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Benefits of the Texas Traffic Light Synchronization (TLS) Grant Program III: Volume II. Appendices D-E

Research Report 3010-2F

Cooperative Research Program

TEXAS TRANSPORTATION INSTITUTE
THE TEXAS A&M UNIVERSITY SYSTEM
COLLEGE STATION, TEXAS

TEXAS DEPARTMENT OF TRANSPORTATION

in cooperation with the
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16. Abstract

The Texas Department of Transportation (TxDOT) was the administering agency for the Texas Traffic Light Synchronization (TLS) Grant Program III which was funded with Oil Overcharge funds made available by the Governor's Energy Office. The TLS Program was approved by the United States Department of Energy as part of a package of transportation-related programs with the objective of reducing energy consumption. TLS III resulted in a total expenditure of $1.7 million in program funds and local matches for the optimization of traffic signal timing plans and the replacement of outdated signal controller equipment across the state. As stated previously, the program's objective was to reduce traffic congestion and facilitate the flow of traffic, with the goal of achieving more efficient use of energy resources.

With 26 completed projects, the TLS III Program has resulted in benefits that will pay for the cost of the program many times over. These benefits were estimated from the required before and after studies that were submitted by the cities. These studies document the major goals of the TLS III Program -- reductions in fuel consumption and unnecessary delay and stops. All projects were evaluated using the same unit costs. The TLS III Program resulted in the improvement of 258 intersections in 19 cities; the expenditure of $1.7 million of program funds and local matches; and annual reductions of 13.3 percent in fuel consumption (5.5 million gallons), 19.4 percent in delay (5.7 million hours), and 8.8 percent in stops (139 million stops). The total savings to the public in the form of reduced fuel, delay, and stops will be approximately $64 million in the next year alone. In regard to fuel savings, Texas motorists are realizing $3.28 in savings for every dollar spent, and if stops and delay are included, Texas motorists are realizing $38.13 in savings for every dollar spent. These savings will continue for the next few years without additional expenditures; therefore, the benefits to the public will be even greater.

This report is the second of two volumes. The other volume is Benefits of the Texas Traffic Light Synchronization (TLS) Grant Program III: Volume I. Executive Summary and Appendices A - C.

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BENEFITS OF THE TEXAS TRAFFIC LIGHT SYNCHRONIZATION (TLS) GRANT PROGRAM III

VOLUME II. APPENDICES D - F

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and
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IMPLEMENTATION STATEMENT

This report documents results of a special grant program, "Texas Traffic Light Synchronization (TLS) Grant Program III" rather than the results of a research study. Thus, there are no findings, recommended procedures for implementation, or additional work needed to achieve implementation.

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 view or policies of the Texas Department of Transportation (TxDOT), Governor's Energy Office, or U.S. Department of Energy. This report does not constitute a standard, specification, or regulation and is NOT INTENDED FOR CONSTRUCTION, BIDDING, OR PERMIT PURPOSES. The engineers in charge of preparing this report were Daniel B. Fambro, P.E. No. 47535 (Texas) and David A. Noyce, P.E. No. 25726 (Wisconsin).

This report provides a summary of the "before" and "after" reports, completed by other agencies using English units, and prepared specifically for the 26 projects in the TLS III program. English units have been maintained in this report to provide consistency with reported data and to allow comparison with the previously completed TLS I and TLS II programs.

ACKNOWLEDGMENT

The results reported herein were accomplished as a result of a program entitled "Texas Traffic Light Synchronization (TLS) Grant Program III." The Texas Department of Transportation (TxDOT) administered the program which was sponsored by the Governor's Energy Office in cooperation with the U.S. Department of Energy. Training and technical assistance for the program were provided by the Texas Transportation Institute and Texas Engineering Extension Service at Texas A&M University and the McTrans Center at the University of Florida. Program managers/supervisors were Robert L. Otto, P.E., with the Governor's Energy Office; Carlos A. Lopez, P.E., and Ronald T. Barnes with the Texas Department of Transportation; and Daniel B. Fambro, P.E., with the Texas Transportation Institute. The authors wish to acknowledge the contributions of the many people who helped make this program a success.

The Texas Department of Transportation secured the funding, prepared the grant manual, and was responsible for all contractual and administrative matters. TxDOT staff members making significant contributions to the TLS III Program include

Nader Ayoub	James Kratz	Brenda Nilsson
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SUMMARY

The Texas Department of Transportation (TxDOT) was the administering agency for the Texas Traffic Light Synchronization III (TLS III) Program, which was funded with Oil Overcharge funds made available through the Governor's Energy Office. The United States Department of Energy approved the TLS III Program as part of a package of transportation-related programs with the objective of reducing energy consumption. TLS III resulted in a total expenditure of $1.7 million in program funds and local matches for the optimization of traffic signal timing plans and the replacement of outdated signal controller equipment across the state. As stated previously, the program's objective was to reduce traffic congestion and facilitate the flow of traffic, with the goal of achieving more efficient use of energy resources.

With 26 completed projects, the TLS III Program has resulted in benefits that will pay for the cost of the program many times over. These benefits were estimated from the required "before" and "after" studies that were submitted by the cities. These studies document the major goals of the TLS III Program -- reductions in fuel consumption and unnecessary delay and stops. All projects were evaluated using the same unit costs. The TLS III Program resulted in the improvement of 258 intersections in 19 cities; the expenditure of $1.7 million in program funds and local matches; and annual reductions of 13.3 percent in fuel consumption (5.5 million gallons), 19.4 percent in delay (5.6 million hours), and 8.8 percent in stops (139 million stops). The total savings to the public in the form of reduced fuel, delay, and stops will be approximately $64 million in the next year alone. In regard to fuel savings, Texas motorists are realizing $3.28 in savings for every dollar spent. These savings will continue for the next few years without additional expenditures; therefore, the benefits to the public will be even greater.

Besides the intuitive benefits of reducing unnecessary vehicle stops, delays, fuel consumption and emissions, the TLS III Program brought together the diverse transportation community of city staffs, consultants, TxDOT personnel, and researchers to improve traffic operations at the state's signalized intersections. The program also has increased the expertise of transportation professionals in Texas and created a traffic database that can be used for additional transportation projects. Most importantly, the TLS III Program has enhanced the image of the transportation profession by improving the quality of traffic flow on signalized streets in Texas.

APPENDIX D

INDIVIDUAL PROJECT SUMMARIES

LARGE CITIES

Table D-1. Individual Project Summaries - Large Cities.

City	System	Reduction In Daily Totals			Total Annual Savings ($)	Total Cost ($)	B/C Ratio	Page
		Stops	Delay (veh-hrs)	Fuel (gals)				
Arlington	Ballpark Area	38,108,050	1,664,920	1,056,636	18,239,349	27,938.39	653	D-5
Arlington	Pioneer Parkway Arkansas Lane	33,266,100	1,648,377	1,280,705	18,230,195	38,596.89	472	D-9

Ballpark Area

The city of Arlington Department of Public Works and Transportation worked on the following project. In conjunction with the construction of the new ballpark for the Texas Rangers, several adjacent streets were reconstructed including the rebuilding of several traffic signals. The new ballpark, the reconstruction of the city streets, and the construction of an exit ramp from Interstate 30 to Ballpark Way have significantly altered the traffic patterns around the ballpark area. The traffic, which primarily accessed old Arlington Stadium from the north, has been re-oriented to access the ballpark from all directions. The following figure shows the project network, cross streets, and link distances.

This project included a total of 19 signals. The signalized intersections were located on Collins Street (4), Copeland Road (2), Ballpark Way/Stadium Drive (6), Randol Mill Road (4), and Six Flags Drive at SH 360 (3). The traffic signal controllers in the ballpark area vary and include Eagle EPAC 300, Eagle DP 9800, DSC 900, Transyt, and NAZTEC 900. All intersections on this project, except for the intersection of Ballpark Way and Wet 'N Wild Way, contain pedestrian control. With the exception of the four traffic signals on Collins Street, the fully actuated traffic signals in the ballpark area were operating in the "free" mode at the before study time with variable cycle and phase lengths and were not coordinated through the central computer. Although these signalized intersections were connected to the central computer system, they were only monitored by the computer.

Weekend traffic patterns were evaluated on Collins Street because of the heavy weekend traffic volumes in this area. High pedestrian volumes required signal timing to be based on minimum pedestrian requirements versus optimal timing and cycle lengths. The limitations of the existing traffic controller capabilities also prevented the installation of phasing arrangements which may have provided additional benefits.

