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TEXAS TRANSPORTATION INSTITUTE · The Texas A&M University System

TRAFFIC INFORMATION PROGRAM

Telephone (713) 686-2971
FAX (713) 686-5396

July 12, 1995

Mr. John Hemme, P.E.
Texas Department of Transportation
P.O. Box 1386
Houston, Texas 77251-1386

Dear Sir:

As per the attached request, the Texas Transportation Institute has completed an evaluation of ramp metering warrants for SH 288 from the US 59 Southwest Freeway to the Brazoria County Line (Control 0598-01-057). If you have any questions or require additional information, please contact Mr. Tony Voigt at (713) 686-2971.

Sincerely,

Darrell Borchardt

Darrell W. Borchardt, P.E.
Associate Research Engineer

DWB
xc: Mr. Wayne Jones, P.E.
Mr. John Gaynor, P.E.
Mr. Tony Voigt

701 NORTH POST OAK · SUITE 430 · HOUSTON, TEXAS 77024-3818

Texas Department of Transportation

P.O. BOX 1386 • HOUSTON, TEXAS 77251-1386 • (713) 869-4571

July 21, 1994

Contact:MWJ-CTMS

Harris County
Control 0598-01-057
SH 288

Mr. William R. McCasland, P.E.
Texas Transportation Institute
701 North Post Oak, Suite 430
Houston, Texas 77024

Dear Mr. McCasland:

The subject project provides for installation of a Computerized Transportation Management System (CTMS). The limits are US 59 to the Brazoria County Line. Assistance is requested to determine the need for ramp metering for this project.

For our approval, it is requested your office submit a proposal to perform this work.

Should you have any questions, please contact Mr. John C. Hemme, P.E., at (713) 802-5836.

Sincerely,

M. Wayne Jones

M. Wayne Jones, P.E.
Director of Transportation Operations
Houston District

JCH:ma
cc: Mr. John C. Hemme, P.E.
bc: Mr. M. Wayne Jones, P.E.

RAMP METERING WARRANT EVALUATION

S.H. 288 South Freeway — U.S. 59 to Beltway 8

INTRODUCTION

The Houston District of the Texas Department of Transportation (TxDOT) is currently developing plans for a Computerized Transportation Management System (CTMS) on S.H. 288 South Freeway (Figure 1). The CTMS will comprise video surveillance, changeable message signs, mainlane vehicle detection, frontage road signal operations, and freeway entrance ramp control. TxDOT requested the Texas Transportation Institute (TTI) to undertake a detailed feasibility study to evaluate the need for ramp metering on S.H. 288. This study includes an analysis of existing and future traffic conditions, a discussion of ramp metering guidelines, and recommendations for the installation of ramp meters.

EXISTING TRAFFIC CONDITIONS

Existing traffic conditions were surveyed by conducting traffic volume counts at all entrance and exit ramps for approximately seven days. A mainlane count at the H.B.&T. railroad was used to calculate mainlane volumes between ramps for each hour, and a mainlane count at Beltway 8 was used to check the summation of inputs and outputs. This volume information was then used to identify critical freeway sections with respect to a demand/capacity relationship. This volume information is presented in Appendix A. Complete copies of seven-day counts are available for ramps and mainlanes upon request.

Northbound Direction

Based on freeway volume data presented in Appendix A and analysis of volume/capacity ratios (*v/c*), the northbound direction operates at Level of Service (LOS) C/D in the AM peak period. Freeways operating in the LOS C/D range generally experience free-flow operations, but minor incidents will cause queuing or reduced speeds. Generally lighter conditions exist from Beltway 8 to Almeda-Genoa (LOS C), but heavier conditions exist (LOS D) from Almeda-Genoa to I-610 and past Holcombe to U.S. 59. Entrance ramps operating at high demands include the Holcombe entry (operating at 1420 vph in the 7:00-8:00 a.m. hour) and the I-610 EB&WB entrance ramps (operating

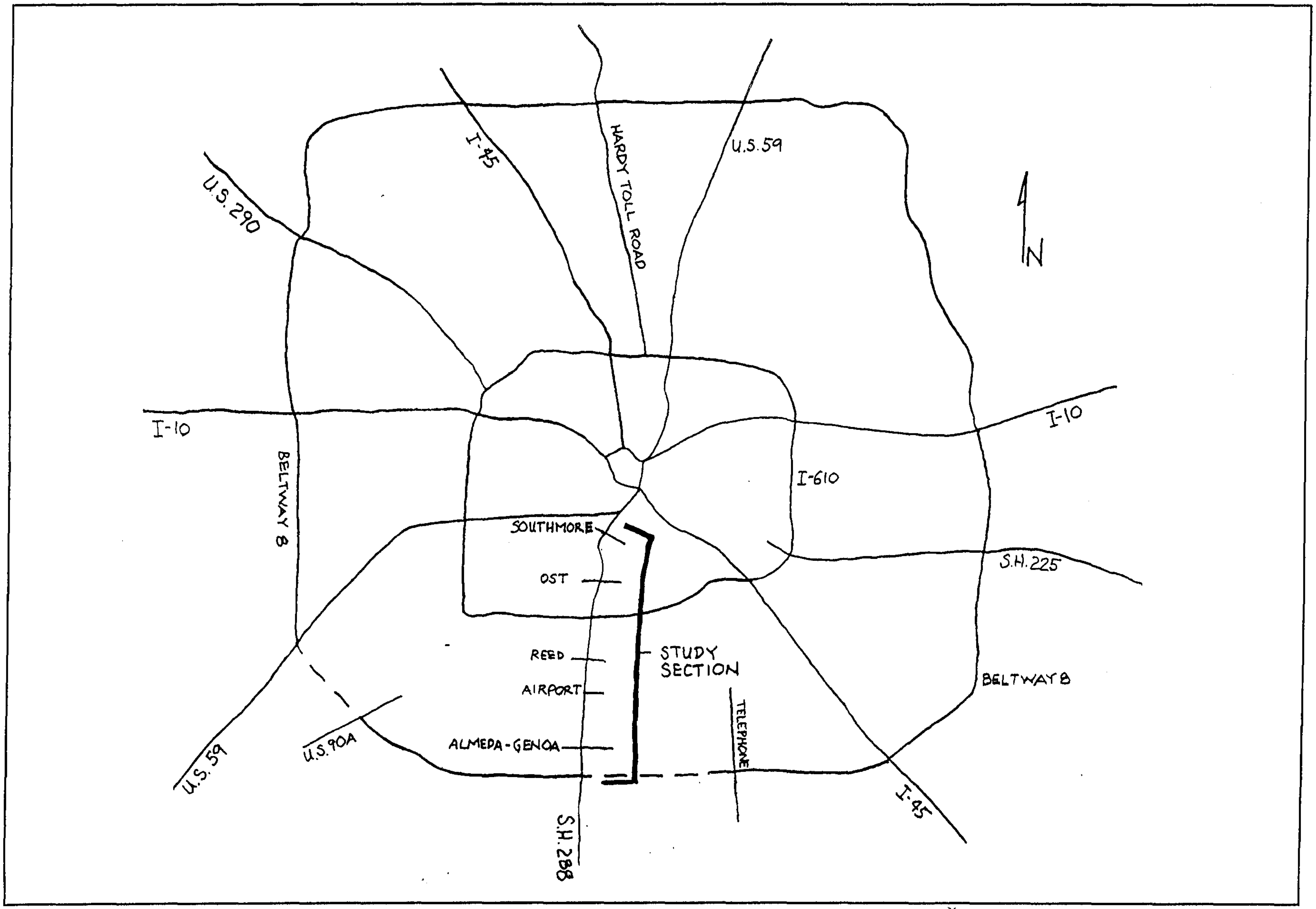

Figure 1. S.H. 288 Study Section. U.S. 59 to South Beltway 8.

over capacity at 2000+ vph) in the same period. The Highway Capacity Manual (1) defines the capacity of a ramp at 1700 vph. The exit ramps operating at a high demand in the AM peak are: I-610 Westbound (1430 vph), Yellowstone (1320 vph), and the MacGregor exit (1400 vph).

Southbound Direction

The southbound direction operates at LOS D from U.S. 59 to Almeda-Genoa, and at LOS C from Almeda-Genoa to the South Beltway in the PM peak. The two most critical entrance ramps at this time are the I-610 EB and Yellowstone ramps. The I-610 EB entry ramp exceeds capacity (1860 vph) from 5:00-6:00 p.m., and the Yellowstone entry (1350 vph) is approaching capacity. The MacGregor (1480 vph) and Holcombe (1300 vph) exit ramps are experiencing heavy volumes in the *AM* peak period. The I-610 EB&WB exit ramps are operating near capacity for 2+ hours in the PM peak.

Travel Times

TTI completed travel time studies on S.H. 288 between I-45 (Gulf Freeway) and F.M. 518 during March and April 1994. Several travel time runs were completed for both directions during the AM, Off-Peak, and PM peak periods using the "floating-car" technique. Average peak period travel times and speeds are presented in Tables 1 and 2. There was no congestion or queuing on the freeway mainlanes during these studies. Detailed travel time and speed information is presented in Appendix B.

TABLE 1. Peak Period Travel Time and Speed Summaries—S.H. 288 Northbound.

