle Occupancy, Avg.	1.2	-	1.3	1.4
% Single Occupant	84	-	78	70
% 2 Occupants	14	-	18	23
% 3+ Occupants	2	-	4	7



APPENDIX A

Interviews with Various Truck Operators in the Houston Area

The following interviews include information pertaining to the nature of trucking operations in the Houston area. Those activities which were subject to North Freeway operations are noted. The operations which were interviewed during April, 1977 included:

- (1) Central Freight Lines
- (2) Brown Express
- (3) Red Ball Motor Freight
- (4) Yellow Freight/Braswell Freight
- (5) McLean Motor Freight
- (6) East Texas Motor Freight
- (7) Consolidated Freightways
- (8) Robertson Tank Lines, Inc.
- (9) Weingarten's Grocery, Inc.
- (10) Transportation Director - Houston Chamber of Commerce

General comments and observations concerning these interviews are presented at the end of Appendix A.

- (1) Interview with: Lee Schroeder
Central Freight Lines
4101 Fulton Street
Houston, Texas
April 27, 1977

Central Terminal is located at 4101 Fulton Street, with the majority of their vehicles entering or leaving the terminal using the Patton Street exit on I-45 North. Central averages 1600 vehicles in or out of the terminal daily. Approximately 600 of these vehicles are intercity, leaving Houston for Galveston,

Beaumont, Dallas, San Antonio, etc. By January 1, 1978, the Central Terminal will be located at 5800 Mesa Street. This is a new terminal located at the intersection of Highway 90 and Mesa Road. Entrance to the freeway system will be on North McCarty Street, to North Loop 610. From there, traffic will go north, then west, to I-45 North, or via I-10 east to Beaumont or west to downtown Houston and San Antonio. Southbound traffic will be via I-610 South, to I-45 South.

The intercity trucks are generally at the terminal before 7:00 a.m. Trucks are dispatched for delivery within the Houston area beginning at 6:00 a.m., with most of the trucks out on the streets no later than 10:30 a.m. The intercity trucks begin leaving the terminal after 6:00 p.m., but the bulk of the vehicles leave after 8:00 p.m. The exact schedule is dependent upon vehicle loading and the availability of drivers.

Dispatch records that would allow sampling of vehicle departure times and destinations are not normally retained. However, Mr. Schroeder said that this would not be difficult to do. If we would furnish the forms, they would complete them on the requested days. The 1600 vehicles per day in-and-out data were obtained from the security guards at the gates.

Mr. Schroeder suggested that one opportunity to meet with the terminal managers for the common carriers of general commodities would be at a meeting of the Houston Freight Carriers Association. This association meets the second Thursday of each month at an area meeting. Current president of the association is Sid Hatfield, Arkansas Best Corporation.

Mr. Schroeder identified operators of large private truck fleets as:

- Champion Paper;
- Continental Can;
- Safeway Stores;

- Weingarten's Inc.;
- Kroger Company;
- Eagle Stores; and
- Grocery Supply Corporation

Mr. Schroeder stated that I-45 North frequently remains congested past 7 or 8 p.m., particularly on Fridays. A major bottleneck is the intersection of Loop 610 and I-45. It appears that, for Central to utilize a priority lane on I-45 North, there would have to be an intersection of the priority lane and Loop 610 North.

(2) Interview with: Michael Wetzig, Terminal Manager
Brown Express
4300 Irvington Boulevard
Houston, Texas
April 27, 1977

Brown Express has approximately 25 inbound and 25 outbound intercity trips per day. Forty-five percent of these trips are on Highway 59 Southwest, approximately 30 percent on I-10 West, and approximately 25 percent on I-45 North and South. Ninety-five percent of the departures are between 9 p.m. and 3 a.m. Returns are more scattered; however, almost everyone is back at the terminal by 7:30 a.m. Consequently, their intercity drivers use the freeways infrequently during peak hours.

Trip tickets are prepared for each vehicle in or out. The trip ticket shows the origin, the destination, the arrival time, and the departure time. These tickets could be sampled to develop route and frequency patterns. Brown Express primarily uses Loop 610 to the intersection of I-10, I-45, or Highway 59. They avoid the elevated portions of the freeways in the downtown sections. City ordinance prohibits transportation of certain hazardous materials on the elevated portions of the freeway except for pickup or delivery.

The transportation of hazardous materials on the elevated freeway sections is controlled by Mr. D. W. Divens, telephone number 222-3271, of the Houston Fire Department.

Mr. Wetzig suggested that long-haul carriers such as Yellow Transit and Consolidated Freightways probably use the freeways to a greater extent during peak hours than the other common carriers in Houston. Other than Trinity Industries and the grocery chains, Mr. Wetzig did not know of any private carriers with a significant number of trips in a single day. Trinity Industries is a large private carrier that primarily hauls steel products within Houston. He commented that the intersection of Highway 290 and Loop 610, particularly during the morning rush hours, is a problem for Brown Express, although this conflict is worse for the city drivers than for the intercity drivers.

(3) Interview with: Mr. Ken L. Allen, Terminal Manager
Red Ball Motor Freight
4004 Irvington Boulevard
Houston, Texas
April 27, 1977

Red Ball Motor Freight has approximately 20 intercity arrivals and 20 departures daily. Departures are primarily between 10 p.m. and 4 a.m. The arrivals are primarily between 10 p.m. and 8 a.m. North- and eastbound traffic use the Patton Street entrance to I-45. East- and westbound traffic use the Irvington Boulevard entrance to Loop 610. Approximately 50 percent of the traffic is eastbound.

Mr. Allen identified major private truck fleet operators as the grocery supply firms, primarily Flemmings, Weingarten's, and Safeway; Walgreens, Coca-Cola Foods, and Hoerner-Waldorf Corporation, a manufacturer of cardboard, also operate private fleets.

The dispatching for the entire Red Ball system is done by computer from the Dallas office. Retained on magnetic tape is the routing and scheduled departure and arrival times for each piece of equipment in the Red Ball system. This file can be sorted by terminal so that a record of Red Ball ins-and-outs for a particular day or a particular time could probably be made available.

(4) Interview with: Mr. Tommy Laughlin, Assistant Terminal Manager
Yellow Freight, Braswell Freight
6767 North Freeway
Houston, Texas
April 27, 1977

At the present time, Yellow operates 35 to 40 inbound and 35 to 40 outbounds between Houston and Dallas daily. They operate approximately six inbound and six outbounds on I-10 between Houston and Beaumont daily. The Yellow terminal is located at 6767 North Freeway, which is north of Loop 610. Generally, their eastbound traffic operates on I-45 down to the intersection of I-10 and then east on I-10 to Beaumont. When they are carrying hazardous materials, they are required to operate on Loop 610. Arrival and departure times for the Dallas to Houston traffic are every 35 to 40 minutes, 24 hours a day, seven days a week. Yellow is a long-haul carrier in contrast to Central, Red Ball, and Brown Express, which are short-haul carriers. Their traffic moves relatively uniformly throughout the day. City pickup and delivery and peddle runs are made weekdays between 6 a.m. and 6 p.m.

In April 1977, Yellow acquired the operating authority and personnel of Braswell Motor Freight. As a result of this new authority, within six months they will be operating 20 schedules per day inbound to Houston and 20 schedules per day outbound from Houston on I-10. Approximately half of this traffic will go through the Houston terminal. The other half is through freight using I-10 through Houston but not stopping at the Houston terminal. This traffic will be

moving at regular intervals 24 hours a day, seven days a week. This is the first interview in which there was through traffic not using the Houston terminal. With the new authority in operation, it appears that approximately one-sixth of Yellow traffic passing through Houston is through traffic, while five-sixths will use the Houston terminal. Approximately half of Yellow's traffic is truckload traffic.

On Mondays, Yellow dispatches 98 pieces of equipment onto the freeways and city streets of Houston, including peddle runs to League City, Pasadena, Galveston, etc. Their low day is Thursday, with about 70 pieces of equipment on the streets. Total daily dispatches from the Houston terminal of pickup and delivery equipment is approximately 200 vehicles.

Mr. Laughlin identified East Texas Motor Freight and Roadway Express as other long-haul carriers operating out of Houston with similar schedules. He indicated that there would be no problem in companies participating in a survey of truck arrival and departure times and origins and destinations. Mr. Laughlin commented extensively on the increasing problems Yellow Freight has within Houston in terms of productivity of city drivers; the increasing traffic congestion and the wide dispersal of pickup and delivery locations being the primary problems. This comment corroborates a comment made by Mr. Wetzig of Brown Express. Mr. Wetzig said that a P&D driver frequently will travel 120 miles within the city on a single run to load his vehicle. In Dallas, a P&D vehicle will normally be loaded with 60 miles of travel. This situation is the direct result of the wide dispersal of industrial activity within Houston and is associated with the lack of zoning.

(5) Interview with: Mr. Tony Richards, Terminal Manager
McLean Motor Freight
5880 Kelley
Houston, Texas
April 27, 1977

McLean is predominately a long-haul carrier operating approximately 30 schedules inbound and 30 schedules outbound each day. Fifteen of these schedules use the Eastex Freeway toward Shreveport, 10 schedules use I-10 East to Beaumont, Baton Rouge, and New Orleans, and five schedules use I-10 West to Austin, El Paso, and points west. They do not operate any traffic between Houston and Dallas. Their present schedule is not optimum due to a tractor shortage resulting from strike-delayed deliveries from Ford Motor Company. Eastbound schedules leave at midnight, 1 a.m., 3 a.m., 5 a.m., and 6 a.m. Inbound traffic is apparently spread throughout the day, with schedules operating seven days a week.

Long-haul carriers work on a 24-hour basis, seven days a week, with shipments arriving on Saturdays and Sundays. These shipments are broken out and delivered primarily on Monday and sometimes on Tuesday. As a result, Monday is a very heavy day for delivery within the city, as Friday, Saturday, and Sunday inbound deliveries are delivered on Monday. McLean operates 70 to 75 vehicles within the city on Monday, about 60 vehicles on Tuesday, 50 on Wednesday and Thursday, and 60 on Friday. Mr. Richards did not identify any particular freeway or intersection as a major problem area. He said that the company was trying a variety of things to increase the productivity of city drivers, such as ten-hour days and a four-day work week, in an attempt to keep the drivers out longer and eliminate one trip to the terminal. He thought that Roadway Express was going to go to a subterminal system in a short period of time, probably locating a terminal near Rosenberg. This type of operation requires a sophisticated schedule; inbound freight must be sorted by subterminal prior to

dispatch to Houston, so that it may proceed directly to the applicable terminal. Mr. Richards thought that Roadway was probably the leading innovator in this type of operation. McLean would be willing to cooperate in any special studies that might be requested.