In order to evaluate the performance, field data was collected in the "before" and "after" TLS traffic conditions. The data included traffic volumes, travel times, signal timing and phasing, arterial data, intersection geometrics, travel delays, and an operating cost study. Timing plans were developed using PASSER II-90. Travel time information was obtained by the test car technique. Six runs were made on each link in each time period (AM peak, OFF peak, NOON peak, PM peak, and Weekend Peak), except Six Flags Drive at SH 360, and mean travel times were computed. Six Flags Drive at SH 360 involved retiming of the diamond interchange signals and was not included in the travel time study. Travel times improved on all roadways in the Ballpark Area except for NOON and PM peaks on southbound Ballpark Way and AM peak on northbound Collins Street.

Based on the PASSER II-90 simulation, the project resulted in an estimated $18,239,349 savings per year in total operating costs, a direct benefit to motorists using these routes. This operating cost savings included a total annual savings of 38,108,050 stops (a 33.5 percent reduction), a total annual fuel savings of 1,056,636 gallons (a 34.1 percent reduction), and an annual delay savings of 1,664,920 veh-hrs (a 53.5 percent reduction). The total cost of the project was $27,938.39, and the resultant benefit-to-cost ratio was 653 to 1.

Table D-2. Summary of Benefits for Ballpark Area - City of Arlington

		STOPS		TOTAL SYSTEM DELAY(veh-hrs)		FUEL(gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	AM	54148	32639	1325.50	434.30	1359.97	779.92
	OFF	9317	8191	44.70	47.90	78.96	157.44
	NOON	20902	13439	179.70	80.10	222.87	286.23
	PM	100081	63806	3985.80	1961.00	3618.56	2089.94
	Weekend	22186	15285	549.40	255.00	684.55	408.73
DIFFERENCES	AM		21509		891.20		580.05
	OFF		1126		-3.20		-78.48
	NOON		7463		99.60		-63.36
	PM		36275		2024.80		1528.62
	Weekend		6901		294.40		275.82
HRS/DAY	AM		2		2		2
	OFF		6		6		6
	NOON		2		2		2
	PM		2		2		2
	Weekend		11		11		11
DAILY TOTALS	AM		43018		1782.40		1160.10
	OFF		6756		-19.20		-470.88
	NOON		14926		199.20		-126.72
	PM		72550		4049.60		3057.24
	Weekend		75911		3238.40		3034.02
	TOTAL		213161		9250.40		6653.76
UNIT VALUES			$0.014		$10.00		$1.00
ANNUAL SAVINGS			$533,513		$16,649,200		$1,056,636
PROJECT COST:			$27,938.39	TOTAL ANNUAL SAVINGS:			$18,239,349
BENEFIT/COST RATIO:			653				

Table D-3. Summary of Travel Time for Ballpark Area - City of Arlington

Project Type	Arterial / Link	Length (ft)	Time Period	Before Travel Time (sec)		After Travel Time (sec)		Percentage Travel Time Savings
				NB	SB	NB	SB	
08	Ballpark Way	7383	AM	165.8	167.9	153.3	146.3	10.2
		7374	OFF	171.1	157.1	153.3	152.6	6.8
		7370	NOON	199.1	183.1	177.8	219.5	-4.0
		7383	PM	171.6	163.7	167.1	190.1	-6.5
	Collins Street	5752	AM	115.9	112.9	127.3	117.5	-7.0
		5752	PM	184.0	160.7	146.6	144.5	15.5
		5729	Weekend	174.1	139.6	165.7	125.3	7.2
				EB	WB	EB	WB	
	Randol Mill Road	6604	AM	164.4	164.5	135.3	134.5	18.0
		6604	OFF	155.0	168.2	132.6	130.7	18.5
		6604	NOON	166.8	182.2	127.0	132.5	25.6
		6604	PM	187.4	145.5	125.7	137.4	21.0
	Copeland Road	2567	AM	47.0	58.1	45.6	55.1	4.2
		2561	OFF	49.6	48.5	41.1	49.3	7.8
		2556	NOON	45.8	67.5	50.1	56.3	6.1
		2563	PM	44.0	51.8	40.5	46.8	8.9

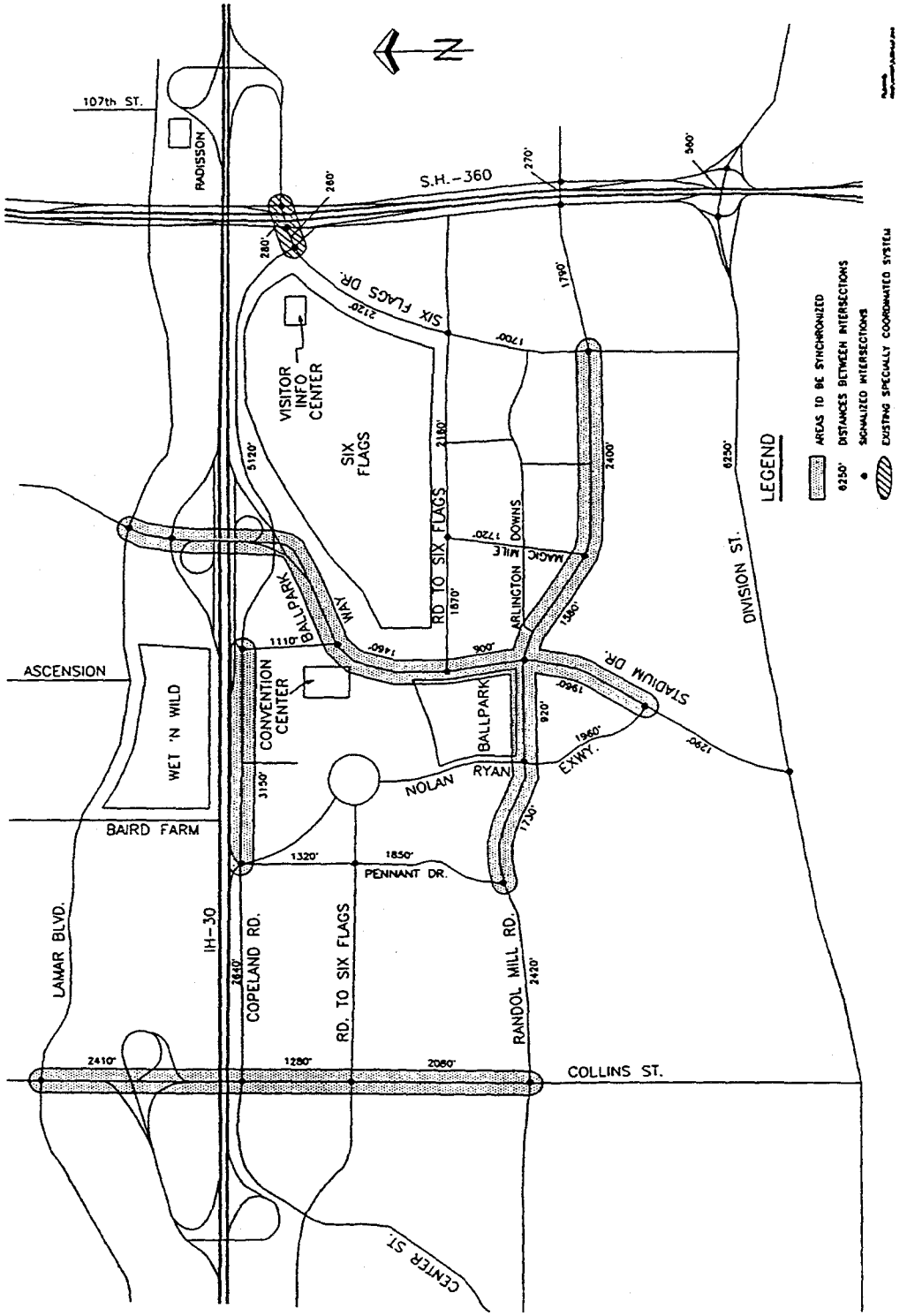


Figure D-1. Project Network for Ballpark Area - Arlington.

Pioneer Parkway and Arkansas Lane

The city of Arlington Department of Public Works and Transportation worked on the following project. Pioneer Parkway (Spur 303), between Fielder Road and Susan Drive, and Arkansas Lane, between Fielder Road and SH 360, are two of the primary east/west arterial streets in the city of Arlington. The distance between these parallel streets ranges from as little as 640 feet to as much as 2430 feet. The Texas Department of Transportation recently completed the widening of Pioneer Parkway from four to six lanes between Fielder Road and SH 360. There are 28 intersections (14 each on Pioneer Parkway and Arkansas Lane) located on this project. The following figure shows the project network, cross streets, and link distances.