Section Limits	Distance		AM Peak Period			PM Peak Period		
			Travel Time	Average Speed		Travel Time	Average Speed	
	(mi)	(km)	(min)	(mi/h)	(km/h)	(min)	(mi/h)	(km/h)
Clear Creek to Fellows	0.78	1.26	0.82	57.2	92.1	0.82	57.4	92.4
Fellows to Almeda-Genoa	1.16	1.87	1.16	60.1	96.5	1.14	61.1	98.2
Almeda-Genoa to Orem	0.96	1.54	0.98	59.1	95.1	0.96	60.1	96.5
Orem to Airport	1.09	1.75	1.06	61.5	99.1	1.07	61.4	98.8
Airport to Reed Rd.	0.98	1.58	0.97	60.7	97.8	0.98	60.3	97.1
Reed Rd. to Bellfort	0.74	1.19	0.84	52.7	84.8	0.73	61.2	98.5
Bellfort to South Loop	0.91	1.46	1.26	43.2	69.6	0.91	60.3	97.1
South Loop to Yellowstone	1.24	1.99	1.51	49.3	79.4	1.25	59.5	95.7
Yellowstone to OST	0.22	0.35	0.26	50.7	81.7	0.24	56.1	90.3
OST to S. MacGregor	0.79	1.27	0.97	48.9	78.8	0.81	58.8	94.7
S. MacGregor to Blodgett	1.06	1.71	1.18	53.9	86.7	1.09	58.3	93.9
Clear Creek to Blodgett	9.93	15.97	11.01	54.1	87.1	10.01	59.5	95.8

TABLE 2. Peak Period Travel Time and Speed Summaries—S.H. 288 Southbound.

Section Limits	Distance		AM Peak Period			PM Peak Period		
			Travel Time	Average Speed		Travel Time	Average Speed	
	(mi)	(km)	(min)	(mi/h)	(km/h)	(min)	(mi/h)	(km/h)
Blodgett to S. MacGregor	1.06	1.71	1.21	52.5	84.5	1.37	46.3	74.5
S. MacGregor to OST	0.79	1.27	0.81	58.5	94.1	0.82	58.1	93.4
OST to Yellowstone	0.22	0.35	0.23	58.6	94.4	0.25	52.8	84.9
Yellowstone to South Loop	1.24	1.99	1.30	57.4	92.4	1.30	57.2	92.1
South Loop to Bellfort	0.91	1.46	0.95	57.4	92.4	0.92	59.5	95.8
Bellfort to Reed Rd.	0.74	1.19	0.80	55.5	89.3	0.83	53.2	85.7
Reed Rd. to Airport	0.98	1.58	0.99	59.7	96.1	0.98	59.8	96.2
Airport to Orem	1.09	1.75	1.15	56.8	91.5	1.12	58.2	93.6
Orem to Almeda-Genoa	0.96	1.54	1.00	57.6	92.7	0.97	59.5	95.9
Almeda-Genoa to Fellows	1.16	1.87	1.23	56.8	91.4	1.14	61.1	98.2
Fellows to Clear Creek	0.78	1.26	0.84	56.1	90.2	0.80	58.7	94.5
Blodgett to Clear Creek	9.93	15.98	10.51	56.7	91.2	10.50	56.7	91.2

SIMULATION OF FUTURE TRAFFIC CONDITIONS

The FREQ simulation model (Release T91) was used to examine the impact of future traffic volumes on mainlane operations. The computer program uses geometric and volume inputs to simulate freeway traffic operations. Program operation is based on a macroscopic deterministic approach that assumes freeway operations can be simulated by disregarding the actual randomness of traffic and individual behavior. Model outputs include freeway travel time, ramp delay, total freeway travel time, total travel distance, average speed, fuel consumption, vehicle emissions, and mainlane delay. The FREQ model was configured for typical weekday traffic operations using the volume data found in Appendix A.

Existing traffic conditions for the year 1995 were simulated using volume and speed data collected at TTI. Simulations for the years 2000, 2005, 2010, and 2015 were run using an assumed 2% growth factor. This growth factor is similar to the historical growth experienced by other freeways in the Houston area. Tables 3 and 4 present the results for the FREQ simulations on S.H. 288 between U.S. 59 and South Beltway 8. These tables include selected model outputs and observations concerning the simulated freeway conditions.

Table 3 summarizes the FREQ10PC results for the existing and projected traffic conditions for northbound S.H. 288. Queuing will begin at the lane drop at the I-610 mainlanes and will grow to Beltway 8 as traffic demand grows over time. Traffic flow problems at this "bottleneck" will be compounded by increasing volumes on the exit ramps to I-610 and increasing entry volumes at Reed Rd. and Bellfort. I-610 EB&WB entrance ramps will soon exceed capacity in both AM and PM peak periods. The Holcombe entrance ramp is currently exceeding capacity in the PM peak, and will exceed capacity in both the AM and PM peaks in approximately 10 years. The MacGregor entrance ramp will also exceed capacity in the AM peak. Exit ramps expected to have capacity problems include Yellowstone, MacGregor, and the U.S. 59 Southwest Freeway exit.

TABLE 3. FREQ10PC Output for S.H. 288 Northbound (24 Hour Totals)

Year	Freeway Travel Time (veh-hr)	Ramp Delay (veh-hr)	Total Travel Time (veh-hr)	Average Speed[2]		Speed[3] <30 mi//h?	Notes/Observations
				(mi/h)	(km/h)		
1995	7489	1480	8969	59.9	96.4	No	No congestion observed. Holcombe entry ramp exceeds capacity during PM peak.
2000[1]	8279	3962	12241	59.6	95.9	No	No congestion observed. I-610 EB&WB entry ramps exceed capacity during AM peak. Holcombe entry ramp exceeds capacity during PM peak.
2005[1]	9077	7676	16753	59.3	95.4	No	No congestion observed. Holcombe entry ramp exceeds capacity during AM and PM peaks. I-610 EB&WB entry ramps exceed capacity during AM peak.
2010[1]	10251	13517	23768	56.9	91.6	Yes	Queuing for 1+ hours during AM peak. AM congestion extends from the lane drop at I-610 to the I-610 entry, and from the Reed Rd exit to Bellfort exit. I-610 EB&WB, and Holcombe entry ramps all exceed capacity in AM peak and I-610 WB and Holcombe entry ramps exceed capacity during PM peak.
2015[1]	11808	28223	40031	53.2	85.6	Yes	Queuing for 1+ hours during AM peak. AM congestion extends from I-610 to Beltway 8 interchange. I-610 EB&WB and Holcombe entry ramps exceed capacity in both AM and PM peaks. MacGregor entry ramp exceeds capacity during AM peak.

NOTES: [1]Future traffic projected by increasing existing demands by 2% per year.
[2]Average speed represents that for the entire freeway modeled for a 24-hour period.
[3]If the average speed for any section was less than 30 mi/h (48 km/h) for a one-hour period, "Yes" is designated.

Table 4 summarized FREQ simulation results for southbound S.H. 288. Based on this analysis, queuing should form in the PM peak period from U.S. 59 to the I-610 interchange. This queuing is a result of: 1) excessive demand on the Yellowstone and I-610 Eastbound entrance ramps; 2) excessive demand on the I-610 EB/WB exit ramps; and 3) the reduction in capacity caused by the 2-lane section between the I-610 exit and I-610 mainlanes. Because of this "bottleneck," conditions improve south of the I-610 entrance to S.H. 288. Another factor in the congestion north of the I-610 interchange is a reduction in mainlane capacity due to merging vehicles at MacGregor and weaving vehicles on the auxiliary lane between the Yellowstone entrance and Holly Hall exit ramps.

TABLE 4. FREQ10PC Output for S.H. 288 Southbound (24 Hour Totals)

Year	Freeway Travel Time (veh-hr)	Ramp Delay (veh-hr)	Total Travel Time (veh-hr)	Average Speed²		Speed³ <30 mi/h ?	Notes/Observations
				(mi/h)	(km/h)		
1995	7797	160	7957	59.6	95.9	No	No congestion observed. Demand exceeds capacity on I-610 EB entry ramp.
2000¹	8638	488	9126	59.2	95.3	No	No congestion observed. Demand exceeds capacity on I-610 EB entry ramp.
2005¹	10095	1818	11913	55.1	88.7	Yes	Queuing for 1+ hours during PM peak. PM peak congestion extends from US 59 to McGregor. I-610 EB entry ramp exceeds capacity (PM).
2010¹	10988	4567	15555	54.5	87.7	Yes	Queuing for 1+ hours during PM peak. PM congestion extends from US 59 to I-610. Yellowstone, I-610 EB entry ramps exceed capacity (PM).
2015¹	11906	8594	20500	53.7	86.4	Yes	Queuing for 2+ hours during PM peak. PM congestion extends from US 59 to I-610. Yellowstone, I-610 EB entry ramps exceed capacity (PM).

NOTES: ¹Future traffic projected by increasing existing demands by 2% per year.
²Average speed represents that for the entire freeway modeled for a 24-hour period.
³If the average speed for any section was less than 30 mi/h (48 km/h) for a one-hour period, "Yes" is designated.