(6) Interview with: Mr. O. D. Rippey, Terminal Manager
East Texas Motor Freight (ETMF)
5700 North Loop East
Houston, Texas
April 27, 1977

Over a 24-hour period, ETMF operates 25 schedules inbound to Houston and 25 schedules outbound from Houston. All the Houston traffic comes to the terminal on Loop 610. ETMF is a long-haul carrier and the arrival times of their traffic are rather uniform throughout the 24-hour period. The traffic uses I-10 West primarily to Austin, El Paso, and the West Coast, I-45 North to Dallas, and Highway 59 to Longview and Shreveport. ETMF puts approximately 85 city vehicles on the street each day, with many of these vehicles making multiple trips to the terminal. Mr. Rippey thought that very few private truck fleet users would operate many intercity vehicles on the freeway system during the peak-hour period. The long-haul carriers like ETMF operate only a few vehicles during any one hour while the short-haul carriers operate predominantly at night.

(7) Interview with: Mr. Fred York, Terminal Manager
Consolidated Freightways
4847 Blaffer Road, 6800 North Loop
Houston, Texas
April 27, 1977

Consolidated Freightways is a long-haul carrier operating about 36 schedules out each day between Dallas and Houston. All of their Houston traffic comes from Dallas, so that I-45 North and Loop 610 are the only freeways used

by the intercity drivers. They operate 50 to 55 tractor-trailers and bobtails on a daily basis for pickup and delivery within the city. These vehicles normally begin departing the terminal about 7 a.m., with subsequent departures at 8, 8:30, and 9 a.m. All downtown deliveries are made using bobtail equipment. Inbound traffic begins arriving at about 10 p.m. and continues until about 4 a.m. Their drivers pick up a trailer in Dallas, deliver it to Houston, have about a 15- to 30-minute turnaround in Houston, pick up a new trailer, and return it to Dallas. Mr. York said there would be no problem in providing documentation needed for an origin-destination and frequency survey. He identified the major long-haul carriers operating out of Houston as Yellow, Rider, McLean, ETMF, Roadway Express, Lee Way, Consolidated Freightways, Transcon, and Strickland.

(8) Interview with: Mr. Tommy Edwards, Terminal Manager
Robertson Tank Lines, Inc.
2401 Battleground Road
Deer Park, Texas
April 28, 1977

Robertson is the largest, in terms of their Houston operation, of any interstate tank line operating in Harris County. Other companies are larger on a national scale while others are large in terms of local delivery operations. Robertson does a large amount of work for Shell Oil Company and Diamond Shamrock Company in Pasadena and Deer Park, for Monsanto Company on Chocolate Bayou, and for Dow Chemical Company in Freeport. Their operation is 24 hours per day, seven days per week. They have 120 tractors domiciled in the Deer Park terminal. There are 50 to 60 intercity departures from the Deer Park terminal per day. There is no particular pattern as to time of day, although they operate very few units during peak-period traffic. The majority of their traffic goes northeast on US 59 via Loop 610 and east on I-10 via Loop 610.

A small amount of traffic uses I-10 West, also via Loop 610. They do not operate any vehicles on I-45 inside Loop 610. The majority of their shipments would be classified as hazardous materials. In addition to the vehicles in the Deer Park terminal, Robertson also operates traffic into and out of Houston from other terminals within their system, such as Beaumont and San Antonio. These vehicles may or may not come to the Deer Park terminal.

Generally, their loads are picked up between 8 a.m. and 5 p.m.; however, the departure time from Houston is predicated on the travel time to the destination city. The travel time to the destination city is computed and the vehicle dispatched so as to arrive at a time when the cargo can be immediately unloaded.

(9) Interview with: Mr. John Grisham, Transportation Manager
Weingarten's Grocery, Inc.
600 Lockwood Drive
Houston, Texas
April 28, 1977

From their Houston warehouses, primarily at 600 Lockwood Drive but also at three other locations, Weingarten's delivers to 105 retail grocery stores. They use approximately 85 tractors and 125 trailers. The Houston warehouses distributes to Lafayette, Lake Charles, Orange, Beaumont, Vidor, Port Arthur, Conroe, Bryan, and other locations in southeast Texas, and to all the Weingarten's stores in the Houston-Galveston area. Deliveries are divided into three primary categories: (1) mixed loads, groceries and perishable items, (2) frozen foods, and (3) non-food items--toothpaste, drugs, etc. Vehicle dispatches are generally on a fixed schedule with deviations due to overloads, breakdowns, cancellations, and so forth. The frequency of dispatches by time of day is somewhat complex. The majority of roadruns (out of the city runs) leave between 4 a.m. and 6 a.m., but some are as early as 1 a.m. and as late

as 9 a.m. Drivers delivering within the city may make two or three trips a day, depending upon the number of stores they make drops to and the unloading times. Scheduled departures are according to the following table.

WEINGARTEN'S WEEKLY SCHEDULE

Day of Week	MIXED LOADS (Perishable & Grocery) (Local & Intercity)	NON-FOOD (Local)	FROZEN FOOD (Local)	ROAD RUNS		EXTRA	TOTAL
				Non-food	Grocery		
M	70	18	0	7	4	--	99
T	39	28	4	9	9	--	89
W	31	22	3	6	11	1	74
T	40	18	3	7	8	9	85
F	42	25	5	6	4	--	82
S	50	17	3	4	13	2	89

Weingarten's uses all of the freeways without any predominant pattern. The morning outbound schedules begin returning about noon; however, for those making second or third trips, returns may be past 6:00 p.m. Almost without exception, all tractors will return the same day they are dispatched.

Mr. Grisham did not know of any organization other than Delta Nu Alpha to which transportation managers of private companies belong. Mr. Grisham thought that documentation of daily trips by origin, destination, and time of day would be somewhat difficult as there are three separate dispatchers involved in the operation and they do not keep logs by actual departure times. All vehicles are logged out at the gate by company security. It may be possible to collect data at this point. Mr. Don Hardy is responsible for local

security; Mr. Charles Maze is head of company security. It appears that the necessary documentation could be acquired at Weingarten's; however, it will not be as easy as with the for-hire carriers.

Inbound cargoes are about equally split between common carriage and Weingarten's trucks.

(10) Interview with: Mr. Frank Kenfield, Transportation Director
Houston Chamber of Commerce
Houston, Texas
April 28, 1977

This interview was conducted to see if Mr. Kenfield could provide any suggestions on how to contact private carriage users in Harris County. Private truck operators participate in the Private Truck Council of ATA, the Texas Motor Transportation Association, and the Private Truck Operators of Texas Association. Additionally, there is a Houston Deliveries Association and an association of warehouse operators. There probably are additional associations, both local and national, of which the Houston operators are members; however, these are the only ones that Mr. Kenfield was familiar with. He thought that getting good information on private carriage would be extremely difficult for several reasons: (1) many firms think that data on their transportation operations affects their competitive position and, thus, are of a proprietary nature; (2) many firms operating private truck fleets in Harris County do not register the vehicles in Harris County for tax and insurance reasons; (3) the number of firms is large; and (4) a great deal of private carriage is operated in and out of Houston by firms that do not maintain offices in the city.

Mr. Kenfield has a particular interest in problems of distributing goods within the metropolitan area, particularly in the CBD. Apparently he is

involved in continual discussions with the Houston Engineering and Traffic Department on the use of curb space for truck loading zones and the elimination of curb parking to improve downtown traffic flow. He was also familiar with the increasing problems of for-hire carriers' productivity as related to pickup and delivery operations.

Expansion of the Houston Commercial zone has been approved by the ICC; however, the action of the ICC is being contested in Federal Court by the American Trucking Association (ATA).

Apparently, the early rulings by the court are somewhat ambiguous, such that there is the possibility that the expansion of the commercial zone may be revoked. The significance of the geographical size of the commercial zone relates to the amount of unregulated transportation that can be provided.

Mr. Kenfield suggested that the motor vehicles records at the County Courthouse, used for the assessment of personal property taxes, are probably the best source of the number of vehicles registered in Harris County. He did not know if the records would allow classification of trucks by size. He also cautioned that many firms domicile their vehicles outside of Harris County for both insurance and tax purposes, even though these vehicles are probably used 95-100% of the time within Harris County. This is particularly true of larger companies that also have offices in other locations.

Commenting on preparing a tabulation of truck operation into and out of Houston, Mr. Kenfield thought that this would be a particularly difficult problem, considering the number of carriers operating into and out of the city that do not have a Houston terminal. He thought that the number of carriers with ICC and RRC Authority that operate in Houston was significantly greater than the number of firms advertising in the Yellow Pages. In that respect,

he commented that it would be easier to get an accurate tabulation of non-regulated for-hire carriage than regulated for-hire carriage, as the non-regulated, for-hire carriage would be listed in the Yellow Pages.

Mr. Kenfield was knowledgeable of TTI's CBD goods movement study for Dallas. He is particularly interested in goods movement within Houston. It may be possible to obtain Mr. Kenfield's help in developing and funding a goods movement study of the CBD, Houston, or Harris County.

General Comments Concerning General Commodity Carriers

(Interviews 1-7)

Based on interviews conducted on April 27, 1977, it appears that the major problem facing general commodity carriers is the pickup and delivery of freight within the metropolitan area and the Houston Commercial Zone. The ICC recently expanded the size of the Houston Commercial Zone. The ICC ruling is being contested in federal court. The expanded zone included Conroe, Galveston, Rosenberg, and several other cities not previously included. Several carriers spoke of problems of the city drivers due to traffic congestion on the freeways. The short-haul carriers generally do not operate intercity trucks on the freeways during peak hours. The long-haul carriers appear to operate on a relatively uniform schedule throughout the day so that one, two, and perhaps three vehicles from a single carrier would be in peak-hour traffic in any one day. However, the total number of vehicles operating in peak hours, even considering all general commodity carriers, does not appear to be large. Labor contracts are such that intercity drivers, almost without exception, do not make deliveries; therefore, all intercity traffic

originates or terminates at a terminal. Without exception, the carriers said they would be willing to cooperate with any special studies required. They are particularly interested in any measures which would improve the productivity of pickup and delivery drivers.

Observations Based on Interviews Conducted April 27 & 28, 1977

It appears that getting documentation on the daily movement of truck trips within the Houston area through collection of data at the individual carrier level will be more difficult than initially thought. There does not appear to be a problem with the regulated for-hire carriers keeping accurate records, on a twenty-four hour basis, of intercity trips. It would also be possible for them to keep a record of intracity dispatches, although the destination of these trips would be difficult to record because of multiple stops. The number of for-hire carriers operating into or out of Houston is large, and although the majority of these carriers operate terminals and can be identified from the Yellow Pages, numerous other carriers apparently operate more limited schedules into and out of Houston but do not maintain terminals or advertise in the Yellow Pages. It would be possible to request tabulations of carriers with authority to operate in Houston from the RRC and ICC; however, it is doubtful that this information would be readily available. A very preliminary estimate is that there are five intracity dispatches for each intercity dispatch for the regulated carriers of general commodities.