The traffic signal controllers on Pioneer Parkway and Arkansas Lane vary and include Econolite, Eagle EPAC 300, Eagle EPAC 300 Gold, Eagle DP 9800, DSC 900, Transyt, Automatic 318, Multisonics, and NAZTEC 900. Of the 28 intersections on the project, 22 contain pedestrian control including all intersections on Arkansas Lane. Although the City of Arlington controls the majority of their traffic signals by a central computer located in the Traffic Operations Center, a number of signals on this project were not computer accessible at the before study time. These non-accessible intersections were primarily the intersections recently reconstructed.

Three timing plans were implemented with 120 second cycle lengths for the OFF peak, NOON Peak, and Weekend peak. These timing plans provided the primary focus of this project. The AM peak and PM peak timing plans were maintained at their existing values. Thus, no measures of effectiveness were computed for these time periods. The weekend peak period was evaluated due to the heavy weekend traffic in the project area.

In order to evaluate the performance, field data was collected in the "before" and "after" TLS traffic conditions. The data included traffic volumes, travel times, signal timings and phasing, arterial data, intersection geometrics, travel delays, and an operating cost study. Timing plans were developed using PASSER II-90. Travel time information was obtained by the test car method. Six runs were made on each link in each time period (OFF peak, NOON peak, and Weekend peak) and the mean travel times were computed. To further assist in the analysis, a portion of the project area was treated as a network to reflect the substantial volumes of side street traffic from South Fielder Road, South Cooper Street, Center Street, and Collins Street. The network portion was analyzed using PASSER IV-94. The data files produced from this analysis were used to run TRANSYT-7F to derive the associated measures of effectiveness.

Travel times improved on both Pioneer Parkway and Arkansas Lane including a 20 percent travel time savings on Pioneer Parkway during the Weekend peak.

Based on the PASSER II-90, PASSER IV-94, and TRANSYT-7F simulation, the project resulted in an estimated $18,230,195 savings per year in total operating costs, a direct benefit to motorists using these routes. This operating cost savings included a total annual savings of 33,266,100 stops (a 33.5 percent reduction), a total annual fuel savings of 1,280,705 gallons (a 39.9 percent reduction), and an annual delay savings of 1,648,377 veh-hrs (a 70.6 percent reduction). The total cost of the project was $38,596.89, and the resultant benefit-to-cost ratio was 472 to 1.

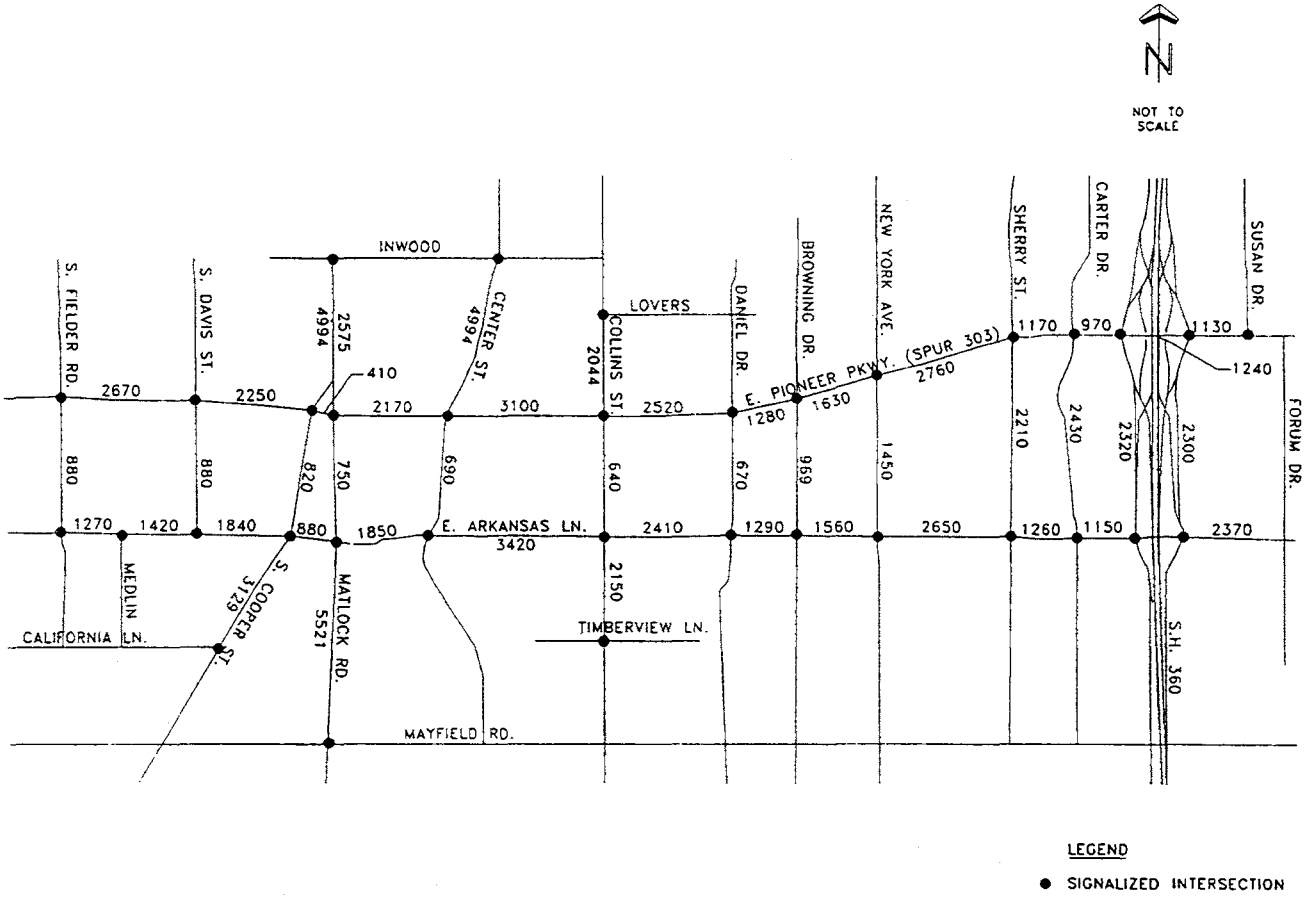
Table D-4. Summary of Benefits for Pioneer Parkway and Arkansas Lane - City of Arlington

		STOPS		TOTAL SYSTEM DELAY(veh-hrs)		FUEL(gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	AM	0	0	0	0	0	0
	OFF	39330	29438	400.90	272.48	992.58	867.10
	NOON	59556	42705	810.30	417.74	1546.86	1232.16
	PM	0	0	0	0	0	0
	Weekend	90774	54602	3144.10	620.67	3524.40	1596.01
DIFFERENCES	AM		0		0		0
	OFF		9892		128.42		125.48
	NOON		16851		392.56		314.70
	PM		0		0		0
	Weekend		36172		2523.43		1928.39
HRS/DAY	AM		0		0		0
	OFF		2		2		2
	NOON		2		2		2
	PM		0		0		0
	Weekend		11		11		11
DAILY	AM		0		0		0
	OFF		19784		256.84		250.96
	NOON		33702		785.12		629.40
	PM		0		0		0
	Weekend		397892		27757.73		21212.29
	TOTAL		451378		28799.69		22092.65
UNIT VALUES			$0.014		$10.00		$1.00
ANNUAL SAVINGS			$465,725		$16,483,765		$1,280,705

PROJECT COST:	$38,596.89	TOTAL ANNUAL SAVINGS:	$18,230,195
BENEFIT/COST RATIO:	472		

Table D-5. Summary of Travel Time for Pioneer Parkway and Arkansas Lane - City of Arlington

Project Type	Arterial / Link	Length (ft)	Time Period	Before Travel Time (sec)		After Travel Time (sec)		Percentage Travel Time Savings
				EB	WB	EB	WB	
03	Pioneer Parkway	23211	OFF	459.0	539.8	449.5	465.1	8.4
			NOON	516.0	536.5	441.0	418.8	18.3
			Weekend	557.8	589.8	481.8	436.6	20.0
	Arkansas Lane	21831	OFF	484.6	540.0	469.1	499.8	5.4
			NOON	504.3	555.1	455.3	469.8	12.7
			Weekend	561.0	573.5	478.3	497.5	14.0



LEGEND

● SIGNALIZED INTERSECTION

Figure D-2. Project Network for Pioneer Parkway and Arkansas Lane - Arlington.

APPENDIX E

INDIVIDUAL PROJECT SUMMARIES

MEDIUM CITIES

Table E-1. Individual Project Summaries - Medium Cities.