GUIDELINES FOR FREEWAY ENTRANCE RAMP CONTROL SIGNALS

The Texas MUTCD (2) furnishes guidelines for freeway entrance ramp control. The manual states:

> *Installation of freeway entrance ramp control signals may be justified when the total expected delay in traffic in the freeway corridor, including freeway ramps and local streets, is expected to be reduced with ramp control signals and when at least one of the following instances occurs:*
>
> *1. There is recurring congestion on the freeway due to traffic demand more than the capacity; or there is recurring congestion or a several accident hazard at the freeway entrance because of inadequate ramp merging area. A good measure of recurring freeway congestion is freeway operating speed. An early indication of a developing congestion pattern would be freeway operating speeds less than 50 mi/h (80.5 km/h), occurring regularly for a period of half an hour. Freeway operating speeds less than 30 mi/h (48.3 km/h) for a 30 minute period would be an indication of severe congestion.*
>
> *2. The signals are needed to accomplish transportation system management objectives identified locally for freeway traffic flow, such as:*
>
> *a) maintenance of a specific freeway level of service, or*
>
> *b) priority treatments with higher levels of service, for mass transit and carpools.*
>
> *3. The signals are needed to reduce (predictable) sporadic congestion on isolated sections of freeway caused by short-period peak traffic loads from special events or from severe peak loads of recreational traffic (2).*

APPLICATIONS OF RAMP METERING FOR S.H. 288 NORTHBOUND

The northbound direction of S.H. 288 has only sporadic reduced levels of service between the I-610 entry and Holcombe. This reduced level of service is typically defined by reduced speeds. The entrance ramps from I-610 eastbound and westbound currently operate above capacity in the AM peak and the Holcombe entry ramp exceeds capacity in the PM peak. Mainlane volumes north of the I-610 entry are approaching capacity and the freeway experiences occasional slowdowns due to heavy entry ramp volumes at Holcombe. Since only the I-610 entry ramps are at or exceeding capacity, metering would not significantly improve *existing* levels of service on S.H. 288 northbound.

Except for the I-610 entry ramps, no other entrance ramps have existing volumes high enough to warrant ramp control in the AM peak period. The Holcombe entry ramp is exceeding capacity in the PM peak, but is not significantly affecting mainlane traffic. However, the FREQ simulation did suggest that the expected traffic growth will deteriorate mainlane traffic conditions significantly by 2005. The analysis also suggested that the Holcombe entry ramp will exceed capacity between 2000 and 2005. Therefore, ramp metering should be considered for implementation within five years to maintain the current level of service on northbound S.H. 288. Again, because of the 2% per year growth rate used, traffic volumes should be monitored carefully to confirm if this growth rate is accurate. If traffic growth exceeds 2%, ramp control installation should be accelerated to within three years to maintain current levels of service.

Most entrance ramps on northbound S.H. 288 are of either significant length or have auxiliary lanes to accommodate ramp metering. One exception is the Holcombe entry. The extremely high entry volumes combined with high mainlane volumes could cause significant queuing back to the intersection. This problem is compounded by the lack of frontage road between Holcombe and MacGregor, so an easily accessible optional route is not available. Ramp metering would help relieve the weaving and merging problems that will grow with increased ramp and mainlane volumes. However, the Holcombe entry may require some additional modifications, either operational or geometric, to provide an acceptable level of service in the future.

APPLICATIONS OF RAMP METERING FOR S.H. 288 SOUTHBOUND

Based on volume and speed data, S.H. 288 southbound has very little recurring congestion due to the basic freeway geometry. Only the I-610 exit area (where the S.H. 288 mainlanes reduce to 2 lanes) causes sporadic congestion in the PM peak. The I-610 EB to S.H. 288 southbound connection is operating above capacity in the 5:00-6:00 PM hour. However, south of this connection, free-flow conditions exist due to the "metering" effect of the 2-lane section at the I-610 exit. Therefore, ramp metering would not have a significant impact on *existing* freeway operations on S.H. 288 southbound.

No entrance ramps except the I-610 EB to S.H. 288 SB have high enough volumes to require ramp control now. However, as traffic volumes increase, travel conditions will deteriorate. The FREQ simulations show significant congestion by 2005. Therefore, ramp metering should be planned for implementation within the next five to seven years to maintain the existing levels of service on southbound S.H. 288. Due to the recent increase in residential and commercial development in the Pearland area, the 2% per year growth rate assumed in simulation may be too conservative. In this case, ramp metering implementation should be accelerated to within the next three to five years.

Entrance ramps serving southbound S.H. 288 from U.S. 59 to I-610 either have auxiliary lanes or are of significant length to allow for adequate vehicle acceleration. There does not appear to be any merging problems due to geometrics. However, as demand increases at these ramps, merging problems could result. Ramp metering would be an effective method to alleviate some merging and weaving problems that will increase with more traffic. Entry volumes south of Bellfort are extremely low in most cases. The entry ramps from Bellfort, Reed, Airport, Almeda-Genoa, and Beltway 8 do not require ramp control within at least the next fifteen years. Again this recommendation is based on the 2% per year growth factor. This corridor should be reevaluated periodically to examine if this assumption was adequate.

POSITIVE AND NEGATIVE ASPECTS OF RAMP METERING

The following discussion outlines some advantages and disadvantages of ramp metering. The advantages include (3):

1) Improved mainlane flow: metering reduces turbulence and smoothes merge operations;
2) Improved safety at on-ramps: metering breaks up platoons and reduces turbulence;
3) Diversion: diversion to alternate routes will eliminate many short trips, reducing system-wide delay.

The disadvantages to ramp metering include (3):

1) Driver Inequity: inner-city residents complain that they are discriminated against because of waiting in longer queues that those drivers making trips from non-metered ramps.
2) Diversion: diverted traffic may choose routes through neighborhoods or may cause greater congestion on arterial routes.
3) Excessive queues: excessive demand may spill back to the intersection.
4) Environmental concerns: queuing at meters may cause emission "hot-spots" although corridor-wide emissions decrease. This is not seen as a major problem.

The advantages to ramp metering are clear: improved flow and safety. The disadvantages can be reduced or eliminated with careful planning and analysis. The equity issue can be handled in two ways: 1) only have metering in the outbound direction, or 2) from the outer edges of the urbanized area, have all entrance ramps metered. Diversion must be examined and a determination made whether or not the diversion will decrease or increase system-wide delay and congestion. The main point is that each ramp control must be examined for its diversionary effect and judged accordingly. Increased congestion on arterial cross-streets due to heavy entrance ramp volumes is of concern. The possibility of heavy queues blocking a frontage road lane and backing into the intersection must be examined for each ramp considered for control.

Ramp metering must have two other components: education and enforcement. A successful education campaign should have three characteristics. It should: 1) explain the difficulty in managing congestion, 2) explain the cost-effectiveness of congestion management, and 3) be ongoing. If changes are made, inform the public (3). The transportation agencies involved should support the project from the beginning and solicit help from industrial and commercial entities in the community. Enforcement should be coordinated with the affected municipalities and the Metropolitan Transit Authority.

The S.H. 288 corridor will benefit from ramp control up to the time where sheer numbers of vehicles overload the facility. Over the next few years, as traffic growth begins to affect off-peak operations, ramp control could reduce short-term congestion and merging conflicts. However, the metering will not prevent congestion after demands exceed capacity. Ramp control will decrease the time that congestion forms, which is a positive effect.

A major concern is how to operate the ramp metering system when ramp metering will not improve freeway conditions. At night, when volumes are low, the accepted approach is to turn the controls off. During peak periods when the volumes are very high and there are no other alternative routes, the options for the operating mode of ramp control are to:

1) operate the signals at a faster rate than the freeway can accept entering traffic, thereby not contributing to cross-street congestion but not improving mainlane operations;

2) operate the signal in the flashing yellow mode giving drivers an indicator that the system is operational, and the motorist should enter with caution; or

3) turn off advanced flashers and signal heads off.

USE OF RAMP METERING TO ENCOURAGE HOV USAGE

The priority treatment of High Occupancy Vehicles (HOV) on S.H. 288 is a factor to be considered with a ramp control treatment. Since dedicated HOV facilities do not exist in the corridor, ramp metering could encourage the use of carpools and vanpools. If possible, priority entry for HOVs should be considered as an enticement to raise occupancy levels in the corridor.

SUMMARY

The following statements are a result from the analysis of traffic conditions on U.S. 288 and other freeways and from the experience of the authors:

Positive: Ramp metering will:

- Complete the CTMS installation.
- Avoid the charge of favoritism (driver inequity).
- Maintain control over freeway operations.
- Provide improved operations, both corridor and freeway.
- Encourage diversion.
- Encourage use of HOVs.
- Discourage overloading of freeways.
- Be cost effective.

Negative: Ramp metering will:

- Increase the cost of installation.
- Produce conflicts with major land developers.
- Increase maintenance costs.
- Result in conflicts with cross-street operations
- Not be perceived as successful by the public.
- Not be effective at all times.

RECOMMENDATIONS

The following recommendations concerning the implementation of ramp metering on S.H. 288 discussed in this report are accompanied by other recommendations concerning general freeway control approaches. The recommendations are those of the author.

1. Implementation of ramp metering on S.H. 288 from U.S. 59 to Beltway 8:
   a) Install and operate the ramp metering system in a three to five year time period.
   b) Consider designs that encourage HOV use.

2. Policy Decisions
   a) TxDOT should make a commitment to provide ramp metering on all entry ramps.
   b) TxDOT should plan for the priority treatment of high occupancy vehicles at ramps controlled by meters.
   c) TxDOT should make a commitment to consider the extension of ramp control to a closure control.

The decision when and where to implement each of these items and when and how to operate each type of control should be made by the TxDOT Freeway Operations Manager.

CLOSURE

Freeway ramp control systems are a beneficial tool in managing congestion. The benefits are dependant on the size and scope of the problem and the cost of implementing and maintaining the system. In the CTMS in Houston, there is a commitment to provide a traffic monitoring system and a data communications system. The costs of the implementation and management of traffic surveillance systems are shared by many agencies. *Therefore, in a justification statement for the decision to implement ramp metering, only the costs associated with adding ramp metering to the infrastructure of CTMS should be considered.*

Freeway ramp control systems have proven to be effective in improving roadway safety. The improvement in freeway mainline operations and the improvement of merging operations have resulted in the frequency of accidents, while maintaining or increasing traffic flow. *Therefore, if a freeway has congestion and an accident experience that can be related to the quality of operations, ramp control systems should be considered for implementation.*

Freeway ramp control systems have proved to be effective in maintaining acceptable traffic patterns. For ramps that have acceptable alternate routes, ramp metering can be effective in reducing the total input volume when congestion conditions, caused by either non-recurrent or recurrent congestion exist. *Therefore, if TxDOT is committed to improving the freeway operations by freeway traffic management and incident management, ramp control systems should be considered for implementation on all access facilities.*

REFERENCES

1. Highway Capacity Manual -- Special Report 209. Washington, D.C.: Transportation Research Board, National Research Council, 1994.