The problem of documentation of private carriage is always difficult. Although the grocery store chains were identified as the major operators of large, private truck fleets, numerous other firms may have significant operations. The opinions of those interviewed differed concerning the extent of this traffic.

An initial observation is that there is not a large amount of intercity traffic operating on I-45 between downtown and Loop 610 during peak hours. None of the terminal managers interviewed used large equipment for downtown deliveries.

APPENDIX B

Truck Characteristics Observed at Crosstimbers Location

At each site a considerable amount of information was collected, largely through taped observations, of trucking and general operations on the freeway. This dialogue provided details regarding the specific haulers and the types of commodities being hauled. Observed changes in freeway operation were also mentioned from time to time. Inclusion of this information for a.m. and p.m. peaks at the Crosstimbers location follows in this Appendix. An axle count and vehicle description are given for each observed truck. Several similar trucks seen traveling together are often included as one observation. Also, each bus, taxi, or emergency vehicle observed is noted.

The premise employed for including a vehicle on this list as a truck involved its relative size or primary functional appearance. A vehicle which was large enough to inhibit flow in the traffic stream was included. Also included were pickups pulling trailers and commercial step vans. Not included were pickups and general-use vans.

In the following vehicle descriptions, the "bobtail" distinction is used only when referring to a two- or three-axle single unit vehicle containing a van assembly as a part of the single chassis. All rigs containing an aggregate of five or more axles were tractor-trailer combinations; thus, no "tractor-trailer" descriptor is included in association with these.

A.M. CROSSTIMBERS SURVEY

Time	Axle Count	Vehicle Description
6:45 a.m.	5	flatbed, loaded
	5	liquid hauler
	5	van
	5	flatbed hauling equipment
	5	dump truck
	4	tractor-trailer van
	5	van

Traffic is moving reasonably smoothly in front of the location southbound into town. It occasionally slows down to about 15 mph, but is now moving at 30 mph.

6:47 a.m.	2	bobtail van
	4	tractor-trailer van (Yellow Freight)
	2	dump truck
	2	flatbed, empty
	3	dump truck
	5	flatbed, empty
	2	step van (Maryland Club Coffee)
6:49 a.m.	4	tractor-trailer van (North American Van Lines)
	3	tractor-trailer van (Montgomery Ward)
	2	bobtail van (U.S. Postal Service)
	2	bobtail van (U-Haul)
	3	tractor-trailer van (North American Van Lines)
	2	step van
	2	flatbed
6:51 a.m.	2	wrecker
	5	van
		small van-type school bus (Goodwill)
	5	flatbed, empty
6:54 a.m.	2	flatbed carrying air compressor
	3	tractor, no trailer

The traffic is creeping to a full stop in front of our location, backing up from I-610.

2	dump truck
5	liquid tanker (Exxon)
5	van
	Continental Trailways bus
5	van (Central Freight)
5	van
2	van (Pepper Rendering Co.)
2	flatbed work truck

6:59 a.m.

The freeway traffic seems to be operating in surges. A wave will move up and then it will stop, then move up and stop.

	4	flatbed truck pulling a two-axle trailer (welding truck)
	3	dump truck
	5	dump truck
	5	lowboy loaded with John Deere tractor and a Bantam C-186 backhoe
	5	van (Central Freight)
	3	tree trimming truck (Trees of Houston)
7:01 a.m.		18-passenger school bus

The average speed right in front of this location is about 15 mph. It never has come to a full stop, but it goes in spurts.

	3	pickup with one-axle stake trailer
	5	van
	2	orange, tree trimming truck (Asplundh)
	5	van
	2	tree trimming truck (Blume)
	5	van, (Sea-Land trailer)
		Dark blue bus with air conditioning, reasonably full of people
	3	tree trimming truck (Trees, Inc.)
	3	dump truck
	3	orange, tree trimming truck (Asplundh)
	5	van
	3	dump truck
		Houtran minibus
7:05 a.m.	5	van (Herner-Waldorf Corp., Container Div.)
	5	moving van (Neptune Worldwide Moving)
	4	moving van (North American Van Lines)

The traffic immediately in front of this location has slowed to 5 mph at the moment.

	3	orange, tree trimming truck on frontage road (Asplundh)
	5	stakebed (Armco Steel Corp.)
	5	moving van (Mayflower Worldwide Moving)
	2	step van (Acme Mop and Broom)
	5	dump truck

Traffic is still moving at about 5-10 mph.

	5	moving van (Allied Van Lines)
	2	flatbed bobtail loaded with oxygen and acetylene tanks
7:07 a.m.		Continental Trailways bus
	2	tractor, no trailer

North Transit Co. bus on frontage road.
Has about 8 people on it. Looks like a
large school bus.

5 flatbed, empty
2 step van (Frosty Acres Frozen Foods)
2 bobtail van (Lilly Ice Cream)
Airport Coach bus
5 pickup truck pulling a three-axle goose-
neck (Fred Bandy Const. Co.) Trailer is
35 ft. long.

7:10 a.m.

Outside right-hand lane in front of us is at a full stop right now. In
the other three lanes traffic is creeping by at 5-10 mph.

The percentage of trucks in the total traffic stream appears to be signi-
ficantly smaller in this morning's peak period than in the afternoon peak
period.

3 refrigerated van (Armour Foods)
2 bobtail van (Leo quality Foods)
5 flatbed loaded with lumber
5 flatbed with lumber (Stowe Lumber Co.)
2 tree trimming truck with trailer (Trees
of Houston)
2 step van from (Oriental Cleaning Co.)
3 tree trimming truck with trailer
(Asplundh)
3 tree trimming truck with trailer (Trees,
Inc.)
5 van
3 tree trimming truck with trailer
(Asplundh)

7:14 a.m.

Traffic is moving about 5 mph on all but the outside lane, and it's just
barely creeping.

5 van (Allen)
4 tractor-trailer flatbed (Texas Pipe
Supply)
Air Coach bus
2 step van (Snap-on tools)
5 van (Globe Union, Inc.)
2 flatbed work truck, empty
3 + 3 two tree trimming trucks with trailers
(Trees, Inc.)

7:15 a.m.

5 gasoline transport
silver and blue private commuter bus.
3 tree trimming truck with trailer
silver and blue private commuter bus on
frontage road

	2	bobtail van
	2	yellow stakebed
		Air Coach bus
7:17 a.m.	5	flatbed loaded with cement bags
	5	liquid chemical hauler

Traffic is moving at 12 to 15 mph in all but the outside right lane.

	5	flatbed, empty
	5	van
	5	moving van (Neptune Movers)
7:18 a.m.	5	dump truck pulling three-axle trailer, both empty

Three of the four lanes are stopped at this location, but that stop was temporary.

	4	dump truck
	5	van (Central Freight)

Overall average speed on the freeway is about 10 mph.

	2	work truck (Trees of Houston)
	3	dump truck (Trees of Houston)
	3	tree trimmer with trailer (Trees, Inc.)
	5	van (Freshlike Canned and Frozen Vegetables)
	5	moving van (North American Van Lines)
	3 + 3 + 3	three tree trimmers with trailers (Trees of Houston)
	5	van (Global Van Lines)
7:22 a.m.	5	van (Truck Transport)
	5	chemical hauler (Chemical Express)
	2	flatbed (Trees, Inc.)
	3	tractor, no trailer
	5	flatbed, loaded (Chemical Express)
	3	gasoline hauler (Exxon)
		taxi
		bus van (Goodwill)
	2	step van
	3 + 3	two tree trimmers with trailers (Blume and Trees of Houston)
7:25 a.m.	5	refrigerated van (Hightop)

The traffic is stop-and-go over the railroad overpass. It surges back past this location to Crosstimbers. Overall average speed for the two inside lanes appears to be about 15 mph. For the outside lanes, about 10 mph.

	2	flatbed (roofing company)
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The directional split is quite dramatic. Traffic heading north is traveling at 55 mph, (maybe more like 65 mph), and there is seldom more than two vehicles abreast. Density is quite low outbound. It appears the density could easily be sandwiched into three lanes of the four with no problem.

	4	dump truck pulling two-axle trailer (roofing company)
	3	dump truck on frontage road (Lone Star Industries)
	2	refrigerated bobtail van
	3	tree trimmer with trailer (Trees, Inc.)
	2	flatbed
	5	refrigerated van
	3	tractor-trailer van (Smith Sleepers - Waco)
		small school bus
	5	van (Central Freight)
	5	refrigerated van (ASA)
	2	bobtail van
	3	bobtail van pulling tar-heating trailer (roofing company)
7:29 a.m.	5	flatbed loaded with steel
	3	tree trimmer with trailer (Trees of Houston)
		taxicab (Yellow)
		North Transit bus
	2	two flatbed work trucks with ladders and roofing material
	5	refrigerated van
	4	tractor-trailer van (Mayflower Moving and Storage)
	3	tree trimmer with trailer
	2	beverage truck (Dr. Pepper)
	5	van (Central Freight)
	5	auto carrier
	2	step van (electrician's truck)
	5	double-bottomed van (Consolidated Freightways)
	2	flatbed, empty
	2	bobtail
	3	tree trimmer with trailer (Blume)
7:32 a.m.	2	tree trimmer (Trees, Inc.)

The traffic is still surging between 5 mph and 20 mph.

	3	tree trimmer with trailer
	5	liquid hauler carrying flammable liquid
	5	moving van (Mayflower Moving and Storage)
		van (Central Freight)
	2	bobtail van (TransAmerican)
	5	short van (Central Freight)
	2	bobtail van

		white, private transit bus, a school bus-type vehicle
	2	flatbed with roofing materials
	4	tractor-trailer van (Yellow Freight)
7:34 a.m.	5	van (Central Freight)

The traffic is now flowing smoothly right up until it reaches the bottleneck at the railroad overpass, just north of I-610.

	4	tractor-trailer van (Yellow Freight)
	2	bobtail
7:35 a.m.	2	step van
	2	tree trimmer (Blume)
	4	tractor-trailer flatbed, empty
	5	grain transport
	5	refrigerated van (Safeway)

The traffic is flowing fast until it reaches the railroad overpass. On top of the overpass, traffic is stop-and-go, (level-of-service F), and it's barely moving over the I-610 overpass.

	3	tree trimmer with trailer (Trees of Houston)
7:36 a.m.	5	van (Yellow Freight)
	4	tractor-trailer van (Yellow Freight)
	5	chemical hauler (York)
	5	chemical hauler (Chemical Express)
	5	liquid hauler
	2	bobtail van (Mustang Equipment, Inc.)

The bottleneck over the railroad overpass is moving a little better now. It's backed up a little upstream from the overpass.