City	System	Reduction In Daily Totals			Total Savings ($)	Total Cost ($)	B/C Ratio	Page
		Stops	Delay (veh-hrs)	Fuel (gals)				
Abilene	Ambler Avenue	1,887,600	4,567.50	(6,760.50)	65,342	61,292.62	1	E-5
	South 14th/US 277	3,529,575	16,350.00	148,098.00	360,937	119,256.31	3	E-9
Brownsville	Boca Chica Boulevard and FM 802	2,079,000	46,620.00	45,600.00	540,906	49,507.47	11	E-14
Bryan	Seven Arterial Signal Systems	6,399,000	308,100.00	333,540.00	3,504,126	79,523.32	44	E-18
Carrollton	Carrollton Signal System	(2,427,000)	250,842.00	633,948.00	3,108,390	134,253.31	23	E-22
Denton	Oak/Hickory System	3,228,000	1,140.00	23,340.00	79,932	57,067.63	1.5	E-26
	Welch Street System	1,453,200	(3,120.00)	(5,760.00)	(57,305)	54,305.80	0	E-30
Killeen	Fort Hood Road	14,727,000	136,635.00	273,406.00	1,845,930	20,002.23	92	E-34
Laredo	IH 35 Frontage Roads	1,461,900	(72,705.00)	(44,940.00)	(751,523)	115,854.00	0	E-38
Longview	CBD System	492,000	(1,200.00)	2,700.00	(2,412)	96,987.41	0	E-42
Mesquite	Bryan-Belt Line Rd.	964,200	48,120.00	297,420.00	792,119	102,602.55	8	E-46
	Galloway Ave.	3,240,000	130,884.00	120,498.00	1,474,698	34,208.99	43	E-50
Midland	CBD-1	19,497,000	168,800.00	225,390.00	2,186,343	100,861.77	22	E-54
	CBD-2	2,725,725	34,098.00	49,824.00	428,965	87,030.91	5	E-58
Tyler	Subsystem 6	4,970,700	876,600.00	716,100.00	9,551,690	74,167.14	129	E-62

Ambler Avenue

The city of Abilene Traffic Engineering Division worked on the following project. Ambler Avenue is an east/west arterial with two through lanes in each direction between Treadaway Boulevard and Old Anson Road. The posted speed limit is 35 mph. Exclusive left-turn storage lanes are provided on the east and west approaches at each signalized intersection. The following figure shows the project network, cross streets, and link distances.

This project included a total of 5 signals. This project included the installation of new 8-phase TCT local controllers at each project intersection to replace the existing CH-DM200, CH-DM400, CH-DM800, and Eagle EF-20 controllers; the installation of microwave sensors and inductive loop detectors at selected left turns and side streets for actuation; and the installation of pedestrian actuation at Hickory Street. Coordination was established between the five intersections on Ambler Avenue.

In order to evaluate the performance, field data was collected in the "before" and "after" TLS traffic conditions. The data included traffic volumes, travel times, signal timings and phasing, arterial data, intersection geometrics, travel delays, and an operating cost study. Timing plans were developed using PASSER II-90. Travel time data was collected using the floating car method with an automated data collection system. Because of problems with the data collection unit, six "before" runs were not obtained for each link. However, a minimum of six runs were made on each link after the implementation of the new timing plans in each time period (AM peak, OFF peak, NOON peak, OFF peak, and PM peak) and the mean travel times were determined.

Since the system was evaluated as five isolated intersections, PASSER II-90 was used to determine fuel consumption at each intersection while the fuel consumption of vehicles traveling between intersections was evaluated using the TRANSYT-7F fuel consumption model. The amount of fuel consumed between intersections was added into each fuel consumption estimate provided in the PASSER II-90 output and included in the simulation results.

Travel times improved on Ambler Avenue in all time periods. This included a 24.5 percent travel time savings during the PM peak period.

Based on the PASSER II-90 simulation, the project resulted in an estimated $65,342 savings per year on total operating cost, a direct benefit to motorists using these routes. This operating cost savings included a total annual savings of 1,887,600 stops (a 9.7 percent reduction), a total annual fuel increase of 6760.50 gallons (a 2.3 percent increase), and a delay annual savings of 4567.50 veh-hrs (a 7.4 percent reduction). Since stops and delays decreased for all intersections, it appears inconsistent for the fuel consumption not to have decreased as well. This is attributed to the methods of determining fuel consumption in the "before" conditions. The total cost of the project was $61,291.62, and the resultant benefit-to-cost ratio was 1 to 1.

Table E-2. Summary of Benefits for Ambler Avenue - City of Abilene

		STOPS		TOTAL SYSTEM DELAY(veh-hrs)		FUEL(gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	AM	8222	7117	27.4	25.3	116.39	119.34
	AM OFF	3878	3762	11.7	11.0	54.74	58.79
	NOON	6753	6188	21.5	19.5	102.71	104.47
	PM OFF	5726	5350	17.6	16.3	85.75	88.63
	PM	7213	5829	23.4	21.9	109.76	105.44
DIFFERENCES	AM	1105		2.1		-2.95	
	AM OFF	116		0.7		-4.05	
	NOON	565		2.0		-1.76	
	PM OFF	376		1.3		-2.88	
	PM	1384		1.5		4.32	
HRS/DAY	AM	1.5		1.5		1.5	
	AM OFF	3		3		3	
	NOON	1.75		1.75		1.75	
	PM OFF	3.25		3.25		3.25	
	PM	1.5		1.5		1.5	
DAILY TOTALS	AM	1658		3.15		-4.43	
	AM OFF	348		2.10		-12.15	
	NOON	989		3.50		-3.08	
	PM OFF	1222		4.23		-9.36	
	PM	2076		2.25		6.48	
	TOTAL	6292		15.22		-22.53	
UNIT VALUES		$0.014		$10.00		$1.00	
ANNUAL SAVINGS		$26,427		$45,675		($6,760.50)	
PROJECT COST:		$61,291.62		TOTAL ANNUAL SAVINGS:		$65,342	
BENEFIT/COST RATIO:		1					

Table E-3. Summary of Travel Time for Ambler Avenue - City of Abilene

Project Type	Arterial / Link	Length (ft)	Time Period	Before Travel Time (sec)		After Travel Time (sec)		Percentage Travel Time Savings
				EB	WB	EB	WB	
04	Ambler Avenue	5300	AM	164.0	135.0	140.0	132.0	9.0
			OFF	157.0	154.0	148.0	129.0	10.9
			NOON	167.0	162.0	157.0	126.0	14.0
			OFF	170.0	156.0	136.0	121.0	21.2
			PM	192.0	159.0	138.0	127.0	24.5