2. Texas Manual on Uniform Traffic Control Devices for Streets and Highways, State Department of Highways and Public Transportation, 1980; Revision 4, 1988.

3. Collins, Kent. *A Guide to Successful Ramp Metering Implementation.* Published in *Graduate Student Papers on Advanced Surface Transportation Systems.* Transportation Engineering Program, Civil Engineering Department, Texas A&M University, August 1994.

SH 288 SOUTH FRWY NORTHBOUND --- TYPICAL WEEKDAY

TIME (Begin)	(Actual Count) Jun-94	M/L	S. BW 8 Exit Jun-94	M/L	S. BW 8 Entry Jun-94	M/L	Almeda-Genoa Exit Jun-94	M/L	Almeda-Genoa Entry Jun-94	M/L	Orem Exit Jun-94	M/L	Orem Entry Jun-94	M/L	Airport Exit Jun-94	M/L
12:00 AM	140	150	10	140	10	150	10	140	50	190	10	180	10	190	10	180
1:00 AM	100	110	10	100	10	110	10	100	40	140	10	130	10	140	10	130
2:00 AM	80	120	10	110	10	120	10	110	30	140	10	130	10	140	10	130
3:00 AM	110	170	10	160	10	170	10	160	20	180	10	170	10	180	10	170
4:00 AM	240	340	10	330	20	350	10	340	60	400	10	390	10	400	10	390
5:00 AM	1060	1270	10	1260	40	1300	60	1240	190	1430	10	1420	10	1430	10	1420
6:00 AM	3170	2960	30	2930	140	3070	160	2910	560	3470	10	3460	10	3470	50	3420
7:00 AM	4590	3810	100	3710	250	3960	260	3700	950	4650	20	4630	20	4650	90	4560
8:00 AM	2550	2360	40	2320	120	2440	130	2310	580	2890	10	2880	10	2890	70	2820
9:00 AM	1540	1450	30	1420	90	1510	80	1430	390	1820	10	1810	10	1820	50	1770
10:00 AM	1370	1730	30	1700	70	1770	90	1680	350	2030	10	2020	10	2030	50	1980
11:00 AM	1270	1490	30	1460	80	1540	80	1460	340	1800	10	1790	10	1800	40	1760
12:00 PM	1250	750	30	720	80	800	90	710	360	1070	10	1060	10	1070	50	1020
1:00 PM	1330	1010	40	970	90	1060	80	980	380	1360	10	1350	10	1360	40	1320
2:00 PM	1380	960	40	920	80	1000	100	900	400	1300	10	1290	10	1300	50	1250
3:00 PM	1270	1050	40	1010	80	1090	100	990	400	1390	10	1380	10	1390	60	1330
4:00 PM	1240	1220	40	1180	80	1260	110	1150	380	1530	10	1520	10	1530	60	1470
5:00 PM	1340	1230	50	1180	90	1270	100	1170	370	1540	10	1530	10	1540	70	1470
6:00 PM	1320	1400	40	1360	50	1410	100	1310	330	1640	10	1630	10	1640	80	1560
7:00 PM	920	1000	30	970	50	1020	80	940	270	1210	10	1200	10	1210	70	1140
8:00 PM	620	740	20	720	40	760	70	690	210	900	10	890	10	900	50	850
9:00 PM	570	500	10	490	20	510	60	450	180	630	10	620	10	630	40	590
10:00 PM	450	440	10	430	20	450	40	410	160	570	10	560	10	570	30	540
11:00 PM	290	100	10	90	10	100	30	70	110	180	10	170	10	180	20	160
TOTAL	28200	26360	680	25680	1540	27220	1870	25350	7110	32460	250	32210	250	32460	1030	31430

All data collected by the Texas Transportation Institute.

SH 288 SOUTH FRWY NORTHBOUND --- TYPICAL WEEKDAY

TIME (Begin)	Airport Entry Jun-94	M/L	Reed Exit Jun-94	M/L	Reed Entry Jun-94	M/L	Bellfort Exit Jun-94	M/L	610 EB Exit Jun-94	610 WB Exit Jun-94	M/L	Bellfort Entry Jun-94	M/L	610 EB Entry Jun-94	610 WB Entry Jun-94	M/L
12:00 AM	70	250	20	230	110	340	20	320	70	100	150	20	170	200	150	520
1:00 AM	40	170	10	160	80	240	10	230	50	70	110	10	120	140	100	360
2:00 AM	40	170	10	160	60	220	10	210	40	70	100	10	110	130	100	340
3:00 AM	50	220	10	210	60	270	10	260	50	90	120	10	130	100	100	330
4:00 AM	70	460	10	450	70	520	10	510	90	260	160	10	170	130	180	480
5:00 AM	220	1640	40	1600	210	1810	30	1780	370	860	550	20	570	370	410	1350
6:00 AM	550	3970	90	3880	570	4450	130	4320	820	1420	2080	70	2150	980	1360	4490
7:00 AM	780	5340	210	5130	820	5950	210	5740	930	1430	3380	100	3480	2040	2050	7570
8:00 AM	480	3300	160	3140	550	3690	110	3580	560	1010	2010	90	2100	1780	1490	5370
9:00 AM	360	2130	110	2020	460	2480	100	2380	410	830	1140	80	1220	1190	1040	3450
10:00 AM	310	2290	90	2200	410	2610	100	2510	420	740	1350	90	1440	920	900	3260
11:00 AM	260	2020	80	1940	420	2360	90	2270	430	710	1130	90	1220	970	900	3090
12:00 PM	290	1310	80	1230	450	1680	100	1580	440	660	480	110	590	1010	1150	2750
1:00 PM	330	1650	90	1560	400	1960	100	1860	460	680	720	100	820	1100	1220	3140
2:00 PM	350	1600	90	1510	490	2000	110	1890	490	750	650	80	730	1130	1340	3200
3:00 PM	380	1710	90	1620	570	2190	100	2090	520	670	900	110	1010	1140	1170	3320
4:00 PM	350	1820	100	1720	540	2260	120	2140	550	750	840	110	950	1180	1140	3270
5:00 PM	320	1790	100	1690	480	2170	120	2050	590	740	720	110	830	1250	1080	3160
6:00 PM	340	1900	90	1810	460	2270	110	2160	490	640	1030	70	1100	990	840	2930
7:00 PM	300	1440	100	1340	400	1740	110	1630	340	450	840	70	910	840	640	2390
8:00 PM	270	1120	80	1040	320	1360	80	1280	230	420	630	50	680	600	440	1720
9:00 PM	230	820	60	760	310	1070	60	1010	210	430	370	50	420	610	400	1430
10:00 PM	250	790	50	740	280	1020	50	970	170	320	480	50	530	530	440	1500
11:00 PM	160	320	40	280	200	480	40	440	120	180	140	40	180	390	300	870
TOTAL	6800	38230	1810	36420	8720	45140	1930	43210	8850	14280	20080	1550	21630	19720	18940	60290

All data collected by the Texas Transportation Institute.

SH 288 SOUTH FRWY NORTHBOUND --- TYPICAL WEEKDAY

TIME (Begin)	Holly Hall Entry Jun-94	M/L	Yellowstone Exit Jun-94	M/L	Holcombe Entry Nov-93	*M/L* May-95	McGregor Exit Nov-93	M/L	Binz Exit Nov-93	M/L	McGregor Entry Nov-93	M/L	Southmore Exit Nov-93	M/L	Southmore Entry Nov-93	M/L	US 59 WB Exit Nov-93	M/L
12:00 AM	60	580	100	480	220	700	40	660	20	640	80	720	70	650	80	730	110	620
1:00 AM	30	390	90	300	180	480	20	460	10	450	50	500	50	450	40	490	60	430
2:00 AM	20	360	80	280	150	430	20	410	10	400	30	430	30	400	40	440	50	390
3:00 AM	20	350	80	270	100	370	20	350	10	340	20	360	20	340	30	370	40	330
4:00 AM	30	510	120	390	170	560	30	530	10	520	30	550	40	510	40	550	50	500
5:00 AM	130	1480	230	1250	340	1590	150	1440	40	1400	90	1490	60	1430	100	1530	140	1390
6:00 AM	330	4820	880	3940	720	4660	770	3890	120	3770	290	4060	160	3900	260	4160	580	3580
7:00 AM	710	8280	1320	6960	1420	8380	1400	6980	310	6670	740	7410	640	6770	570	7340	1620	5720
8:00 AM	510	5880	950	4930	1110	6040	1260	4780	330	4450	470	4920	670	4250	450	4700	1180	3520
9:00 AM	360	3810	710	3100	980	4080	710	3370	180	3190	380	3570	530	3040	380	3420	610	2810
10:00 AM	320	3580	680	2900	1050	3950	540	3410	140	3270	470	3740	400	3340	390	3730	600	3130
11:00 AM	360	3450	650	2800	1130	3930	480	3450	130	3320	590	3910	310	3600	490	4090	680	3410
12:00 PM	350	3100	690	2410	1230	3640	490	3150	120	3030	620	3650	350	3300	580	3880	710	3170
1:00 PM	380	3520	920	2600	1240	3840	450	3390	130	3260	630	3890	340	3550	540	4090	650	3440
2:00 PM	390	3590	840	2750	1330	4080	550	3530	140	3390	800	4190	340	3850	550	4400	700	3700
3:00 PM	410	3730	790	2940	1800	4740	460	4280	160	4120	1250	5370	380	4990	670	5660	820	4840
4:00 PM	490	3760	730	3030	1730	4760	410	4350	150	4200	1240	5440	370	5070	610	5680	780	4900
5:00 PM	550	3710	680	3030	1520	4550	410	4140	160	3980	1070	5050	450	4600	670	5270	700	4570
6:00 PM	360	3290	550	2740	980	3720	370	3350	130	3220	620	3840	290	3550	530	4080	630	3450
7:00 PM	270	2660	420	2240	740	2980	240	2740	80	2660	500	3160	230	2930	420	3350	520	2830
8:00 PM	180	1900	320	1580	550	2130	140	1990	60	1930	360	2290	170	2120	280	2400	360	2040
9:00 PM	170	1600	260	1340	510	1850	140	1710	60	1650	290	1940	130	1810	250	2060	300	1760
10:00 PM	180	1680	270	1410	430	1840	220	1620	60	1560	230	1790	120	1670	200	1870	250	1620
11:00 PM	110	980	230	750	410	1160	110	1050	40	1010	350	1360	90	1270	160	1430	200	1230
TOTAL	6720	67010	12590	54420	20040	74460	9430	65030	2600	62430	11200	73630	6240	67390	8330	75720	12340	63380

All data collected by the Texas Transportation Institute.