	5	van (Yellow Freight)
	5	moving van (North American Van Lines)
	3	tractor, no trailer

The speed is now up to 55 mph. Over the railroad overpass it's just the right two lanes that are slowing down.

7:38 a.m.

The level-of-service approaching the railroad overpass inbound is good, (L-0-S. B or C), but at the overpass it drops to L-0-S. F.

	3	tree trimmer with trailer (Trees, Inc.)
	2	sign truck
	3	concrete hauler (CASH)
	2	flatbed work truck
	2	gasoline hauler (Springer)
	5	refrigerated van (Kraft Foods)
	4	tractor-trailer van (Yellow Freight)
7:40 a.m.	3	tree trimmer with trailer (Asplundh)

The traffic is operating at a good level-of-service C up to the railroad overpass, then it comes suddenly to level-of-service F.

2	step van
4	bobtail van pulling two-axle trailer
5 + 5 + 5	three vans (Yellow Freight)
5	flatbed hauling roof trusses
4	tractor-trailer van
2	bobtail van on frontage road at entry ramp (Ryder)
5	van (Central Freight)
5	van (Yellow Freight)
2	flatbed work truck
5	double bottomed van
5	flatbed lowboy with large piece of work equipment
5	flatbed hauling roof trusses
5	van (Central Freight)

During the last ten minutes, the percentage of trucks in the traffic stream has picked up significantly.

7:43 a.m.

The stop-and-go segment has moved toward town near the I-610 interchange.

	4	tractor-trailer van (Yellow Freight)
	2	tree trimmer (Trees of Houston)
	5	van (Bekins Movers) wrecker
7:44 a.m.	3	tractor-trailer van (Yellow Freight)

Traffic is flowing smoothly across the railroad overpass, but it's still level-of-service F at the interchange.

	2	bobtail van
	3	tree trimmer with trailer (Blume)
		taxi (Yellow)
	5	moving van (Bekins Movers)
	3	tree trimmer with trailer (Blume)
	5	chemical hauler (Chemical Express)
	2	bobtail van (U-Haul)
	5	flatbed with roof trusses
	3	tractor, no trailer
	5	chemical hauler (Chemical Express)
	5	flatbed, fully loaded (Chemical Express)
	2	flatbed
	5	flatbed, empty
	5	flatbed (Ace)
	5 + 5	two flatbeds, empty
	2	work truck (Trees, Inc.)
	3	work truck with trailer (Trees of Houston)
	5	flatbed carrying four tractors
	5	liquid hauler (Gas Products)

	3	tree trimmer with trailer (Trees, Inc.)
	3	wrecker
	2	stakebed
7:49 a.m.	2	flatbed (Trees, Inc.)

The traffic is backing up over the railroad overpass again.

	2	stakebed
	5	flatbed loaded with assorted equipment
	2	bobtail van
	3	tree trimming truck with trailer (Trees, Inc.)
	5	flatbed, empty
	3	flatbed loaded with roofing material
		school bus - 18 passenger
	2	flatbed work truck
	3	dump truck
	5	van (Globe Union, Inc.)
	5	van (Santa Fe)
	5	van
	5	moving van
	3	tractor, no trailer
	5	van (Phillips 66)
	5	van (Yellow Freight)
	5	van (Bekins Moving Co.)
	5	van (Central Freight Lines)
	4	van (Yellow Freight)
7:51 a.m.	3 + 3	two tree trimmers with trailers (Blume)
	5	van (Yellow Freight)
	4	van (North American Van Lines)
	3	tree trimmer with trailer (Blume)
	3	dump truck
		blue and silver private commuter bus
	3	trash-compactor truck
	5	flatbed bobtail with three-axle trailer
	5	flatbed, empty
7:52 a.m.	3	tree trimmer truck (Trees, Inc.)
	5	van (Global Movers)
	5	flatbed, loaded
	5	automobile transport
	5	van
	5	liquid hauler
		Air Coach bus
	3	stakebed with trailer
	5	van (Yellow Freight)
	5 + 5 + 5	three vans
	3	dump truck
	3	pickup with flatbed one-axle trailer
	3	dump truck
	2	stakebed
	5	van
	3	wrecker

	3	tractor, no trailer
	5	van
		Air Coach bus
	5	van
	5	Central tractor, Sea-Land trailer
	5	dump truck
	5	dump truck
	2	bobtail van
7:55 a.m.	5	van (Central Freight)
	5 + 5	two flatbeds, empty
		flatbed loaded with machinery
	5	van
	5	flatbed, empty
	5	flatbed, loaded
	5	van (Mayflower Moving Co.)
	2	bobtail van (Shipley Donuts)
	4	red van
	5 + 5 + 5	three vans
	2	stakebed
	4	tractor-trailer van (Yellow Freight)
	3	tree trimmer truck with trailer
	5	grain hauler
	5	van
	5	grain hauler
	4	pickup with modified goosneck over-cab
	5	liquid hauler
	2	bobtail van
	5	cattle hauler
	2	flatbed
	2	tree trimmer (Trees of Houston)
	3	tree trimmer with trailer (Trees of Houston)
	5	chemical hauler
	3	dumptruck
	5	van
	2	bobtail van
	5	Central tractor, container trailer
	5	flatbed
	3	bobtail van
8:00 a.m.	5 + 5	two flatbeds, loaded
	5	van
	2	bobtail van
	3	garbage truck
	3	pickup with large trailer
	3	tractor, no trailer
	5	flatbed
	5	van
	5	liquid hauler
	2	stakebed, construction truck
	2	glass carrier
	5	van
	5	stakebed

	5	van (United Van Lines)
		school bus-18 passenger
	2	stakebed
	5	orange flatbed
	5	van
	5	flatbed
	4	tractor-trailer van
	5	van (Central Freight)
	2	stakebed
	5	van (North American Van Lines)
	2	tree trimmer
	5	van
	5	flatbed
	3	concrete hauler
	5	flatbed
	5	stakebed loaded with trusses
	3	dump truck
	5	van
	3 + 3	two tree trimmers with trailers (Trees of Houston)
	5	flatbed
	5	liquid hauler
8:05 a.m.	2 + 2	two bobtail vans
	5	van (Central Freight)
	5	van
	5	van (Safeway)
	2	bobtail van (Ryder)
	3	trash dumpster truck
		full-size school bus
	2	stakebed
	2	red bobtail van
	5	moving van (Atlas Moving)
	5	van
	3	pickup with one-axle trailer loaded with construction equipment
	5	grain transport
	3	dump truck
		school bus - 18 passenger
	2	meat delivery van
	2	bobtail van
	2	stakebed
	5	chemical hauler
	5	van (Red Ball)
	6	lowboy, loaded
8:10 a.m.	2	stakebed
	2	flatbed
	2	trash truck
	3	dump truck
	2 + 2	two stakebeds
	3	tractor, no trailer
	5	liquid hauler
	5	flatbed, empty
	5	flatbed

	3	pickup with one-axle flatbed
	5	flatbed, loaded
	5	flatbed, loaded with lumber
8:15 a.m.	5 + 5 + 5	three vans
	3	tractor, no trailer
	5	flatbed
	5	van
	5	flatbed loaded with lumber
	3	tractor, no trailer
	5	flatbed
	2	stakebed
		school bus - 18 passenger
	5	van
	2	flatbed
	4	tractor-trailer van
	5	moving van (United Van Lines)
	5	stakebed
	4	pickup pulling two-axle trailer with equipment
	4	van (Yellow Freight)
		Airport Coach bus
	5 + 5	two vans
	5 + 5	two flatbeds, loaded
	2	bobtail van
		school bus - 18 passenger
	3	tractor, no trailer on frontage road
		Airport Coach bus
		Private silver and blue commuter bus
	5	grain hauler
8:20 a.m.	5 + 5	two vans
	2	stakebed
	5 + 5 + 5	three vans
	3	tractor, no trailer
	5	liquid hauler
	2	stakebed, loaded
	5	gasoline hauler
	2	stakebed
	3	tractor, no trailer
	2	bobtail van
	2	step van
	2	stakebed
	5	stakebed
	2	bobtail van
	6	lowboy, empty
	4	tractor pulling a truck
	5	flatbed
	2	stakebed
	4	tractor-trailer van - (Yellow Freight)
	2	bobtail van (U-Haul)
	2	stakebed
	5	van
	3	tractor, no trailer
	3	concrete hauler

8:25 a.m.

5 flatbed
5 van (Yellow Freight)
5 concrete hauler
5 liquid hauler
2 bobtail van
5 liquid hauler
5 + 5 two vans
2 stakebed
4 tractor-trailer van (Yellow Freight)
2 stakebed
5 van
5 van (Safeway)
5 liquid hauler
2 bobtail van (Borden's)
5 van
3 concrete hauler
2 step van
2 flatbed
5 liquid hauler
5 van
3 bobtail van pulling trailer (Yellow Freight)
5 van
5 flatbed, empty
5 dump truck
5 flatbed, empty
5 flatbed, loaded with lumber
2 stakebed
2 bobtail van
school bus - 18 passenger

8:30 a.m.

5 van
2 stakebed
4 tractor-trailer van (Yellow Freight)
2 stakebed
2 bobtail
5 + 5 + 5 three auto carriers, empty
2 step van
2 gasoline hauler
5 two vans
3 concrete hauler
5 trailer specially built flatbed with oil rig
5 van (Yellow Freight)
5 van
3 tractor, no trailer
5 stakebed, loaded
5 grain hauler
6 lowboy, loaded
5 van
2 bobtail van
5 flatbed
5 van (Yellow Freight)

	2	flatbed
	5	beverage carrier (Coca-Cola)
	5	covered stakebed
	5	van (Central Freight)
	5	flatbed, loaded
	5	auto carrier, empty
	2	bobtail van
	5	van (Mayflower Moving & Storage)
	5	van
	5	stakebed
	3	dump truck
	4	tractor-trailer van (Yellow Freight)
	5	moving van
8:35 a.m.	2 + 2	two flatbeds
	5	liquid hauler
	5	van
		school bus - 18 passenger
	5	van (Yellow Freight)
	2	refrigerated bobtail van
	5	van
	5	flatbed hauling wide load
	5	flatbed
	2 + 2	two flatbeds
	3	stakebed
	5	flatbed
	3	tractor, no trailer
	5 + 5	two vans
	3	tractor, no trailer
	2 + 2	stakebeds
	2	refrigerated bobtail van
	7	van, double bottomed
	5 + 5	two vans
	2	flatbed
	5	van
	3	dump truck
	3	tractor, no trailer
	4	tractor-trailer van (Yellow Freight)
	5	flatbed
8:40 a.m.	4	moving van (Allied Van Lines)
	5	van (Yellow Freight)
	5	van (King Koil)
	5	van
	2	stakebed
	3	dump truck
	5	van
	5	moving van (United Van Lines)
8:41 a.m.	2	bobtail van