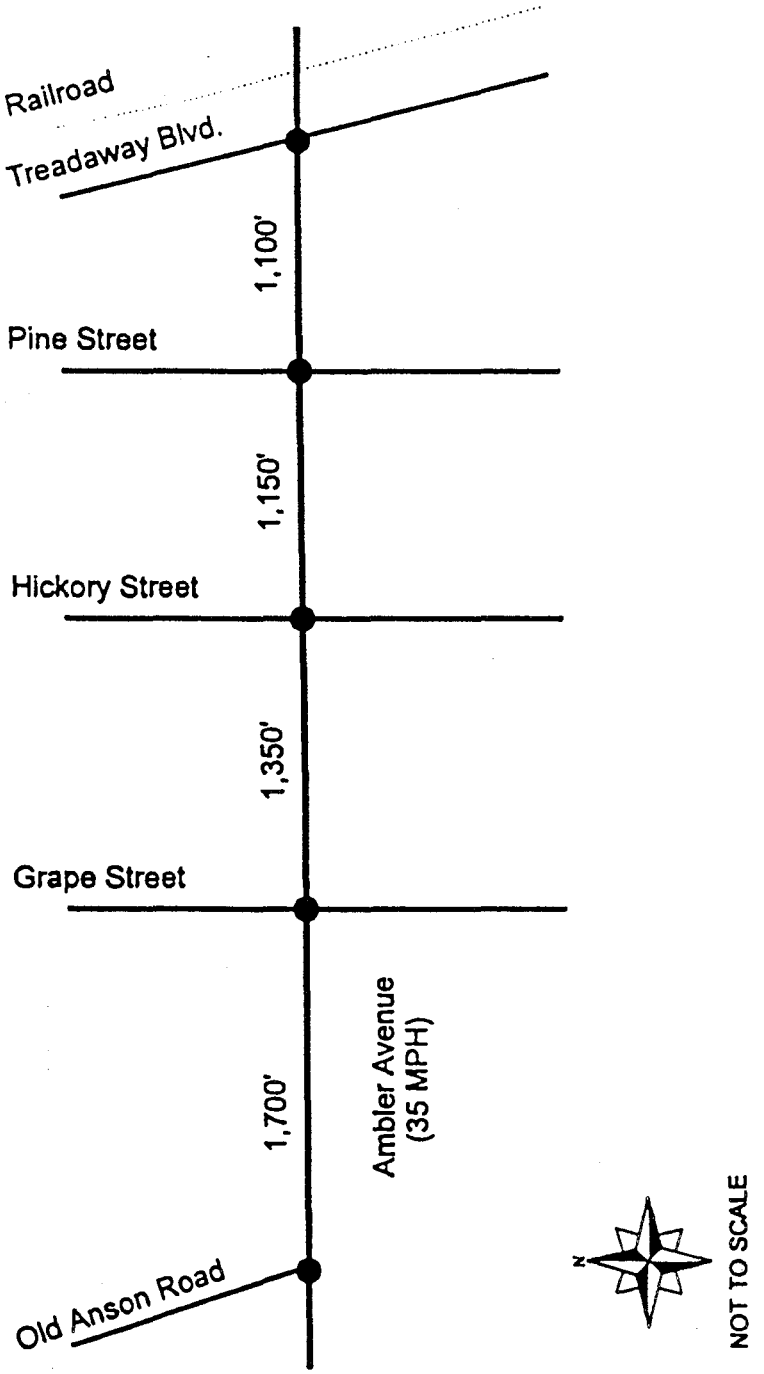


Figure E-1. Project Network for Ambler Avenue - Abilene.

US 277/South 14th Street

The city of Abilene Traffic Engineering Division worked on the following project. US 277/South 14th Street is a major northeast/southwest to east/west arterial between Barrow Street and Texas Avenue serving the downtown and southwest parts of the city. From Barrow Street to Pioneer Drive, US 277/South 14th Street runs east/west with two through lanes in each direction. From Pioneer Drive to Texas Avenue, US 277/South 14th Street runs northeast/southwest with two through lanes in each direction. The posted speed limit along South 14th Street is 35 mph from the east project limits to a point west of Willis Street. From that point to the east project limits, the speed limit is 40 mph. Left turn storage lanes are provided on US 277/South 14th Street at each signalized intersection. The following figure shows the project network, cross streets, and link distances.

This project included a total of 8 signals. The project included the installation of new 8-phase TCT local controllers to replace the existing Eagle EF 20, PCE 3000, CH-DM 200, and CHDM-800 pretimed controllers. One TCT MDM-100 field master for closed-loop control of the system was installed along with the installation of 6-pair interconnect cable to link the controllers with the TCT MDM-100 field master. The project also included the installation of new inductance detector loops for actuated left-turn phases at Pioneer Drive (eastbound), Danville Drive (eastbound), and Clack Street (westbound). Five timing plans were developed for all eight intersections on both a time-of-day and day-of-week basis. All eight intersections currently operate as one coordinated system.

In order to evaluate the performance, field data was collected in the "before" and "after" TLS traffic conditions. The data included traffic volumes, travel times, signal timings and phasing, arterial data, intersection geometrics, travel delays, and an operating cost study. Timing plans were developed using PASSER II-90. The Texas Avenue, Willis Street and Barrow Street intersections were analyzed as isolated intersections. The remaining 5 intersections were evaluated as a system. Travel time data was collected using the floating car method with an automated data collection system. Because of problems with the data collection unit, six runs were not obtained for each link. However, a minimum of four runs were made on each link in each time period (AM peak, OFF peak, NOON peak, OFF peak, and PM peak) and the mean travel times were determined.

Since three of the intersections were evaluated as isolated intersections, PASSER II-90 was used to determine fuel consumption at each intersection while the fuel consumption of vehicles traveling between intersections was evaluated using the TRANSYT-7F fuel consumption model. The amount of fuel consumed between intersections was added into each fuel consumption estimate provided in the PASSER II-90 output and included in the simulation results.

Willis Street and Barrow Street were added to the project after the "before" study, thus no travel time runs were completed in the "before" condition for these links. This also prevented the computation of the percentage of travel time savings for the project. Average travel speeds did, however, show an improvement on South 14th Street as speeds were between 21 and 24 mph in the "before" condition and 27.2 and 35.3 mph in the "after" condition.

Based on the PASSER II-90 simulation, the project resulted in an estimated $360,937 savings per year on total operating cost, a direct benefit to motorists using these routes. This operating cost savings include a total annual savings of 3,529,575 stops (a 9.6 percent reduction), a total annual fuel savings of 148,098 gallons (a 17.3 percent reduction), and an annual delay savings of 16,350 veh-hrs (an 11.0 percent reduction). The total cost of the project was $119,256.31, and the resultant benefit-to-cost ratio was 3 to 1.

Table E-4. Summary of Benefits for US 277/South 14th Street - City of Abilene

		STOPS		TOTAL SYSTEM DELAY(veh-hrs)		FUEL(gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	AM	13225	12174	53.6	49.0	288.74	254.05
	OFF	8450	7835	30.6	26.7	190.73	157.50
	NOON	11257	9670	46.3	39.6	272.22	216.19
	OFF	11033	9491	44.0	39.8	260.52	209.77
	PM	14797	14427	64.9	57.9	344.73	292.10
DIFFERENCES	AM		1051		4.6		34.69
	OFF		615		3.9		33.23
	NOON		1587		6.7		56.03
	OFF		1542		4.2		50.75
	PM		370		7.0		52.63
HRS/DAY	AM		1.5		1.5		1.5
	OFF		3		3		3
	NOON		1.75		1.75		1.75
	OFF		3.25		3.25		3.25
	PM		1.5		1.5		1.5
DAILY TOTALS	AM		1577		6.90		52.04
	OFF		1845		11.70		99.69
	NOON		2777		11.72		98.05
	OFF		5012		13.65		164.94
	PM		555		10.50		78.95
	TOTAL		11765		54.48		493.66
UNIT VALUES			$0.014		$10.00		$1.00
ANNUAL SAVINGS			$49,414		$163,425		$148,098
PROJECT COST:			$119,256.31	TOTAL ANNUAL SAVINGS:			$360,937
BENEFIT/COST RATIO:			3				

Table E-5. Summary of Travel Time for US 277/South 14th Street - City of Abilene

Project Type	Arterial / Link	Length (ft)	Time Period	Before Travel Time (sec)		After Travel Time (sec)*		Percentage Travel Time Savings*
				EB	WB	EB	WB	
04	South 14th Street	6760	AM	144.0	159.0	178.0	130.0	N/A
			OFF	143.0	138.0	131.0	130.0	N/A
			NOON	141.0	143.0	152.0	155.0	N/A
			OFF	139.0	138.0	146.0	143.0	N/A
			PM	154.0	172.0	169.0	143.0	N/A

* After travel time included 3770 feet of additional length and two additional intersections.