SH 288 SOUTH FRWY SOUTHBOUND --- TYPICAL WEEKDAY

TIME (Begin)	M/L	U.S. 59 EB Entry	M/L	Southmore Exit Nov-93	M/L	Southmore Entry Nov-93	M/L	McGregor Exit Nov-93	M/L	Binz Entry Nov-93	M/L	McGregor Entry Nov-93	Nov-93 *M/L*	Holcombe Exit Nov-93	M/L	Yellowstone Entry Jun-94	M/L	Holly Hall Exit Jun-94
12:00 AM	780	130	910	90	820	80	900	90	810	30	840	60	900	160	740	160	900	90
1:00 AM	520	80	600	60	540	50	590	50	540	10	550	30	580	100	480	100	580	50
2:00 AM	380	100	480	50	430	40	470	30	440	10	450	30	480	110	370	90	460	40
3:00 AM	310	50	360	30	330	20	350	40	310	10	320	20	340	100	240	70	310	20
4:00 AM	450	50	500	40	460	20	480	80	400	10	410	20	430	170	260	90	350	40
5:00 AM	1340	110	1450	90	1360	40	1400	390	1010	20	1030	40	1070	340	730	130	860	120
6:00 AM	3930	420	4350	410	3940	100	4040	1340	2700	50	2750	110	2860	1100	1760	270	2030	310
7:00 AM	4890	760	5650	920	4730	250	4980	1480	3500	130	3630	350	3980	1300	2680	540	3220	450
8:00 AM	4200	660	4860	830	4030	270	4300	1240	3060	130	3190	250	3440	1080	2360	450	2810	440
9:00 AM	3590	600	4190	600	3590	280	3870	920	2950	90	3040	210	3250	860	2390	450	2840	330
10:00 AM	3460	600	4060	550	3510	330	3840	770	3070	120	3190	280	3470	900	2570	520	3090	340
11:00 AM	3600	650	4250	570	3680	400	4080	750	3330	140	3470	360	3830	900	2930	610	3540	370
12:00 PM	3200	700	3900	540	3360	500	3860	790	3070	160	3230	450	3680	950	2730	610	3340	420
1:00 PM	3490	730	4220	570	3650	460	4110	790	3320	150	3470	380	3850	950	2900	670	3570	410
2:00 PM	3820	740	4560	570	3990	500	4490	950	3540	160	3700	500	4200	1020	3180	730	3910	430
3:00 PM	4400	700	5100	610	4490	570	5060	750	4310	250	4560	720	5280	1010	4270	1090	5360	460
4:00 PM	5290	800	6090	680	5410	590	6000	670	5330	340	5670	870	6540	990	5550	1350	6900	530
5:00 PM	6670	780	7450	770	6680	700	7380	710	6670	490	7160	890	8050	990	7060	1240	8300	650
6:00 PM	4270	750	5020	520	4500	520	5020	620	4400	220	4620	480	5100	780	4320	710	5030	480
7:00 PM	2780	520	3300	400	2900	400	3300	370	2930	140	3070	370	3440	600	2840	530	3370	360
8:00 PM	2100	400	2500	280	2220	310	2530	250	2280	100	2380	270	2650	440	2210	410	2620	260
9:00 PM	2270	410	2680	270	2410	240	2650	230	2420	100	2520	210	2730	420	2310	330	2640	220
10:00 PM	2010	370	2380	250	2130	180	2310	380	1930	60	1990	170	2160	370	1790	310	2100	200
11:00 PM	1400	230	1630	180	1450	130	1580	180	1400	60	1460	200	1660	300	1360	340	1700	180
TOTAL	69150	11340	80490	9880	42870	6980	49850	13870	63720	2980	66700	7270	73970	15940	58030	11800	69830	7200

All data collected by the Texas Transportation Institute.

SH 288 SOUTH FRWY SOUTHBOUND --- TYPICAL WEEKDAY

TIME (Begin)	M/L	610 EB Exit Jul-94	610 WB Exit Jun-94	M/L	610 EB Entry Jun-94	M/L	Bellfort Exit Jun-94	M/L	610 WB Entry Jun-94	M/L	Bellfort Entry Jun-94	M/L	Reed Exit Jun-94	M/L	Reed Entry Jul-94	M/L	Airport Exit Jun-94
12:00 AM	810	200	270	340	190	530	70	460	100	560	30	590	140	450	30	480	140
1:00 AM	530	140	160	230	110	340	50	290	60	350	10	360	80	280	20	300	60
2:00 AM	420	110	140	170	100	270	50	220	50	270	10	280	70	210	20	230	70
3:00 AM	290	90	80	120	50	170	30	140	40	180	10	190	50	140	10	150	40
4:00 AM	310	90	110	110	50	160	40	120	70	190	10	200	40	160	10	170	30
5:00 AM	740	180	230	330	140	470	60	410	230	640	20	660	100	560	20	580	40
6:00 AM	1720	430	710	580	390	970	230	740	470	1210	60	1270	290	980	30	1010	120
7:00 AM	2770	700	940	1130	570	1700	290	1410	440	1850	80	1930	390	1540	50	1590	280
8:00 AM	2370	630	1080	660	530	1190	240	950	330	1280	80	1360	360	1000	40	1040	230
9:00 AM	2510	610	890	1010	530	1540	240	1300	340	1640	90	1730	350	1380	40	1420	190
10:00 AM	2750	720	960	1070	600	1670	220	1450	340	1790	90	1880	380	1500	50	1550	230
11:00 AM	3170	780	1070	1320	670	1990	270	1720	350	2070	90	2160	390	1770	50	1820	260
12:00 PM	2920	850	1200	870	720	1590	280	1310	400	1710	100	1810	440	1370	70	1440	280
1:00 PM	3160	880	1150	1130	740	1870	290	1580	360	1940	100	2040	460	1580	70	1650	290
2:00 PM	3480	1010	1260	1210	840	2050	370	1680	440	2120	110	2230	530	1700	70	1770	340
3:00 PM	4900	1410	1360	2130	1050	3180	380	2800	530	3330	140	3470	620	2850	90	2940	460
4:00 PM	6370	1650	1650	3070	1440	4510	350	4160	690	4850	170	5020	730	4290	120	4410	600
5:00 PM	7650	1760	2030	3860	1860	5720	320	5400	830	6230	210	6440	760	5680	170	5850	690
6:00 PM	4550	1020	1480	2050	1360	3410	300	3110	590	3700	140	3840	600	3240	120	3360	540
7:00 PM	3010	740	1100	1170	880	2050	260	1790	370	2160	110	2270	490	1780	100	1880	430
8:00 PM	2360	590	850	920	610	1530	210	1320	300	1620	100	1720	400	1320	80	1400	350
9:00 PM	2420	520	740	1160	580	1740	190	1550	270	1820	90	1910	390	1520	90	1610	300
10:00 PM	1900	450	630	820	460	1280	150	1130	230	1360	70	1430	350	1080	60	1140	270
11:00 PM	1520	420	590	510	380	890	120	770	160	930	50	980	270	710	40	750	240
TOTAL	62630	15980	20680	25970	14850	40820	5010	35810	7990	43800	1970	45770	8680	37090	1450	38540	6480

All data collected by the Texas Transportation Institute.