End of a.m. documentation

P.M. CROSSTIMBERS SURVEY

Time	Axle Count	Vehicle Description	
3:30 p.m.	5	liquid hauler	
	5	van	
	3	garbage truck	
	5	flatbed	
	2	bobtail van	
	2	trash truck	
	5	flatbed	
	5	liquid hauler	
		small school bus - 18 passenger	
	5	white van	
	2	bobtail truck	
	5	van	
	2	flatbed	
	3	tractor, no trailer	
	2	stakebed	
		ambulance	
	2	blue flatbed	
	7	tractor-trailer with additional trailer	
	5	van	
	2	blue wrecker	
	3	pickup with trailer carrying construction equipment	
	3	tractor-trailer van (Yellow Freight)	
	5	van	
	5	lowboy hauling construction equipment	
	3	tree trimmer with trailer (Asplundh)	
	5	flatbed	
	2	blue and white step van	
	2	flatbed	
	3:35 p.m.	3	garbage truck
		5	van (Pepsico)
2		bobtail van	
5		chemical hauler	
2		wrecker	
2		bobtail van	
2		dump truck	
5		van (Wacker's)	
5		van (Yellow Freight)	
5		Central Freight tractor with Sea-Land trailer	
2		bobtail van	
2		flatbed	
2		flatbed loaded with construction equipment	
5		van (Yellow Freight)	
2		bobtail van	
3	tree trimmer with trailer (Asplundh)		
5	petroleum hauler		
5	red grain hauler		

3:40 p.m.	5	flatbed
	5	van
	3	tree trimmer with trailer (Asplundh)
	2	butane truck
	2	bobtail moving van
	2	bobtail white van
	3	bobtail van (Yellow Freight)
	5	van
	3	tree trimmer with trailer (Asplundh)
	3	cement hauler
3:46 p.m.	2	bobtail with crane
	2	dump truck
	7	tractor pulling 4-axle trailer with crane
		school bus - 18 passenger
	5	dump truck
	3	flatbed (Yellow Freight) with barrels
	5	van (Dentler's Potato Chips)
	4	van (Mayflower Moving Co.)
	4	bobtail with winch
	2	van (Yellow Freight)
3:48 p.m.	3	tree trimmer pulling trailer
	5	van (United States Ceramic Tile Co. Houston, Miss.)
	2	flatbed
	3	flatbed pulling trailer carrying forklift
	5	petroleum hauler from Phillips 66
	2	flatbed
		Airport Coach bus
	5	tank truck
	4	bobtail pulling gooseneck trailer with structural steel
	3	dump truck, heavily loaded
3:51 p.m.	5	van, Sea-Land
	5	dump truck
	2	tree trimmer (Asplundh)
	5	red flatbed
	3	tractor-trailer van (Yellow Freight)
	5 + 5	Airport Coach bus
		two grain haulers, loaded with bulk grain
		lowboy with a motor grader and steam roller on it
	4	tractor-trailer van (Incorporated Carriers, Limited)
	2	dump truck
3:51 p.m.	5	open top van (Yellow Freight)
	2	bobtail van
	3	maroon and white dump truck
	3	tractor-trailer (Yellow Freight)
	5	van (ATL - Florida)
	4	van (Roadway)
	5	grain hauler (Holman Grain)

	2	flatbed with winch
	5	grain hauler (Grain Molasses Liquid)
	5	flatbed carrying structural steel
	5	van (Robbie Smith Transport, Inc.)
3:54 p.m.	3	dump truck loaded with gravel
	5	van (Yellow Freight)
	2	white step van
	5 + 5	two flatbeds hauling pipe (United States Service)
	2	flatbed
	4	flatbed with pipe
	5	dump truck
3:56 p.m.	5	van (Affiliated Foods)
	3	dump truck
	5	flatbed
	4	van (Yellow Freight)
	5	flatbed with creosote poles (Jack Puckett Trucking Co.)
	2	bobtail van (Armstrong Movers)
	2 + 2 + 2	three small work vans
	5	auto carrier, loaded (United Transport)
	3	concrete hauler (Gifford-Hill)
	5	flatbed, empty
	2	wrecker
	3	tractor-trailer van (Yellow Freight)
	5	lowboy carrying pickup
	5	bobtail with crane pulling 2-axle trailer
	5	flatbed loaded with plate steel (Western Lines)
	2	step van
	5	chemical hauler (Chemical Express)
	2	step van
	2	flatbed
	2	dump truck
4:00 p.m.	5	flatbed, empty, (Gulf Coast)
	5	van (North American Van Lines)
	2	step van
	2	red bobtail van
	5	tank truck
	2	stake truck
	5	van
	2	bobtail van
4:03 p.m.	4	wrecker (Dan Wheeler) pulling a truck
	2	bobtail van (Owen Lighting Co.)
	5	chemical hauler with lime (Texas Construction Service)
	2	bobtail van
	4	tractor-trailer lowboy, empty
	2	bobtail van
	3	tractor, no trailer
	5	flatbed with plate steel from Wise
	2	pickup with overhead boom
	3	dump truck (B&D Trucking Co.)

4:11 p.m.

2 van
5 chemical hauler, #44, with red tractor
(York)
2 flatbed with trash and tree clippings
5 lowboy with couple of pieces of equipment
(Ardco)
2 wrecker
4 pickup pulling empty lowboy 2-axle trailer
2 wrecker
2 flatbed
3 dump truck (Coward Trucking)
2 bobtail van (Air Freight)
2 flatbed with welding equipment
2 bobtail van (Suniland Furniture)
3 dump truck (Coward)
5 flatbed, empty, (Natchez Steel Pipe Co.)
5 van (Watkins)
3 concrete hauler (Gifford Hill)
5 van (Schepp Dairies)
4 tractor-trailer (Mayflower Moving and
Storage)
3 dump truck with heater for tar
3 dump truck (T-Faks)
5 van (Exxon)
5 van (W&L Motor Lines, Inc.)
5 van (Exxon)
2 step van (Thompson Foundation Contractors)
3 flatbed hauling structural steel (Gulf
State Steel)
2 step van
2 flatbed
5 flatbed, empty
2 flatbed, empty
5 flatbed, empty
2 flatbed with assorted equipment
3 tractor-trailer van (Yellow Freight)
5 flatbed carrying sheetrock (Steel Truck
Line, Inc.)
3 tractor-trailer van (Brown Express)
4 tractor-trailer van (Reeves)
4 tractor-trailer van (International Van and
Storage, Inc.)
5 flatbed with load covered with tarpaulin
5 flatbed, almost empty
2 tree trimmer truck
2 tree trimmer truck
2 work truck with tree branches
2 tree trimmer truck
2 van (Borden Dairies)
2 wrecker
5 flatbed loaded with pipeline valves
(Magnolia)
5 flatbed lowboy, empty

	2	flatbed with plywood and building materials
	3	tractor, no trailer, (BFI)
	4	tractor-trailer van (3 axles were on tractor)
	2	stakebed, empty
	5	lowboy, empty
4:14 p.m.	5	dump truck
	5	van (North American Van Lines)
	2	dump truck
	5	van (Continental)
	2	dump truck
	2	flatbed with work equipment
	4	flatbed, empty
	5	chemical hauler
	5	van (Elex)
		modular ambulance
	2	work truck with overhead boom
	2	dump truck, empty
4:17 p.m.	4	tractor-trailer van (Continental)
	4	tractor pulling tractor
	5	van (B.B Nash)
	5	livestock hauler, empty
	2	stepvan
	5	flatbed, empty
	5	van (Schepps Dairies)
	5	liquid hauler
	2	dump truck
	3	dump truck, loaded
	5	van
	3	pickup with long gooseneck
	5	grain hauler
4:19 p.m.	4	tractor-trailer van (Wholesale Grocers)
	5	liquid hauler
	4	flatbed, empty, (Moore Transportation Co.)
	5	van (Paxtex)
	4	tractor-trailer van (ABC Truck Rental)
	2	van-work truck
	2	flatbed with overhead boom (Howser Electric Co.)
	5	flatbed loaded with crates (J.D. Hughes)
	2	van
		Airport Coach bus
	5	dump truck pulling trailer, also loaded with gravel
	5	flatbed (Moore Transportation Co.)
	2	step van (Jackson Wholesale Supply)
4:22 p.m.	5 + 5	two flatbeds, empty (Louisiana Pacific)
	5	flatbed with scaffolding
	4	rig carrying derrick (Tiger Trucking Co.)
	2	flatbed
	2	bobtail van
	2	tree trimmer (Trees, Inc.)
	5	flatbed (Louisiana Pacific)
	2	step van (Leo's Quality Foods)

3	dump truck
5	flatbed with several LPG tanks
5	lowboy with a dump truck on it
2	bobtail (U.S. Postal Service)
2	bobtail van
5	flatbed with structural steel (Ligon)
4	pickup with trailer loaded with barrels
5	van (Douglas Truck Co.)
5	flatbed with plate steel (Ligon)
3	tractor-trailer van (Kitchen)
4	tractor-trailer van (Rollins)
5	van (Caravan)
	Airport Coach bus, fairly loaded
5 + 5	two vans
2	bobtail (Davis Auto Reconditioning, Inc.)
	Old Greyhound Bus painted turquoise and white; unknown as to whether it was commuter bus or not

We've got a traffic jam backing to our location.

4:26 p.m. 2 step van

The jam has backed up from Northline Mall to our location.

5	flatbed, empty, (Navajo)
2	bobtail

Only the inside lanes are backed up. It looks like there may be an accident somewhere upstream.

2	flatbed (Acme Truck Lines, Inc.)
3	gasoline hauler (Exxon)
2	flatbed

There is also a traffic jam that has backed over the railroad overpass for no apparent reason unless there is a stalled vehicle. Now that front vehicle is moving; but it takes about 10 seconds for each subsequent vehicle to start moving again.

2	bobtail van
3	concrete hauler (Lone Star Industries)
4	tractor-trailer van (Allied Van Lines)
4	bobtail pulling 2-axle trailer loaded with construction equipment
5	flatbed
5	van (Merchants Fast Motor Express)
5	van (Yellow Freight Lines)
3	tractor-trailer (Yellow Freight)
5	refrigerated van (Udaris)
5	van (Etton Williams)
5	automobile carrier, loaded, (United Transport)

5	flatbed, lightly loaded (Puckett Trucking Co.)
2	bobtail van
4	flatbed (United Plastics)
2	conventional trash compactor truck
3	dump truck
5	van (Globe Union, Inc.)
2	flatbed loaded with old tires
4	tractor-trailer van (Yellow Freight)

We have a stalled vehicle on the shoulder right in front of us with a very exasperated driver.