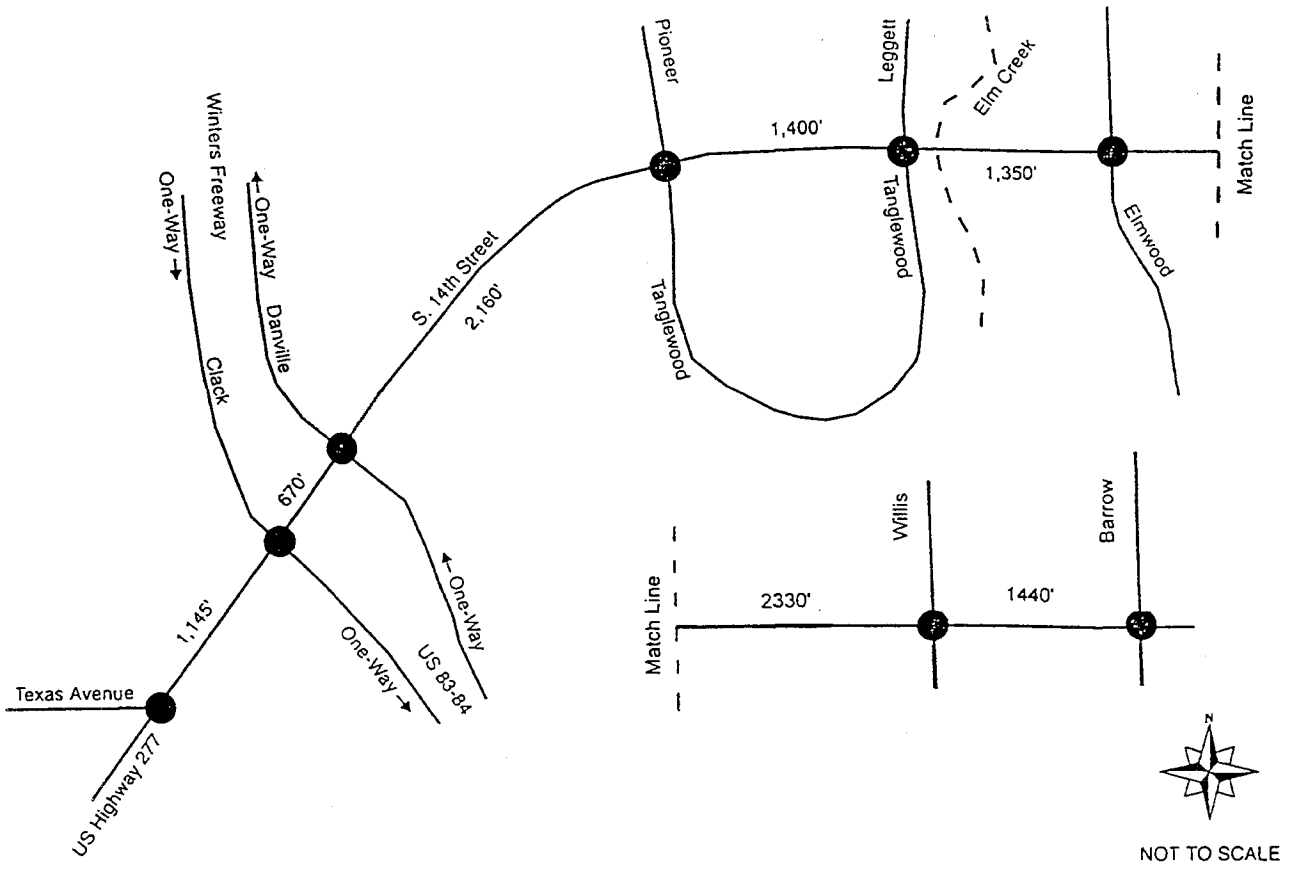


Figure E-2. Project Network for US 277/South 14th Street - Abilene.

Boca Chica Boulevard and FM 802

The city of Brownsville Department of Public Works and Transportation worked on the following project. Boca Chica Boulevard, from Owens Road to Minnesota Avenue, is a major arterial connecting the east side of Brownsville to the US 83 Expressway and the Brownsville/South Padre Island International Airport. FM 802, from Central Boulevard to Old Alice Road, serves as a principal connector between the US 83 Expressway and the commercial and residential areas located east and west of the US 83 Expressway. The following figure shows the project network, cross streets, traffic volumes, and link distances.

The Boca Chica Boulevard project included a total of 4 signals, and the FM 802 project included a total of 5 signals. At the time of the "before" study, all traffic signal controllers in this system were either Eagle EPAC-300 or Kentron KST with the exception of the Owens Road intersection which contained a Multisonic controller. The project replaced the controllers located on FM 802 at US 83 Frontage Roads and Central Boulevard with a Naztec Texas Diamond controller and Naztec Pretimed controller, respectively. This project also replaced the controller at the Boca Chica Boulevard and Owens Road intersection with a Naztec controller containing time based coordination. Inductance loop detectors were installed in the major street left turn lanes. All hardwire signal interconnects were maintained.

In order to evaluate the performance, field data was collected in the "before" and "after" TLS traffic conditions. The data included traffic volumes, travel times, signal timings and phasing, arterial data, intersection geometrics, travel delays, and an operating cost study. Timing plans were developed using PASSER II-90. Travel time information was obtained by the probe vehicle method. Six runs were made on each link in each time period (AM peak, NOON peak, and PM peak) and the mean travel times were determined.

Travel times improved on both FM 802 and Boca Chica Boulevard in all time periods. FM 802 experienced an average decrease of 33 percent in travel times with the new signal timing plans while Boca Chica Boulevard experienced an average decrease of 29 percent.

Based on the PASSER II-90 simulation, the project resulted in an estimated $540,906 savings per year on total operating cost, a direct benefit to motorists using these routes. This operating cost savings include a total annual savings of 2,079,000 stops (a 5.3 percent reduction), a total annual fuel savings of 45,600 gallons (a 5.8 percent reduction), and an annual delay savings of 46,620 veh-hrs (a 15.4 percent reduction). Substantial travel time savings were observed for most segments of the system. The total cost of the project was $49,507.47, and the resultant benefit-to-cost ratio was 11 to 1.

Table E-6. Summary of Benefits for Boca Chica Boulevard and FM 802 - City of Brownsville

		STOPS		TOTAL SYSTEM DELAY(veh-hrs)		FUEL(gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	AM	12731	12963	94.0	80.2	269.0	261.7
	OFF	12343	11905	90.0	76.0	241.0	227.4
	PM	16215	13832	139.0	117.1	314.0	286.1
DIFFERENCES	AM		-232		13.8		7.3
	OFF		438		14.0		13.6
	PM		2383		21.9		27.9
HRS/DAY	AM		2		2		2
	OFF		6		6		6
	PM		2		2		2
DAILY TOTALS	AM		-464		27.6		14.6
	OFF		2628		84.0		81.6
	PM		4766		43.8		55.8
	TOTAL		6930		155.4		152.0
UNIT VALUES			$0.014		$10.00		$1.00
ANNUAL SAVINGS			$29,106		$466,200		$45,600
PROJECT COST:			$49,507.47	TOTAL ANNUAL SAVINGS:			$540,906
BENEFIT/COST RATIO:			11				

Table E-7. Summary of Travel Time for Boca Chica Boulevard and FM 802 - City of Brownsville

Project Type	Arterial / Link	Length (ft)	Time Period	Before Travel Time (sec)		After Travel Time (sec)		Percentage Travel Time Savings
				EB	WB	EB	WB	
05	FM 802	2560	AM	82.0	82.0	62.0	62.0	24.4
			OFF	88.0	88.0	56.0	56.0	36.4
			PM	141.0	141.0	86.0	86.0	39.0
	Boca Chica Blvd.	9510	AM	256.0	256.0	166.0	166.0	35.2
			OFF	208.0	208.0	153.0	153.0	26.4
			PM	221.0	221.0	157.0	157.0	29.0