SH 288 SOUTH FRWY SOUTHBOUND --- TYPICAL WEEKDAY

M/L	TIME (Begin)	Airport Entry Jun-94	M/L	Orem Exit Jun-94	M/L	Orem Entry Jun-94	M/L	Almeda-Genoa Exit Jun-94	M/L	Almeda-Genoa Entry Jun-94	M/L	S. BW 8 Exit Jun-94	M/L	S. BW 8 Entry Jun-94	(Calc.) M/L	Actual Count Jun-94
340	12:00 AM	20	360	10	350	10	360	90	270	20	290	10	280	10	290	330
240	1:00 AM	10	250	10	240	10	250	50	200	10	210	10	200	10	210	180
160	2:00 AM	10	170	10	160	10	170	50	120	10	130	10	120	10	130	150
110	3:00 AM	10	120	10	110	10	120	30	90	10	100	10	90	10	100	130
140	4:00 AM	10	150	10	140	10	150	30	120	20	140	10	130	10	140	210
540	5:00 AM	10	550	10	540	10	550	70	480	20	500	20	480	10	490	520
890	6:00 AM	30	920	10	910	10	920	250	670	70	740	110	630	20	650	1010
1310	7:00 AM	50	1360	10	1350	10	1360	350	1010	80	1090	80	1010	30	1040	1000
810	8:00 AM	40	850	10	840	10	850	300	550	70	620	70	550	20	570	970
1230	9:00 AM	40	1270	10	1260	10	1270	280	990	70	1060	70	990	20	1010	1070
1320	10:00 AM	50	1370	10	1360	10	1370	340	1030	70	1100	70	1030	20	1050	1140
1560	11:00 AM	50	1610	20	1590	10	1600	330	1270	70	1340	60	1280	30	1310	1250
1160	12:00 PM	60	1220	20	1200	10	1210	390	820	90	910	80	830	30	860	1320
1360	1:00 PM	60	1420	20	1400	20	1420	370	1050	70	1120	70	1050	30	1080	1340
1430	2:00 PM	70	1500	20	1480	20	1500	410	1090	80	1170	80	1090	30	1120	1510
2480	3:00 PM	90	2570	20	2550	20	2570	560	2010	120	2130	110	2020	40	2060	2040
3810	4:00 PM	90	3900	10	3890	10	3900	680	3220	140	3360	160	3200	60	3260	3050
5160	5:00 PM	130	5290	20	5270	10	5280	830	4450	200	4650	220	4430	80	4510	4350
2820	6:00 PM	110	2930	20	2910	10	2920	560	2360	140	2500	110	2390	50	2440	2620
1450	7:00 PM	90	1540	10	1530	10	1540	400	1140	90	1230	60	1170	30	1200	1480
1050	8:00 PM	80	1130	10	1120	10	1130	320	810	70	880	40	840	30	870	1100
1310	9:00 PM	60	1370	10	1360	10	1370	280	1090	70	1160	40	1120	20	1140	990
870	10:00 PM	60	930	10	920	10	930	240	690	60	750	30	720	10	730	820
510	11:00 PM	40	550	10	540	10	550	170	380	50	430	20	410	10	420	640
32060	TOTAL	1270	33330	310	33020	270	33290	7380	25910	1700	27610	1550	26060	620	26680	29220

All data collected by the Texas Transportation Institute.

ROADWAY NAME : SH 288 (SOUTH FREEWAY)
FUNCTIONAL CLASS : OTHER FREEWAY OR EXPRESSWAY
DIRECTION OF TRAVEL : NORTHBOUND
STUDY PERIOD : A.M. PEAK (6:30 - 8:30)

SEGMENT DESCRIPTION	LENGTH (MI)	TIME (MIN)	SPEED (MPH)	TIME (MIN)	SPEED (MPH)	TIME (MIN)	SPEED (MPH)	TIME (MIN)	SPEED (MPH)	TIME (MIN)	SPEED (MPH)	TIME (MIN)	SPEED (MPH)	TIME (MIN)	SPEED (MPH)	TIME (MIN)	SPEED (MPH)	AVG. TIME (MIN)	CUM. TIME (MIN)	AVG. SPEED (MPH)
DATE (M/D/Y) :		03/24/94		03/30/94		03/30/94		04/29/94		.		.		.		.				
START TIME :		655		730		805		730		.		.		.		.				
WEATHER :		CLEAR		CLEAR		CLEAR		CLEAR		.		.		.		.				
LIGHT :		DAYLIGHT		DAYLIGHT		DAYLIGHT		DAYLIGHT		.		.		.		.				
PAVEMENT :		DRY		DRY		DRY		DRY		.		.		.		.				
INCIDENTS :		NONE		NONE		NONE		NONE												
SH 6 TO FM 518/FM 3344	5.27	4.93	64.14	5.03	62.86	5.40	58.56	5.28	59.89	.	.	.	.	.	.	.	.	5.16	5.16	61.28
FM 518/FM 3344 TO HUGHES RANCH ROAD	1.04	1.02	61.18	0.97	64.33	1.10	56.73	1.00	62.40	.	.	.	.	.	.	.	.	1.02	6.18	61.03
HUGHES RANCH ROAD TO CLEAR CREEK	1.05	1.00	63.00	0.98	64.29	1.10	57.27	1.03	61.17	.	.	.	.	.	.	.	.	1.03	7.21	61.31
CLEAR CREEK TO FELLOWS	0.78	0.77	60.78	0.78	60.00	0.87	53.79	0.85	55.06	.	.	.	.	.	.	.	.	0.82	8.03	57.25
FELLOWS TO ALMEDA-GENOA	1.16	1.12	62.14	1.12	62.14	1.23	56.59	1.17	59.49	.	.	.	.	.	.	.	.	1.16	9.19	60.00
ALMEDA-GENOA TO OREM	0.96	0.93	61.94	1.05	54.86	0.97	59.38	0.95	60.63	.	.	.	.	.	.	.	.	0.98	10.16	59.08
OREM TO AIRPORT	1.09	1.03	63.50	1.05	62.29	1.10	59.45	1.07	61.12	.	.	.	.	.	.	.	.	1.06	11.23	61.55
AIRPORT TO REED RD	0.98	0.97	60.62	0.93	63.23	1.02	57.65	0.95	61.89	.	.	.	.	.	.	.	.	0.97	12.19	60.78
REED RD TO BELLFORT	0.74	0.70	63.43	0.82	54.15	0.78	56.92	1.07	41.50	.	.	.	.	.	.	.	.	0.84	13.04	52.70
BELLFORT TO SOUTH LOOP	0.91	0.88	62.05	2.27	24.05	0.98	55.71	0.92	59.35	.	.	.	.	.	.	.	.	1.26	14.30	43.25
SOUTH LOOP TO YELLOWSTONE	1.24	1.20	62.00	2.28	32.63	1.30	57.23	1.25	59.52	.	.	.	.	.	.	.	.	1.51	15.81	49.35
YELLOWSTONE TO O S T	0.22	0.23	57.39	0.33	40.00	0.25	52.80	0.23	57.39	.	.	.	.	.	.	.	.	0.26	16.07	50.77
O S T TO S MACGREGOR	0.79	0.82	57.80	1.40	33.86	0.82	57.80	0.83	57.11	.	.	.	.	.	.	.	.	0.97	17.03	48.99
S MACGREGOR TO BLODGETT	1.06	1.08	58.89	1.30	48.92	1.12	56.79	1.22	52.13	.	.	.	.	.	.	.	.	1.18	18.21	53.90
BLODGETT TO ALABAMA	0.51	0.52	58.85	0.98	31.22	0.52	58.85	0.48	63.75	.	.	.	.	.	.	.	.	0.63	18.84	48.96
ALABAMA TO GULF FWY	1.00	1.02	58.82	1.30	46.15	0.97	61.86	0.98	61.22	.	.	.	.	.	.	.	.	1.07	19.91	56.21
TOTALS :	18.80	18.22		22.59		19.53		19.28		.		.		.		.				
AVERAGES :			61.91		49.93		57.76		58.51		.		.		.		.		19.91	56.67

ROADWAY NAME : SH 288 (SOUTH FREEWAY)
FUNCTIONAL CLASS : OTHER FREEWAY OR EXPRESSWAY
DIRECTION OF TRAVEL : NORTHBOUND
STUDY PERIOD : OFF PEAK (9:30 - 15:00)

DATE (M/D/Y) :		04/28/94		04/29/94		.		.		.		.		.		.					
START TIME :		1450		1204		.		.		.		.		.		.					
WEATHER :		OVERCAST		CLEAR		.		.		.		.		.		.					
LIGHT :		DAYLIGHT		DAYLIGHT		.		.		.		.		.		.					
PAVEMENT :		DRY		DRY		.		.		.		.		.		.					
INCIDENTS :		NONE		NONE																	
SEGMENT DESCRIPTION	LENGTH (MI)	TIME (MIN)	SPEED (MPH)	TIME (MIN)	SPEED (MPH)	TIME (MIN)	SPEED (MPH)	TIME (MIN)	SPEED (MPH)	TIME (MIN)	SPEED (MPH)	TIME (MIN)	SPEED (MPH)	TIME (MIN)	SPEED (MPH)	TIME (MIN)	SPEED (MPH)	AVG. TIME (MIN)	CUM. TIME (MIN)	AVG. SPEED (MPH)	
SH 6 TO FM 518/FM 3344	5.27	5.38	58.77	5.22	60.57	.	.	.	.	.	.	.	.	.	.	.	.	5.30	5.30	59.66	
FM 518/FM 3344 TO HUGHES RANCH ROAD	1.04	1.07	58.32	0.97	64.33	.	.	.	.	.	.	.	.	.	.	.	.	1.02	6.32	61.18	
HUGHES RANCH ROAD TO CLEAR CREEK	1.05	1.05	60.00	1.17	53.85	.	.	.	.	.	.	.	.	.	.	.	.	1.11	7.43	56.76	
CLEAR CREEK TO FELLOWS	0.78	0.85	55.06	0.77	60.78	.	.	.	.	.	.	.	.	.	.	.	.	0.81	8.24	57.78	
FELLOWS TO ALMEDA-GENOA	1.16	1.15	60.52	1.08	64.44	.	.	.	.	.	.	.	.	.	.	.	.	1.12	9.36	62.42	
ALMEDA-GENOA TO OREM	0.96	0.92	62.61	0.90	64.00	.	.	.	.	.	.	.	.	.	.	.	.	0.91	10.27	63.30	
OREM TO AIRPORT	1.09	1.07	61.12	1.03	63.50	.	.	.	.	.	.	.	.	.	.	.	.	1.05	11.32	62.29	
AIRPORT TO REED RD	0.98	1.00	58.80	0.93	63.23	.	.	.	.	.	.	.	.	.	.	.	.	0.97	12.28	60.93	
REED RD TO BELLFORT	0.74	0.80	55.50	0.72	61.67	.	.	.	.	.	.	.	.	.	.	.	.	0.76	13.04	58.42	
BELLFORT TO SOUTH LOOP	0.91	0.88	62.05	0.92	59.35	.	.	.	.	.	.	.	.	.	.	.	.	0.90	13.94	60.67	
SOUTH LOOP TO YELLOWSTONE	1.24	1.30	57.23	1.27	58.58	.	.	.	.	.	.	.	.	.	.	.	.	1.29	15.23	57.90	
YELLOWSTONE TO O S T	0.22	0.25	52.80	0.25	52.80	.	.	.	.	.	.	.	.	.	.	.	.	0.25	15.48	52.80	
O S T TO S MACGREGOR	0.79	0.83	57.11	0.90	52.67	.	.	.	.	.	.	.	.	.	.	.	.	0.87	16.34	54.80	
S MACGREGOR TO BLODGETT	1.06	1.12	56.79	1.07	59.44	.	.	.	.	.	.	.	.	.	.	.	.	1.10	17.44	58.08	
BLODGETT TO ALABAMA	0.51	0.53	57.74	0.72	42.50	.	.	.	.	.	.	.	.	.	.	.	.	0.63	18.06	48.96	
ALABAMA TO GULF FWY	1.00	1.97	30.46	1.10	54.55	.	.	.	.	.	.	.	.	.	.	.	.	1.54	19.60	39.09	
TOTALS :	18.80	20.17		19.02		.		.		.		.		.		.					
AVERAGES :			55.92		59.31		.		.		.		.		.		.		19.60	57.57	