	3	tractor, no trailer (Frozen Food Express)
	2	step van (Maxwell House Coffee)
	3	dump truck
	3	tractor, no trailer
	5	van (Elex)
	2	bobtail van
	5	flatbed, empty
	5	van (Wyatt's Cafeterias)
	3	tractor-trailer van (Smith Furniture Manufacturing Co.)
	5 + 5	two grain transports (R.L. Morrow - Raymondville)
4:33 p.m.	3	bobtail van (Pepper Rendering Co.)
	2	orange tree trimmer truck (Asplundh)
	2	tree trimmer truck (Trees, Inc.)
	3	concrete hauler
	5	van
	2	step van
	2	flatbed, empty
	5	dry chemical hauler (Chemical Express)
	2	flatbed
	3	flatbed loaded with sacks of cement
	3	tree trimming truck
	5	van (Refrigerated Truck Co.)
	5 + 5	two vans (Pepsi-Cola)
	2	bobtail van (U-Haul)
	5	van (Statewide Trucking, Inc.)
	2	flatbed loaded with cartons (Moore Supply Co.)
4:35 p.m.	5	flatbed with covered load (Hardal)
	5	van (Yellow Freight)
	3	tractor-trailer van (Yellow Freight)
4:36 p.m.	2	flatbed
	5	van (Normandy Cypress, Inc.)
	2	bobtail van (Air Freight)
	3	tractor trailer van (Yellow Freight)
	2	bobtail van (Houston Post)
		taxicab
	3	tractor, no trailer
	2	flatbed, loaded (International Hammer Services Co.)

	3	tractor, no trailer (Madam League Molasses Co.)
	2	bobtail van (U-Haul)
	3	flatbed with crane
	5	van (Universal Plastics-Oklahoma City)
	3	cement hauler (3M)
	5	flatbed loaded with fencing material Hurricane Steel Ind. - LaGrange)
	2	red flatbed
4:40 p.m.	2	trash compactor truck
	5	van (Central Freight)

Traffic is backing up to our location again. It is back farther than it was awhile ago.

2	flatbed, probably welding rig
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The traffic in front of us is flowing at about 20 mph.

	3	tractor-trailer van (Yellow Freight)
	5	liquid carrier with carbon dioxide (NEC Corp.)
	2	bobtail van
4:42 p.m.	5	flatbed carrying plate steel (Hill and Hill)
	2 + 2	two tree trimming trucks
	2	silver van
	2 + 2	two bobtail vans
	2	bobtail van (Yellow Freight)
	6	articulated 40 ft. van (Virco)
	4	tractor-trailer van (Yellow Freight)
	2	flatbed
	5	flatbed (Houston Lead Co.)
	5 + 5	two flatbeds carrying pipe (Wales Transportation Co.)
	5	van (Chemical Industries)
	5	flatbed
	3	tree trimmer with trailer
	2	step van (Foster's Paper Co.)
	3	tractor-trailer van (Yellow Freight)
	5	flatbed with Ryder tractor pulling load of reinforcing steel
4:45 p.m.	3	tractor-trailer (Yellow Freight)

The traffic is stop-and-go all the way back to I-610.

5	van (Overhead Trucking Co.)
2	bobtail van (Air Freight)
5	van (Boise Cascade)
5	flatbed with covered load (Amsco Transportation)
2	bobtail van (Mustang)
2	flatbed carrying lumber (Security Lumber Co.)

	2	tree trimmer
		private over-the-road commuter bus, fully loaded
	5	flatbed, loaded
	5	flatbed carrying grass sod (Schultz Bros.)
3 + 3 + 3		three tree trimmers pulling trailers
	5	grain hauler (ECK Miller)
	5	flatbed loaded with construction steel
	2	tree trimmer
		silver and blue over-the-road private commuter bus, fully loaded
	5	van
	5	van (Kraft)
	2	bobtail van (Trees, Inc.)
5 + 5		two vans
	2	blue bobtail van
	5	flatbed
	5	grain hauler (Netco)
	2	flatbed with cage
	5	flatbed empty (Ennis Transportation Co.)
	3	tree trimmer hauling grinder (Trees, Inc.)
	3	tractor, no trailer (Neptune Worldwide Moving)
		Air Coach bus
	3	van (Yellow Freight)
	3	tree trimmer with grinder trailer (Trees, Inc.)
	5	grain hauler (Teakill)
	5	flatbed loaded with plate steel
	2	bobtail van (U-Haul)
	2	tree trimmer (Trees, Inc.)
	2	step van (Cookbook)
		Continental Trailways bus, fully loaded
5:01 p.m.	3	bobtail van with trailer (Trees, Inc.)
	4	tractor-trailer van (XTRZ)
	5	chemical truck (Thorndike)
	4	tractor trailer (Pepper Rendering)
		North Transit private commuter bus, school bus-type vehicle
		taxicab
	5	tank truck (Petro-Chemical Inc.-PTC)
	4	tractor-trailer van (Mayflower Moving)
	5	flatbed lowboy loaded with crates
	5	flatbed, empty (Utex)
	5	flatbed, partially loaded (Trees, Inc.)
	2	flatbed with crane
	2	flatbed loaded with lumber
5:04 p.m.	5	van (Champion Mid-America Form Line)

The average speed was about 30 mph, but now it is all stopped in the lane closest to us.

5:06 p.m.	5 + 5	two white tractor vans
	3 + 3	two tree trimmer trucks hauling grinders (Trees, Inc.)

The traffic is stopped up to our location on the inside lanes.

	2	step van
	2	flatbed with pipeline valves
	2	maxi-van (Henny's Draperies)
	4 + 5	two tractor-trailer vans (Yellow Freight)
	5	van (Grocer's Supply)
	5	van (Hobb's Trucking Co.-Grosebeck, Tex.)

The traffic is backed all the way over the railroad overpass.

5:08 p.m.	5	grain hauler (Imperial Trucking Co.)
	3	tree trimmer with trailer
	5	van
	2	flatbed, empty
	5	liquid hauler
	2	bobtail van
	2	step van (candy distributor)
	5	van
	5	flatbed loaded with steel (Magnabox)
	2	glass hauler (Brunsinger)
	5	flatbed hauling pipe (Aetan)
	5	Red Arrow tractor, Sea-Land trailer
	5	Air Coach bus, with few passengers
	5	flatbed loaded with steel (Arrow Trucking Co.-Tulsa, Okla.)
	5	refrigerated van (Refrigerated Transport Inc.)
	4	tractor-trailer van (North American Van Lines)
	5	liquid hauler (Exxon)
	2	tree trimming truck with crane (Trees of Houston)
5:12 p.m.	5	van (Melton Truck Lines)
	5	flatbed lowboy hauling earth mover (J. E. Weisman)
	3	tractor, no trailer (Park-Hill)
	5	van (Allied Van Lines)
5:13 p.m.	3 + 3	two vans (Yellow Freight)
	5	auto carrier, fully loaded
	3	tree trimmer with trailer
	5	white van
	5	van (Yellow Freight)
	3	dump truck
	3	tree trimmer with grinder (Trees of Houston)
	5	flatbed
	2 + 2	two tree trimmers (Trees of Houston)
	2	bobtail van (Ryder)
	5	white van

The traffic is stopped over the railroad overpass on the inside two lanes and moving at 10 mph on the outer two lanes.

	5	flatbed with 4-36 in. pipes (J.J. Jeffreys Co.)
	3	tractor-trailer van (Yellow Freight)
	2	flatbed
	5	flatbed hauling reinforcing steel and plate steel from Big Mac
	2	butane truck
	5	chemical hauler (TXI Chemicals)
	3	tree trimmer with grinder
	2	bobtail van (Sleep-Air Mattress Co.)
5:20 p.m.	2 + 2	two vans (North American Van Lines)

The traffic on the two inside lanes is stopped in front of our location and backed up all the way to the south over the I-610 overpass.

	5	flatbed with steel (Park Hill Truck Co.)
	5	flatbed, empty (Consolidated Freightways and Storage)
5:21 p.m.	2 + 2	two bobtail vans (Yellow Freight)
	4	tractor-trailer van (Allied Van Lines)
	3	flatbed pulling tarpot trailer (roofing company)
	4	tractor-trailer van (Allied Van Lines)
	3	silver and blue private commuter bus
	3	flatbed loaded with large concrete pipe (Gifford Hill)
5:23 p.m.	5	liquid hauler (Western Continental Transport)
	5	flatbed hauling 5 joints of pipe (J.J. Jeffreys Co.)
	3	tractor-trailer van (Yellow Freight)
	2	flatbed with high pressure tanks
	4	tractor-trailer van (Allied Van Lines)
	5	grain transport
	2	flatbed (Swan Roofing)
	2	flatbed (Globe Sheet Metal and Roofing)
	5 + 5	two flatbeds with reinforcing steel (Ducommun Metals)
5:25 p.m.	5	grain transport (Junior Anderson)
	2	flatbed with construction materials
	5	green and white grain hauler
	2	flatbed
	5	flatbed lowboy loaded with construction equipment
	3	van (Montgomery Ward)
	5	van
	5	flatbed
		Air Coach bus
	2	bobtail van
	5	flatbed (Woodard Trucking Co.)

	2	dump truck
	2	bobtail van (Yellow Freight)
	2	flatbed (T&L)
	5	liquid hauler (Ranger)
	3	dump truck
5:31 p.m.	3	tractor-trailer van (Yellow Freight)
	3	Entomatic tractor, one-axle trailer (cabinet and sink company)
	3	tractor-trailer van (Yellow Freight)
	3	North Transit commuter bus
	3	tractor, no trailer (BC)
	5	grain transport
		blue and silver private commuter bus, fully loaded
5:33 p.m.	3	bobtail flatbed with plywood and lumber (Vaughn)
	5	van (Griffith Packing Co.-Demopolis, Ala.)
5:34 p.m.	2	flatbed work truck (Gail Fence Co.)
	5	van (Foremost Dairies)
	4	flatbed carrying concrete monuments
	5	flatbed carrying pallets and covered load (Concrete of Texas)
	5	flatbed lowboy with load of crates (Containerized Van Lines)
5:35 p.m.	5	van (Lucius, Inc. tractor and trailer)
	5	tank truck (Chemical Express)
	2	bobtail van (Trans Central)
5:36 p.m.	5	flatbed carrying reinforcing steel
	2	bobtail van (Yellow Freight)
	5	van (Allectric)
	2	dump truck (L&L Truck and Tractors)
	5	flatbed carrying rolled steel
	5	van
	5	flatbed
5:38 p.m.	2	step van
	2	van
	5	flatbed, empty (Anderson Trucking Service)
	3 + 4	two tractor-trailer vans (Yellow Freight)

The traffic is stop and go on the inside two lanes in front of our location.

5:40 p.m.

The traffic on the inside lane is stopped. The other three lanes are moving at 15 mph.