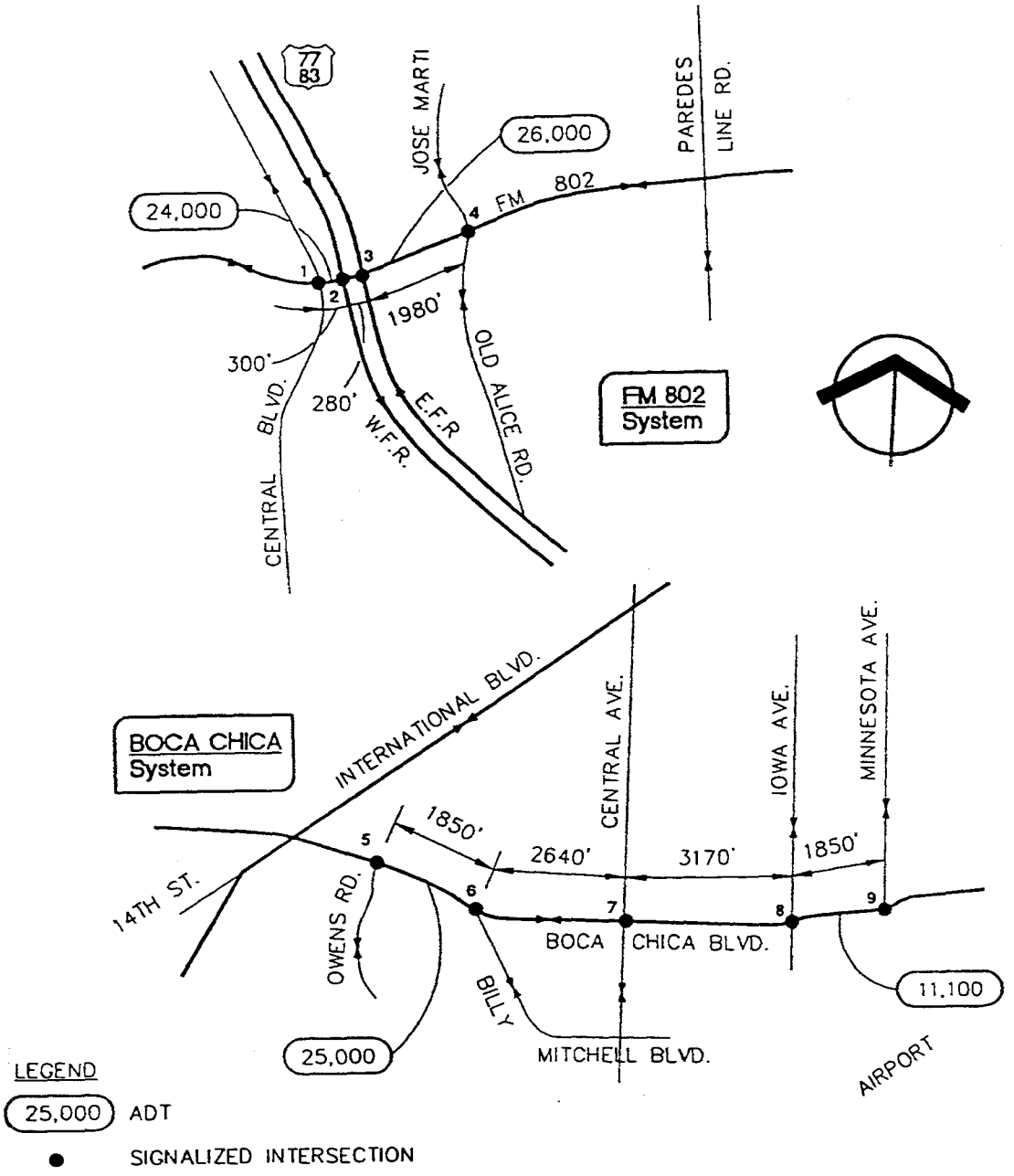


Figure E-3. Project Network for Boca Chica Boulevard and FM 802 - Brownsville.

Seven Arterial Signal Systems

The city of Bryan Department of Public Works and Transportation worked on the following project. The project contains multiple systems located on various arterials throughout the city. The signal system included in this project consists of 7 arterial signal systems and 33 intersections. The 7 signal systems and the corresponding signalized intersections include North Texas Avenue (5), Villa Maria Road (7), Briarcrest Drive (1), 29th Street (7), William Joel Bryan Parkway (3), College Avenue (3), and South Texas Avenue (7). The following figure shows the project network and cross streets.

Recently, in a previous project under the State's Traffic Management Program, 27 of the 33 intersections were evaluated. PASSER II-90 simulation data was used to determine the optimal cycle lengths. The cycle lengths were adjusted to maximize progression and minimize delay. The traffic signal controllers are coordinated within each system with the exception of controllers at William Joel Bryan Parkway and Sims Street, College Avenue and Sulphur Springs Road, College Avenue and Pleasant Street, and College Avenue and North Avenue, which are all isolated.

In order to evaluate the performance, field data was collected in the "before" and "after" TLS traffic conditions. The data included traffic volumes, travel times, signal timings and phasing, arterial data, intersection geometrics, travel delays, and an operating cost study. Timing plans were developed using PASSER II-90. Travel time information was obtained by the test car method. Six runs were made on each link in each time period (AM peak, NOON peak, OFF peak, and PM peak) and the mean travel times were determined.

The results of the PASSER II-90 runs were implemented in the field using cycle lengths ranging from 54 to 102 seconds in the coordinated systems. Each system had 4 timing plans, one for each peak period and off period.

Overall travel times improved on all arterials as a result of this project except for the Villa Maria Road/Briarcrest Drive link. This included over a 43 percent travel time savings on William Joel Bryan Parkway during both the AM and PM peak periods.

Based on the PASSER II-90 simulation, the project resulted in an estimated $3,504,126 savings per year on total operating cost, a direct benefit to motorists using these routes. This operating cost savings include a total annual savings of 6,399,000 stops (a 3.3 percent reduction), a total annual fuel savings of 333,540 gallons (an 8.7 percent reduction), and an annual delay savings of 308,100 veh-hrs (an 18.9 percent reduction). The total cost of the project was $79,523.32, and the resultant benefit-to-cost ratio was 44 to 1.

Table E-8. Summary of Benefits for Seven Arterial Signal Systems - City of Bryan

		STOPS		TOTAL SYSTEM DELAY(veh-hrs)		FUEL(gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	AM	63129	59097	504.5	450.0	1213.6	1123.4
	NOON	60046	62480	480.5	415.4	1185.4	1138.7
	OFF	58205	56238	464.5	350.4	1145.1	1029.1
	PM	81396	76263	806.3	640.6	1693.1	1506.1
DIFFERENCES	AM		4032		54.5		90.2
	NOON		-2434		65.1		46.7
	OFF		1967		114.1		116.0
	PM		5133		165.7		187.0
HRS/DAY	AM		2		2		2
	NOON		2		2		2
	OFF		4		4		4
	PM		2		2		2
DAILY TOTALS	AM		8064		109.0		180.4
	NOON		-4868		130.2		93.4
	OFF		7868		456.4		464.0
	PM		10266		331.4		374.0
	TOTAL		21330		1027.0		1111.8
UNIT VALUES			$0.014		$10.00		$1.00
ANNUAL SAVINGS			$89,586		$3,081,000		$333,540
PROJECT COST:			$79,523.32	TOTAL ANNUAL SAVINGS:			$3,504,126
BENEFIT/COST RATIO:			44				

Table E-9. Summary of Travel Time for Seven Arterial Signal Systems - City of Bryan

Project Type	Arterial / Link	Length (ft)	Time Period	Before Travel Time (sec)		After Travel Time (sec)		Percentage Travel Time Savings
				NB	SB	NB	SB	
11	N. Texas Ave.	N. A.(1)	AM	106.0	115.3	93.3	115.0	5.9
			NOON	118.0	89.0	98.3	83.3	12.3
			PM	94.3	119.3	88.0	108.3	8.1
			OFF	109.7	105.0	84.4	80.7	23.1
	College Ave.	N. A.	AM	117.0	115.0	104.7	78.7	20.9
			NOON	104.7	111.7	80.7	81.7	25.0
			PM	161.0	100.0	153.0	94.7	5.1
			OFF	105.3	78.0	74.7	69.7	21.2
	29th Street	N. A.	AM	208.3	210.7	186.3	179.7	12.6
			NOON	243.0	229.0	218.3	210.0	9.3
			PM	259.3	205.3	228.3	238.0	-0.4
			OFF	225.0	210.7	186.0	185.7	14.7
	S. Texas Ave.	N. A.	AM	196.0	142.3	163.3	254.3	-23.4
			NOON	207.3	209.3	170.3	185.7	14.5
			PM	245.3	250.7	192.0	306.7	-0.5
			OFF	202.0	161.0	168.7	185.0	2.6
				EB	WB	EB	WB	
	W. J. Bryan Parkway	N. A.	AM	148.3	88.0	80.0	39.0	49.6
			NOON	103.0	80.5	88.0	68.3	14.8
			PM	174.3	100.0	116.0	39.3	43.4
			OFF	87.0	61.3	72.7	95.0	-13.1
	Villa Maria/ Briarcrest	N. A.	AM	359.0	385.7	395.0	348.0	0.2
			NOON	413.7	344.3	465.0	395.3	-13.5
			PM	373.0	366.3	408.0	356.0	-3.3
			OFF	330.0	345.7	405.3	359.6	-13.2