ROADWAY NAME : SH 288 (SOUTH FREEWAY)
FUNCTIONAL CLASS : OTHER FREEWAY OR EXPRESSWAY
DIRECTION OF TRAVEL : NORTHBOUND
STUDY PERIOD : P.M. PEAK (16:30 - 18:30)

SEGMENT DESCRIPTION	LENGTH (MI)	TIME (MIN)	SPEED (MPH)	TIME (MIN)	SPEED (MPH)	TIME (MIN)	SPEED (MPH)	TIME (MIN)	SPEED (MPH)	TIME (MIN)	SPEED (MPH)	TIME (MIN)	SPEED (MPH)	TIME (MIN)	SPEED (MPH)	TIME (MIN)	SPEED (MPH)	AVG. TIME (MIN)	CUM. TIME (MIN)	AVG. SPEED (MPH)
DATE (M/D/Y) :		04/18/94		04/20/94		.		.		.		.		.		.				
START TIME :		1800		1705		.		.		.		.		.		.				
WEATHER :		OVERCAST		OVERCAST		.		.		.		.		.		.				
LIGHT :		DAYLIGHT		DAYLIGHT		.		.		.		.		.		.				
PAVEMENT :		DRY		DRY		.		.		.		.		.		.				
INCIDENTS :		NONE		NONE																
SH 6 TO FM 518/FM 3344	5.27	5.20	60.81	5.17	61.16	.	.	.	.	.	.	.	.	.	.	.	.	5.19	5.19	60.98
FM 518/FM 3344 TO HUGHES RANCH ROAD	1.04	1.02	61.18	1.05	59.43	.	.	.	.	.	.	.	.	.	.	.	.	1.04	6.22	60.29
HUGHES RANCH ROAD TO CLEAR CREEK	1.05	1.07	58.88	1.05	60.00	.	.	.	.	.	.	.	.	.	.	.	.	1.06	7.28	59.43
CLEAR CREEK TO FELLOWS	0.78	0.78	60.00	0.85	55.06	.	.	.	.	.	.	.	.	.	.	.	.	0.82	8.10	57.42
FELLOWS TO ALMEDA-GENOA	1.16	1.13	61.59	1.15	60.52	.	.	.	.	.	.	.	.	.	.	.	.	1.14	9.24	61.05
ALMEDA-GENOA TO OREM	0.96	0.95	60.63	0.97	59.38	.	.	.	.	.	.	.	.	.	.	.	.	0.96	10.20	60.00
OREM TO AIRPORT	1.09	1.05	62.29	1.08	60.56	.	.	.	.	.	.	.	.	.	.	.	.	1.07	11.26	61.41
AIRPORT TO REED RD	0.98	0.97	60.62	0.98	60.00	.	.	.	.	.	.	.	.	.	.	.	.	0.98	12.24	60.31
REED RD TO BELLFORT	0.74	0.72	61.67	0.73	60.82	.	.	.	.	.	.	.	.	.	.	.	.	0.73	12.96	61.24
BELLFORT TO SOUTH LOOP	0.91	0.88	62.05	0.93	58.71	.	.	.	.	.	.	.	.	.	.	.	.	0.91	13.87	60.33
SOUTH LOOP TO YELLOWSTONE	1.24	1.25	59.52	1.25	59.52	.	.	.	.	.	.	.	.	.	.	.	.	1.25	15.12	59.52
YELLOWSTONE TO O S T	0.22	0.22	60.00	0.25	52.80	.	.	.	.	.	.	.	.	.	.	.	.	0.24	15.35	56.17
O S T TO S MACGREGOR	0.79	0.83	57.11	0.78	60.77	.	.	.	.	.	.	.	.	.	.	.	.	0.81	16.16	58.88
S MACGREGOR TO BLODGETT	1.06	1.10	57.82	1.08	58.89	.	.	.	.	.	.	.	.	.	.	.	.	1.09	17.25	58.35
BLODGETT TO ALABAMA	0.51	0.58	52.76	0.53	57.74	.	.	.	.	.	.	.	.	.	.	.	.	0.56	17.80	55.14
ALABAMA TO GULF FWY	1.00	1.07	56.07	3.05	19.67	.	.	.	.	.	.	.	.	.	.	.	.	2.06	19.86	29.13
TOTALS :	18.80	18.82		20.90		.		.		.		.		.		.				
AVERAGES :			59.94		53.97		.		.		.		.		.		.		19.86	56.80

ROADWAY NAME : SH 288 (SOUTH FREEWAY)
FUNCTIONAL CLASS : OTHER FREEWAY OR EXPRESSWAY
DIRECTION OF TRAVEL : SOUTHBOUND
STUDY PERIOD : A.M. PEAK (6:30 - 8:30)

DATE (M/D/Y) :	04/14/94	04/29/94	.	.	.	.	.	.
START TIME :	630	705	.	.	.	.	.	.
WEATHER :	DRIZZLE	CLEAR	.	.	.	.	.	.
LIGHT :	TWILIGHT	DAYLIGHT	.	.	.	.	.	.
PAVEMENT :	DRY	DRY	.	.	.	.	.	.
INCIDENTS :	NONE	NONE						

SEGMENT DESCRIPTION	LENGTH (MI)	TIME (MIN)	SPEED (MPH)	TIME (MIN)	SPEED (MPH)	TIME (MIN)	SPEED (MPH)	TIME (MIN)	SPEED (MPH)	TIME (MIN)	SPEED (MPH)	TIME (MIN)	SPEED (MPH)	TIME (MIN)	SPEED (MPH)	TIME (MIN)	SPEED (MPH)	AVG. TIME (MIN)	CUM. TIME (MIN)	AVG. SPEED (MPH)
GULF FWY TO ALABAMA	1.00	0.97	61.86	0.95	63.16	.	.	.	.	.	.	.	.	.	.	.	.	0.96	0.96	62.50
ALABAMA TO BLODGETT	0.51	0.53	57.74	0.48	63.75	.	.	.	.	.	.	.	.	.	.	.	.	0.51	1.47	60.59
BLODGETT TO S MACGREGOR	1.06	1.42	44.79	1.00	63.60	.	.	.	.	.	.	.	.	.	.	.	.	1.21	2.68	52.56
S MACGREGOR TO O S T	0.79	0.82	57.80	0.80	59.25	.	.	.	.	.	.	.	.	.	.	.	.	0.81	3.49	58.52
O S T TO YELLOWSTONE	0.22	0.23	57.39	0.22	60.00	.	.	.	.	.	.	.	.	.	.	.	.	0.23	3.71	58.67
YELLOWSTONE TO SOUTH LOOP	1.24	1.37	54.31	1.22	60.98	.	.	.	.	.	.	.	.	.	.	.	.	1.30	5.01	57.45
SOUTH LOOP TO BELLFORT	0.91	0.97	56.29	0.93	58.71	.	.	.	.	.	.	.	.	.	.	.	.	0.95	5.96	57.47
BELLFORT TO REED RD	0.74	0.88	50.45	0.72	61.67	.	.	.	.	.	.	.	.	.	.	.	.	0.80	6.76	55.50
REED RD TO AIRPORT	0.98	1.05	56.00	0.92	63.91	.	.	.	.	.	.	.	.	.	.	.	.	0.99	7.74	59.70
AIRPORT TO OREM	1.09	1.17	55.90	1.13	57.88	.	.	.	.	.	.	.	.	.	.	.	.	1.15	8.89	56.87
OREM TO ALMEDA-GENOA	0.96	1.05	54.86	0.95	60.63	.	.	.	.	.	.	.	.	.	.	.	.	1.00	9.89	57.60
ALMEDA-GENOA TO FELLOWS	1.16	1.23	56.59	1.22	57.05	.	.	.	.	.	.	.	.	.	.	.	.	1.23	11.12	56.82
FELLOWS TO CLEAR CREEK	0.78	0.85	55.06	0.82	57.07	.	.	.	.	.	.	.	.	.	.	.	.	0.84	11.95	56.05
CLEAR CREEK TO HUGHES RANCH ROAD	1.05	1.12	56.25	1.05	60.00	.	.	.	.	.	.	.	.	.	.	.	.	1.09	13.04	58.06
HUGHES RANCH ROAD TO FM 518/FM 3344	1.04	1.15	54.26	1.07	58.32	.	.	.	.	.	.	.	.	.	.	.	.	1.11	14.15	56.22
FM 518/FM 3344 TO SH 6	5.27	5.45	58.02	5.70	55.47	.	.	.	.	.	.	.	.	.	.	.	.	5.58	19.72	56.72
TOTALS :	18.80	20.26		19.18		.		.		.		.		.		.				
AVERAGES :			55.68		58.81		.		.		.		.		.		.		19.72	57.20