3	tractor-trailer flatbed hauling construc- tion shed (Wolf's Portable Building Co.)
5	Merchant's Tractor Service tractor, Sea- Land trailer van
2	rig, that looks like dump truck
5	flatbed with steel and pipe
2	bobtail van, empty

	5	Merchant's Fast Motor Express tractor, Sea-Land container trailer van
5:42 p.m.	2	step van
	4	tractor-trailer van (Yellow Freight)
	2	bobtail van (A&F Messenger Service)
	2	bobtail van (J.H. Rose Truck Line)

Three lanes are traveling at less than 10 mph. The outside lane is moving at about 25 or 30 mph.

	3	tractor-trailer van (Yellow Freight)
	5	van on frontage road
	4	tractor-trailer van (North American Van Lines)
	2	bobtail van (Trees, Inc.)
	2	wrecker (Trees of Houston)

The traffic is fully stopped in two of the four lanes in front of us.

	2	bobtail van (Yellow Freight)
	2	bobtail
	4	tractor-trailer van (Red Arrow Freight)
	5	chemical hauler
	5	grain transport (Transco Transportation)
	5	automobile hauler (TAT)
5:45 p.m.	2	bobtail van (Yellow Freight)
	5	liquid hauler
	3	bobtail van with lift on back
	5	van (Southeastern Express)
	3	tree trimmer with trailer
	5	van (Allied Van Lines)
	2	dump truck

The traffic seems to be backing up from Crosstimbers.

5:46 p.m.

The traffic in front of us is moving at 15 mph.

	2	step van (Frito-Lay)
5:47 p.m.	3	flatbed (John Garza)
	3	tree trimmer with choppers (Blume)
	2	flatbed
5:49 p.m.	5	flatbed, empty (U-Tex Transportation, Inc.)
		Continental Trailways bus
	3	tractor, no trailer (MOTCO)
5:50 p.m.	2	bobtail van (U.S. Postal Service)
	5	van (Atlas Van Lines)
	2	tree trimmer (Asplundh)
	2	wrecker
		Continental Trailways Golden Eagle bus, fully loaded
	5	flatbed hauling reinforcing steel

5:52 p.m.	2	bobtail van (Yellow Freight)
	3	tractor-trailer van (Yellow Freight)
	4	tractor-trailer van (Houston Corrugated Box Co.)
	2	tree trimmer (Blume)
	2	Airport Coach bus, with about 30 people flatbed
5:53 p.m.	5	United Transport tractor, Neptune Worldwide Moving Van
	5	automobile carrier, empty
	5	flatbed with three coils of cable (Knox Trucking Co.)
		Airport Coach bus
	5	grain transport
	5	flatbed with reinforcing steel (Acme Fence)
	2	bobtail van (Yellow Freight)
	3	concrete hauler
	2	red step van
5:54 p.m.	2	bobtail van (Yellow Freight)
	5	van (General Battery Corp.)
	5	flatbed with covered load (Sitco Lumber Co.)

The traffic in the inside two lanes was stop-and-go in front of us, and now it's rippling back toward the railroad overpass.

5:55 p.m.	2	tree trimmer (Blume)
	2	bobtail van
	5	flatbed hauling steel (Hou-Tex Transportation, Inc.)
	2	bobtail van (Neil's Moving Co.)
	4	tractor-trailer van (Atlas Van Lines)
	4	red and white flatbed
	2	white step van
	5	liquid hauler, probably petroleum
	5	red and white gravel hauler
	5	grain transport
5:57 p.m.	2	bobtail van
	2	tree trimmer (Blume)
	5 + 5	two grain transports
	5	gasoline hauler (Exxon)
	5	van (Boise Cascade)
	2	flatbed, empty
	2	dump truck
	2	bobtail van (Ryder)
6:00 p.m.	5	moving van (Atlas Van Lines)

The traffic is stopped up to our location from Crosstimbers

3	tractor-trailer van (Yellow Freight)
2	flatbed
2	bobtail van (Yellow Freight)
5	van (American Red Ball Worldwide Movers)

	2	flatbed ("W")
	5	van (Western Foods - Colorado)
	3	concrete hauler (Builders Supply)
6:02 p.m.	4	tractor-trailer van (Bekins Moving and Storage)

The traffic has fully stopped in front of our location on the inside two lanes.

6:03 p.m.	2	bobtail van
	3 + 3	two dump trucks (B.T. Blair)
	2	glass hauler
	2	bobtail flatbed
6:05 p.m.	2	tree trimmer (Blume)
	5	hopper (Chemical Express)
	5	van (Yellow Freight)
6:06 p.m.	6	3-axle wrecker (Dan Wheeler) pulling 3-axle tractor (Yellow Freight)
	2	dump truck (Roffing Co., Inc.)
	3	flatbed pulling electric welder trailer
	5	tank truck (Texas Liquid Fertilizer)
	5	grain hauler
	3	tractor trailer (Yellow Freight)
	2	bobtail van (Yellow Freight)
6:08 p.m.	4	pickup pulling large gooseneck loaded with crates (Mustang Transportation Inc.)

The traffic conditions in front of our location have increased to at least level-of-service B, 50 mph.

6:09 p.m.	2	bobtail van on frontage road (Frosty Acres)
	5	tank truck (Groendyke)
	2	bobtail van
	2	bobtail
	4	pickup with two-axle axle gooseneck trailer

The traffic is continuing to move at about 50 mph. Density is about one car for two of the four lanes running side by side on 80 ft. spacing.

6:11 p.m.	3	flatbed carrying huge piece of equipment
	2	flatbed carrying post hole digger
6:12 p.m.	2	bobtail van (Yellow Freight)
	5	flatbed, loaded (Acme Brick)
		Houtran bus
	2	bobtail van (Airborne Freight)
	2	flatbed with gypsum board
	4	pickup pulling U-Haul trailer
	5	grain transport (George L. Morrow - Raymondville)
	5	auto carrier loaded with Hondas (Commercial Carriers)
	2	flatbed (New and Used Tires)

	3	flatbed with crane (Kefhauer Rigging Co.)
	2	dump truck loaded with tree trimmings
6:14 p.m.	2	step van on frontage road
	2	flatbed carrying old car body
		Airport Coach bus
	2	bobtail van
	4	flatbed pulling two-axle trailer loaded with construction equipment
	5	container van (Sea-Land trailer)
	2	tree trimmer (Blume)
	2	dump truck
	4	flatbed with horse trailer
	5	van (U.S. Postal Service)
	2	bobtail van (Don Cunningham)
	5	van (Yellow Freight)
	2 + 2	two wreckers
6:17 p.m.	3	concrete hauler (Lone Star)
	2	white bobtail
		silver and blue private commuter bus
	5	flatbed with plate steel (Knox)
	3	tractor-trailer van (North American Van Lines)

The traffic continues to move at least 50 mph, probably nearer to 60 mph in level-of-service B.

	3	tractor, no trailer (All-Star Transportation, Inc.)
	3	tractor, no trailer (Rowbar)
6:19 p.m.		two taxis (Yellow)
	5 + 5	two flatbeds with piping (Clark-Hill Trucking Co.)
	5	double bottomed van (Sherwin-Williams)
6:22 p.m.	5 + 5	two grain transports (B.L. Stokes)
	2	step van (Snap-on Tools)
6:23 p.m.	5	flatbed (Chemical Express)
	2	flatbed with welding equipment (Trees, Inc.)
6:24 p.m.		taxi (Yellow)
	2	bobtail van (Burlington Northern Air Freight)
	5	refrigerated van (Green Produce-Greenville, Tex.)
6:26 p.m.	4	pickup with gooseneck flatbed trailer, empty
	5	van (Allied Van Lines)
	5	flatbed hauling pipe (Farmer and Company)
	2	tree trimmer with crane (Blume)
6:27 p.m.	3	bobtail van hauling trailer with motorcycles
	4	bobtail van with trailer loaded with two cars
	5	liquid hauler (Shell Oil Co.)
	2	work truck with an A-Frame boom

	5	flatbed with huge steel and equipment (John Olds-Kansas City, Mo.)
	2	work truck with A-Frame on it
6:29 p.m.	2	taxi (Yellow)
	2	bobtail van (Yellow Freight)
	5	flatbed hauling steel (Texas Farm Lines)
	5	van (Big John Transportation Service)
	4	flatbed hauling trailer with forklift
	5	flatbed (Jack Puckett Trucking Co.)
	2	bobtail van (Yellow Freight)
6:31 p.m.	2	bobtail van
	5	flatbed with steel (P.F.)
	5	van (Central Freight)
		taxi (Yellow)
	5	pick-up truck with three-axle horse trailer
	3	tractor, no trailer
	2	flatbed
	2	bobtail van (Yellow Freight)
	5	flatbed hauling heavy equipment
	5 + 5	two auto carriers, fully loaded
		Houtran minibus
	3	dump truck

End of P.M. Documentation



APPENDIX C

Data Collection and Retrieval Methods

Equipment Used in the Surveys

Continuous records of traffic movements was made possible by use of a time-lapse, super 8 mm. camera setup. The setup included a modified Kodak Super 8 mm. camera equipped with a rechargeable, battery-powered intervalometer. Both the intervalometer and focal length of the lens were adjustable to allow for variations in frequency of exposures and picture angle. A time interval of two seconds was selected as being adequate for recording each passing vehicle on no less than two movie frames over a length of the main lanes at least 320 feet long. This selected time interval permitted about 1 1/2 hours of uninterrupted documentation between film changes.

Detailed descriptions of trucking movements were collected on tape recordings and later transcribed. Information on tapes included the name of the carrier, type of truck, number of axles, and often the commodity being transported.

Traffic conditions throughout the peak period were documented on the tape recordings and with use of two 35 mm cameras. One camera was positioned near the time-lapse location and was used to focus on specific occurrences in the immediate vicinity. Another 35 mm camera, equipped with a telephoto lens, was used to monitor traffic conditions throughout a four to five mile segment of the North Freeway around the survey location. This monitoring procedure helped to document traffic bottleneck locations and truck and bus operations not occurring within the limits of the recording site.

Peak-period occupancy information was recorded adjacent to the freeway main lanes. Random five-minute spot counts were typically made of the outermost

two lanes in the peak directions. Near the Crosstimbers location, a.m. and p.m. counts were taken at the HB&T railroad overpass. One 25-minute peak-period count was taken at the N. Main location. All vehicles, except for trucks with five or more axles, were included in the occupancy counts.

Survey Locations Selected

Two locations, one inside and one outside the I-610 Loop, were selected as offering suitable vantage points to observe travel characteristics across the four main lanes in each peak direction. Earthen embankments adjoining the south side of the N. Main over-crossing provided sufficient elevation inside I-610. At Crosstimbers, a fourth floor motel balcony coupled with advantageous grades from overpasses at Crosstimbers and the HB&T railroad, permitted documentation of peak and off-peak traffic.