ROADWAY NAME : SH 288 (SOUTH FREEWAY)
FUNCTIONAL CLASS : OTHER FREEWAY OR EXPRESSWAY
DIRECTION OF TRAVEL : SOUTHBOUND
STUDY PERIOD : OFF PEAK (9:30 - 15:00)

SEGMENT DESCRIPTION	LENGTH (MI)	TIME (MIN)	SPEED (MPH)	TIME (MIN)	SPEED (MPH)	TIME (MIN)	SPEED (MPH)	TIME (MIN)	SPEED (MPH)	TIME (MIN)	SPEED (MPH)	TIME (MIN)	SPEED (MPH)	TIME (MIN)	SPEED (MPH)	TIME (MIN)	SPEED (MPH)	AVG. TIME (MIN)	CUM. TIME (MIN)	AVG. SPEED (MPH)
DATE (M/D/Y) :		04/28/94		04/29/94		.		.		.		.		.		.				
START TIME :		1335		943		.		.		.		.		.		.				
WEATHER :		OVERCAST		CLEAR		.		.		.		.		.		.				
LIGHT :		DAYLIGHT		DAYLIGHT		.		.		.		.		.		.				
PAVEMENT :		DRY		DRY		.		.		.		.		.		.				
INCIDENTS :		NONE		NONE																
GULF FWY TO ALABAMA	1.00	1.05	57.14	0.97	61.86	.	.	.	.	.	.	.	.	.	.	.	.	1.01	1.01	59.41
ALABAMA TO BLODGETT	0.51	0.53	57.74	0.68	45.00	.	.	.	.	.	.	.	.	.	.	.	.	0.61	1.62	50.58
BLODGETT TO S MACGREGOR	1.06	1.15	55.30	1.32	48.18	.	.	.	.	.	.	.	.	.	.	.	.	1.24	2.85	51.50
S MACGREGOR TO O S T	0.79	0.80	59.25	0.85	55.76	.	.	.	.	.	.	.	.	.	.	.	.	0.83	3.68	57.45
O S T TO YELLOWSTONE	0.22	0.25	52.80	0.22	60.00	.	.	.	.	.	.	.	.	.	.	.	.	0.24	3.91	56.17
YELLOWSTONE TO SOUTH LOOP	1.24	1.23	60.49	1.30	57.23	.	.	.	.	.	.	.	.	.	.	.	.	1.27	5.18	58.81
SOUTH LOOP TO BELLFORT	0.91	0.98	55.71	0.88	62.05	.	.	.	.	.	.	.	.	.	.	.	.	0.93	6.11	58.71
BELLFORT TO REED RD	0.74	0.78	56.92	0.83	53.49	.	.	.	.	.	.	.	.	.	.	.	.	0.81	6.91	55.16
REED RD TO AIRPORT	0.98	1.02	57.65	1.05	56.00	.	.	.	.	.	.	.	.	.	.	.	.	1.04	7.95	56.81
AIRPORT TO OREM	1.09	1.10	59.45	1.08	60.56	.	.	.	.	.	.	.	.	.	.	.	.	1.09	9.04	60.00
OREM TO ALMEDA-GENOA	0.96	0.98	58.78	0.95	60.63	.	.	.	.	.	.	.	.	.	.	.	.	0.97	10.00	59.69
ALMEDA-GENOA TO FELLOWS	1.16	1.15	60.52	1.12	62.14	.	.	.	.	.	.	.	.	.	.	.	.	1.14	11.14	61.32
FELLOWS TO CLEAR CREEK	0.78	0.88	53.18	0.80	58.50	.	.	.	.	.	.	.	.	.	.	.	.	0.84	11.98	55.71
CLEAR CREEK TO HUGHES RANCH ROAD	1.05	1.18	53.39	1.13	55.75	.	.	.	.	.	.	.	.	.	.	.	.	1.16	13.13	54.55
HUGHES RANCH ROAD TO FM 518/FM 3344	1.04	1.15	54.26	1.05	59.43	.	.	.	.	.	.	.	.	.	.	.	.	1.10	14.23	56.73
FM 518/FM 3344 TO SH 6	5.27	5.45	58.02	5.10	62.00	.	.	.	.	.	.	.	.	.	.	.	.	5.28	19.51	59.94
TOTALS :	18.80	19.68		19.33		.		.		.		.		.		.				
AVERAGES :			57.32		58.35		.		.		.		.		.		.		19.51	57.83

ROADWAY NAME : SH 288 (SOUTH FREEWAY)
FUNCTIONAL CLASS : OTHER FREEWAY OR EXPRESSWAY
DIRECTION OF TRAVEL : SOUTHBOUND
STUDY PERIOD : P.M. PEAK (16:30 - 18:30)

DATE (M/D/Y) :		03/29/94		04/12/94		04/25/94		.		.		.		.		.				
START TIME :		1630		1700		1719		.		.		.		.		.				
WEATHER :		CLEAR		CLEAR		CLEAR		.		.		.		.		.				
LIGHT :		DAYLIGHT		DAYLIGHT		DAYLIGHT		.		.		.		.		.				
PAVEMENT :		DRY		DRY		DRY		.		.		.		.		.				
INCIDENTS :		NONE		NONE		NONE														
SEGMENT DESCRIPTION	LENGTH (MI)	TIME (MIN)	SPEED (MPH)	TIME (MIN)	SPEED (MPH)	TIME (MIN)	SPEED (MPH)	TIME (MIN)	SPEED (MPH)	TIME (MIN)	SPEED (MPH)	TIME (MIN)	SPEED (MPH)	TIME (MIN)	SPEED (MPH)	TIME (MIN)	SPEED (MPH)	AVG. TIME (MIN)	CUM. TIME (MIN)	AVG. SPEED (MPH)
GULF FWY TO ALABAMA	1.00	0.97	61.86	0.97	61.86	1.17	51.28	.	.	.	.	.	.	.	.	.	.	1.04	1.04	57.88
ALABAMA TO BLOODGETT	0.51	0.53	57.74	0.50	61.20	0.52	58.85	.	.	.	.	.	.	.	.	.	.	0.52	1.55	59.23
BLOODGETT TO S MACGREGOR	1.06	1.40	45.43	1.55	41.03	1.17	54.36	.	.	.	.	.	.	.	.	.	.	1.37	2.93	46.31
S MACGREGOR TO O S T	0.79	0.82	57.80	0.78	60.77	0.85	55.76	.	.	.	.	.	.	.	.	.	.	0.82	3.74	58.04
O S T TO YELLOWSTONE	0.22	0.25	52.80	0.23	57.39	0.27	48.89	.	.	.	.	.	.	.	.	.	.	0.25	3.99	52.80
YELLOWSTONE TO SOUTH LOOP	1.24	1.33	55.94	1.25	59.52	1.32	56.36	.	.	.	.	.	.	.	.	.	.	1.30	5.29	57.23
SOUTH LOOP TO BELLFORT	0.91	1.00	54.60	0.90	60.67	0.85	64.24	.	.	.	.	.	.	.	.	.	.	0.92	6.21	59.56
BELLFORT TO REED RD	0.74	0.85	52.24	0.87	51.03	0.78	56.92	.	.	.	.	.	.	.	.	.	.	0.83	7.04	53.28
REED RD TO AIRPORT	0.98	1.00	58.80	0.95	61.89	1.00	58.80	.	.	.	.	.	.	.	.	.	.	0.98	8.03	59.80
AIRPORT TO OREM	1.09	1.15	56.87	1.15	56.87	1.07	61.12	.	.	.	.	.	.	.	.	.	.	1.12	9.15	58.22
OREM TO ALMEDA-GENOA	0.96	1.02	56.47	0.90	64.00	0.98	58.78	.	.	.	.	.	.	.	.	.	.	0.97	10.12	59.59
ALMEDA-GENOA TO FELLOWS	1.16	1.18	58.98	1.12	62.14	1.12	62.14	.	.	.	.	.	.	.	.	.	.	1.14	11.26	61.05
FELLOWS TO CLEAR CREEK	0.78	0.82	57.07	0.80	58.50	0.77	60.78	.	.	.	.	.	.	.	.	.	.	0.80	12.05	58.74
CLEAR CREEK TO HUGHES RANCH ROAD	1.05	1.07	58.88	1.05	60.00	1.10	57.27	.	.	.	.	.	.	.	.	.	.	1.07	13.13	58.70
HUGHES RANCH ROAD TO FM 518/FM 3344	1.04	1.12	55.71	1.03	60.58	1.78	35.06	.	.	.	.	.	.	.	.	.	.	1.31	14.44	47.63
FM 518/FM 3344 TO SH 6	5.27	5.45	58.02	5.38	58.77	5.37	58.88	.	.	.	.	.	.	.	.	.	.	5.40	19.84	58.56
TOTALS :	18.80	19.96		19.43		20.12		.		.		.		.		.				
AVERAGES :			56.51		58.05		56.06		.		.		.		.		.		19.84	56.86