A general orientation of the N. Main and Crosstimbers location, including the time-lapse camera angle used during each peak-period survey, are shown in Figures C-1 and C-2, respectively.

Data Retrieved

The Super 8 mm. movie film was initially indexed at five minute intervals. Each interval was then compared with tape transcripts to verify accuracy in both mediums. Information retrieved from time-lapse film included traffic speed, volume, and special count data.

Travel Speeds

Speed data were derived by knowing the length of each peak direction lane in the picture angle and the time lapse interval. A random sampling of at least four vehicles was made by counting the number of frames in which each vehicle

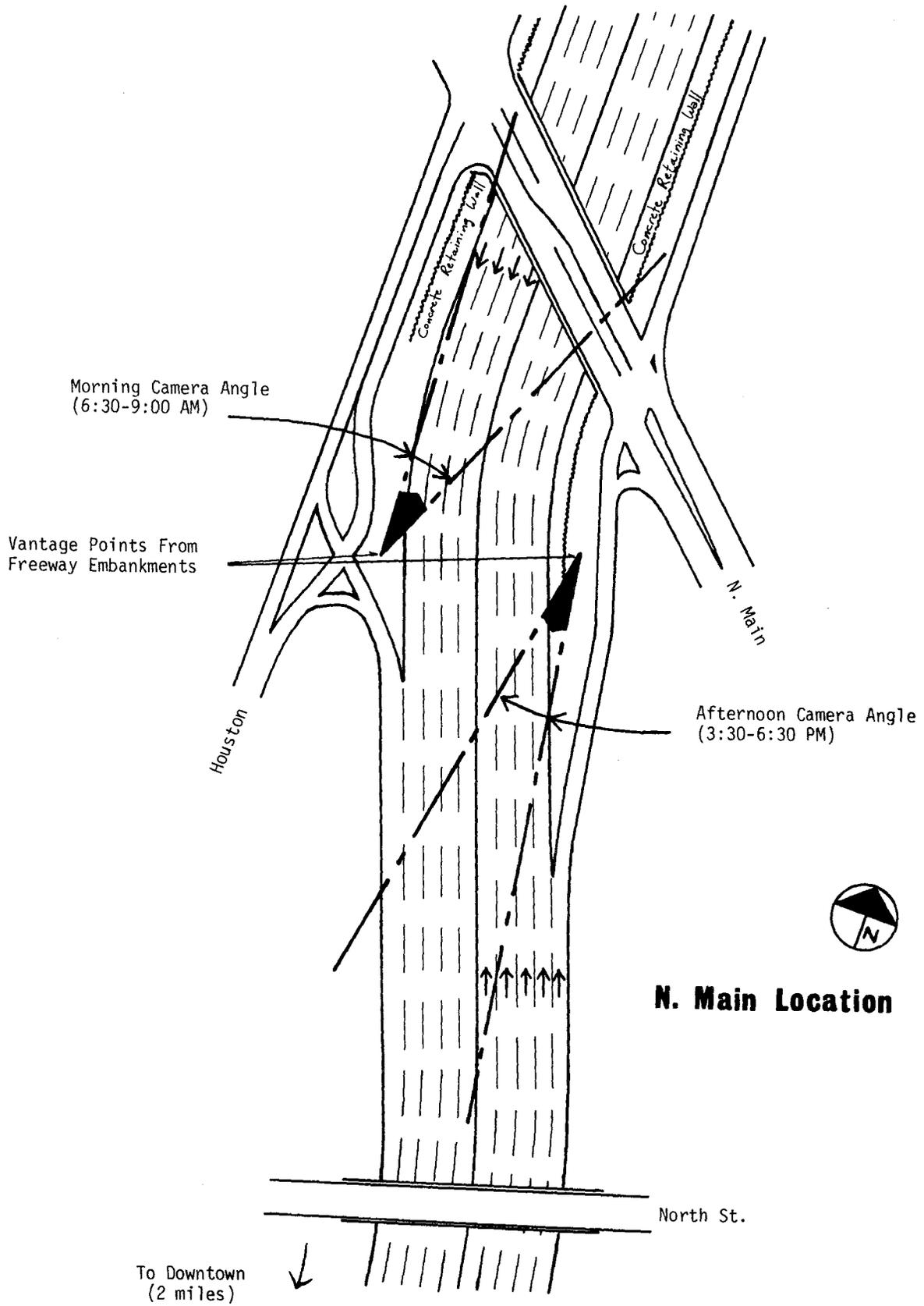


Figure C-1: Survey Sites at North Main

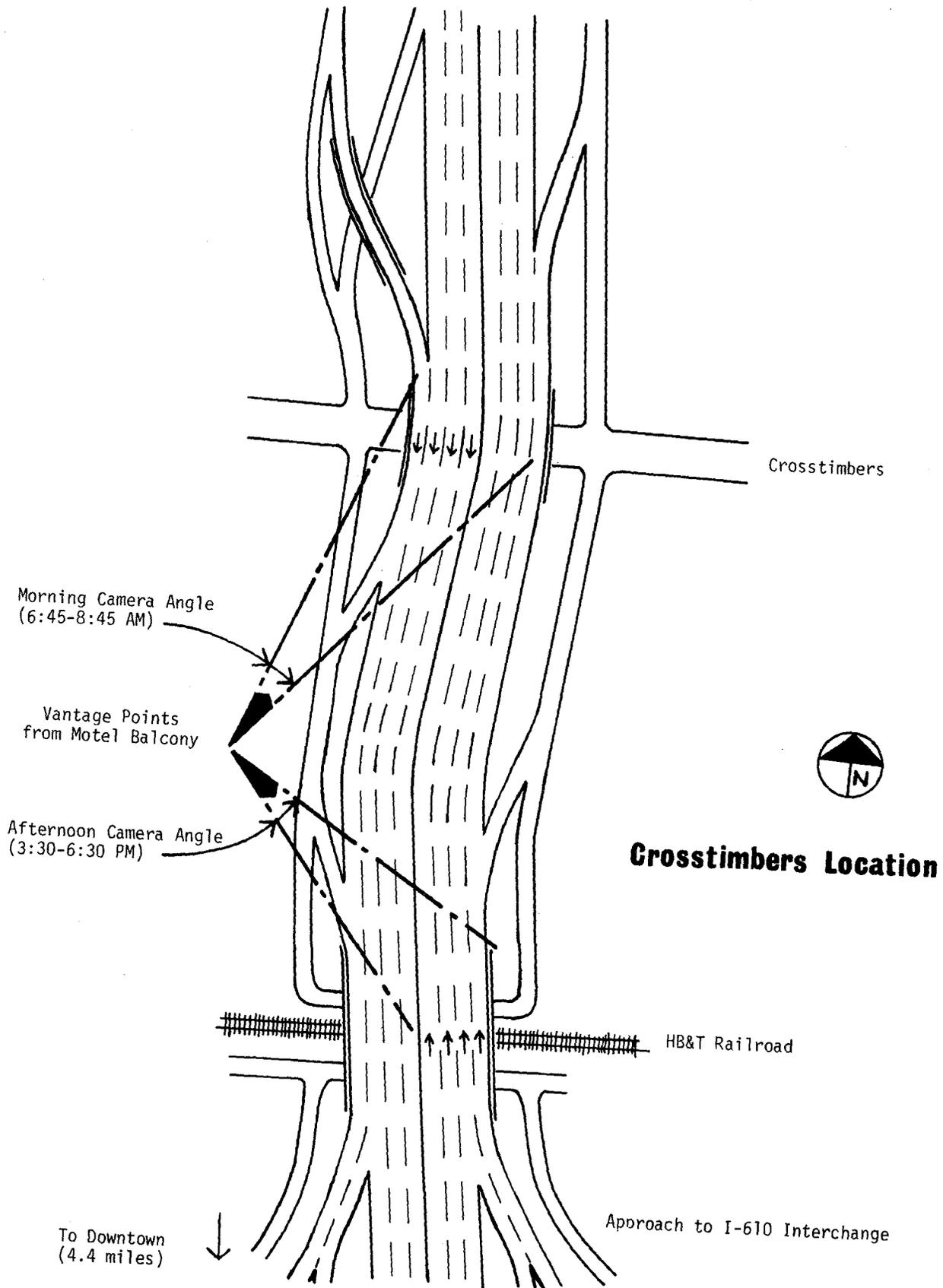


Figure C-2: Survey Sites at Crosstimbers

appeared. This sampling was averaged to generate a five-minute speed profile for each lane.

Because of the rather oblique camera angle necessitated by each setup alongside the main lanes, lengths of coverage of the inside and outside lanes varied. Freeway plans were reviewed to determine a close approximation for lane lengths at each setup site. The resulting estimates for lane lengths used in calculating travel speeds are shown below:

	Inside Lane	Outside Lane
N. Main (a.m.)	400 ft.(120 m)	500 ft.(150 m)
(p.m.)	425 ft.(127 m)	325 ft.(97 m)
Crosstimbers (a.m.)	700 ft.(210 m)	850 ft.(255 m)
(p.m.)	750 ft.(225 m)	550 ft.(165 m)

Before these travel speeds were calculated, a verification of the time lapse interval was undertaken. These checks revealed that the battery powered intervalometer set for exposures every two seconds had actually triggered exposures every 1.89 seconds. Tape transcriptions, synchronized with time readings indicated this rate was relatively consistent.

Margins of error resulting from this methodology could have been induced by the random process of selecting vehicles, by slight inaccuracies in the approximated lane lengths and fixed exposure intervals, and in several cases, by unclear background delineation as vehicles entered the measured lane lengths. After rechecking, it was estimated that these variables added no more than a ten percent error margin.

Traffic speed data resulting from this methodology yielded a fairly representative speed profile for each peak-direction lane over the peak period. Average speeds calculated from the collective input of all lanes appeared to correlate with traffic conditions that were observed and described on other mediums.

Volume Counts

Volumes were counted by lane for a five minute period once every fifteen minutes. These five-minute counts were then expanded to hourly flows. Volume data were retrieved in the peak direction at N. Main and the peak and off-peak directions at Crosstimbers. Periodic recounts indicated that errors attributable to merging or hidden vehicles accounted for differences of less than five percent.

Special Vehicle Counts

Some categories of vehicles, namely specific types of trucks and buses, were counted throughout the total films and aggregated by 15-minute interval.

These categories included:

- Trucks - - single unit
 - - multiple unit
- Buses - - Houtran (city bus system)
 - - Private commuter
 - - Air coach (airport shuttle)
 - - Other (intercity, church, school buses)

Single unit trucks included any vehicle on a single chassis, including most commercial bobtails, ready-mix cement haulers, tree pruning rigs, flatbeds, and stakebeds. Multiple unit configurations primarily included large over-the-road haulers with one or two trailers. Goosenecks, house trailers, and large horse trailers were also included in this category.