(1) Not Available

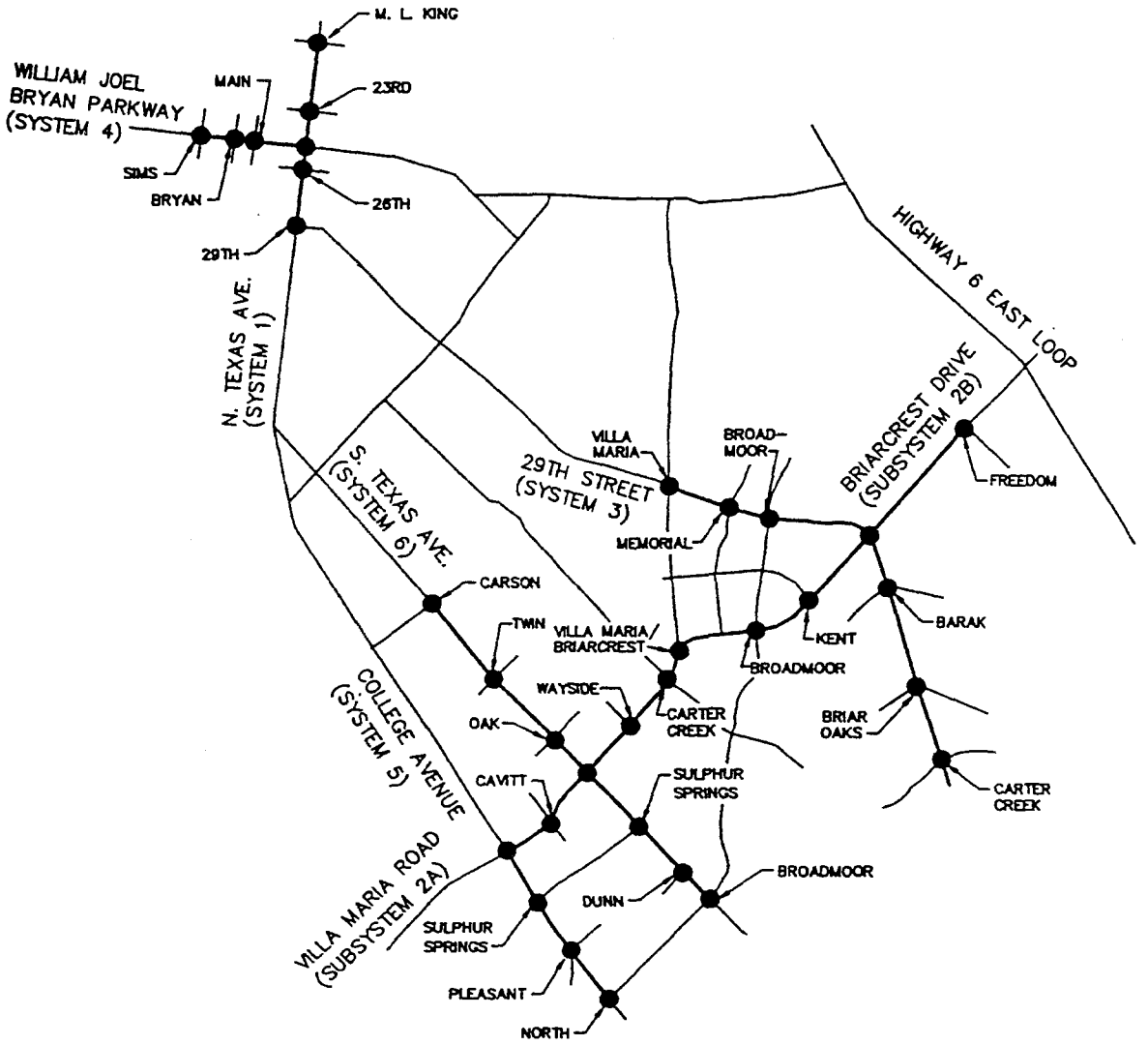


Figure E-4. Project Network for Seven Arterial Signal Systems - Bryan.

Carrollton Signal System

The city of Carrollton Department of Public Works and Transportation worked on the following project. The network is comprised of two subsystems located along two arterials within the city. The first subsystem was located on Belt Line Road between Denton Drive and the southbound Frontage Road of IH 35, and the second subsystem was located on Whitlock Lane between McCoy Road and the southbound Frontage Road of IH 35. The Belt Line Road subsystem contained 4 intersections and the Whitlock Drive subsystem contained 5 intersections. The following figure shows the project network and cross streets.

All intersections currently have Eagle EPAC 300 controllers. At the time of the "before" study, the IH 35 northbound and southbound Frontage Roads on Belt Line Road used one controller and Denton Drive and Broadway Road on Belt Line Road used one controller. The four intersections on Belt Line Road were time-based coordinated and had nine timing plans. On Whitlock Lane, the IH 35 northbound and southbound Frontage Roads used one controller. The intersections on Whitlock Lane were actuated and ran "free" throughout the day.

In order to evaluate the performance, field data was collected in the "before" and "after" TLS traffic conditions. The data included arterial data, peak hour turning movement volumes, signal phasing and timing, and network travel time data using the floating car technique. All of this data was collected to evaluate and calibrate before and after conditions. Intersection approach configurations and lane assignments for all 9 intersections were used to derive saturation flows needed as input into the TRANSYT-7F modeling program. The existing AM peak, NOON peak, and PM peak turning movement volumes, saturation flow rates, as well as signal phasing and timing data were input into the TRANSYT-7F model to simulate before and after conditions. PASSER II-90 and PASSER III were used to develop optimum signal phasing patterns and intersection offsets. Implementation of the new timing plans and fine tuning of system signal timings were carried out in part by the City of Carrollton. Some intersections required minor offset changes. This was due in part to the variability in vehicular speeds between intersections. The revised final timings plans for all intersections were simulated with TRANSYT-7F to obtain the final measures of effectiveness.

Overall travel times improved on both Belt Line Road and Whitlock Lane in all time periods. This included over a 44 percent travel time savings on Whitlock Lane during the NOON peak period. Isolated links within each arterial did, however, experience travel time increases.

Based on the TRANSYT-7F, PASSER II-90, and PASSER III simulation, the project resulted in an estimated $3,108,390 savings per year on total operating cost, a direct benefit to motorists using these routes. This operating cost savings included a total annual increase of 2,427,000 stops (a 6.5 percent increase), a total annual fuel savings of 633,948 gallons (a 41.6 percent reduction), and a delay annual savings of 250,842 veh-hrs (a 21.0 percent reduction). The total cost of the project was $134,253.31, and the resultant benefit-to-cost ratio was 23 to 1.

Table E-10. Summary of Benefits for Carrollton Signal System - City of Carrollton

		STOPS		TOTAL SYSTEM DELAY(veh-hrs)		FUEL(gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	AM	15112	13906	424.78	249.45	555.53	378.55
	OFF/NOON	8328	9518	94.05	89.19	213.70	186.39
	PM	14125	14616	1193.00	969.70	1129.76	359.40
DIFFERENCES	AM		1206		175.33		176.98
	OFF/NOON		-1190		4.86		27.31
	PM		-491		223.30		770.36
HRS/DAY	AM		2		2		2
	OFF/NOON		8		8		8
	PM		2		2		2
DAILY TOTALS	AM		2412		350.66		353.96
	OFF/NOON		-9520		38.88		218.48
	PM		-982		446.6		1540.72
	TOTAL		-8090		836.14		2113.16
UNIT VALUES			$0.014		$10.00		$1.00
ANNUAL SAVINGS			($33,978)		$2,508,420		$633,948
PROJECT COST:			$134,253.31	TOTAL ANNUAL SAVINGS:			$3,108,390
BENEFIT/COST RATIO:			23				

Table E-11. Summary of Travel Time for Carrollton Signal System - City of Carrollton

Project Type	Arterial / Link	Length (ft)	Time Period	Before Travel Time (sec)		After Travel Time (sec)		Percentage Travel Time Savings
				EB	WB	EB	WB	
05	Belt Line Road							
	Denton Dr. to Broadway Rd.	N.A.(1)	AM	9.8	26.0	9.7	10.0	45.1
			NOON	8.8	15.1	11.9	32.7	-86.3
			PM	6.2	12.4	11.8	9.6	-15.4
	Broadway Rd. t o IH-35 NBF Rd.	N.A.	AM	41.5	36.8	43.7	22.2	15.8
			NOON	21.5	66.2	27.5	36.3	27.3
			PM	53.5	150.3	39.9	39.6	61.0
	IH-35 NFR Rd. to IH-35 SBF Rd.	N.A.	AM	11.2	7.7	9.5	7.3	11.3
			NOON	8.7	9.8	9.7	9.1	-1.4
			PM	9.0	8.6	8.8	9.5	-3.3
	Whitlock Lane							
	McCoy Rd. to Denton Dr.	N.A.	AM	45.7	57.8	50.1	50.9	2.4
			NOON	45.8	76.0	29.8	30.1	50.9
			PM	45.5	71.9	25.7	24.5	57.3
	Denton Dr. to Old Denton Rd.	N.A.	AM	59.8	61.7	52.6	33.9	28.8
			NOON	39.7	55.2	32.8	21.0	43.4
			PM	30.7	59.8	30.4	27.7	35.8
	Old Denton Rd. to IH-35 NBF Rd.	N.A.	AM	73.8	165.2	56.0	140.9	17.6
			NOON	60.0	111.2	31.6	47.6	53.7
			PM	60.4	111.0	29.9	47.6	54.7
	IH-35 NFR Rd. to IH-35 SBF Rd.	N.A.	AM	8.3	11.9	8.6	8.8	13.8
			NOON	8.5	8.3	4.5	7.6	28.1
			PM	8.5	8.5	6.0	15.8	-28.6

(1) Not Available

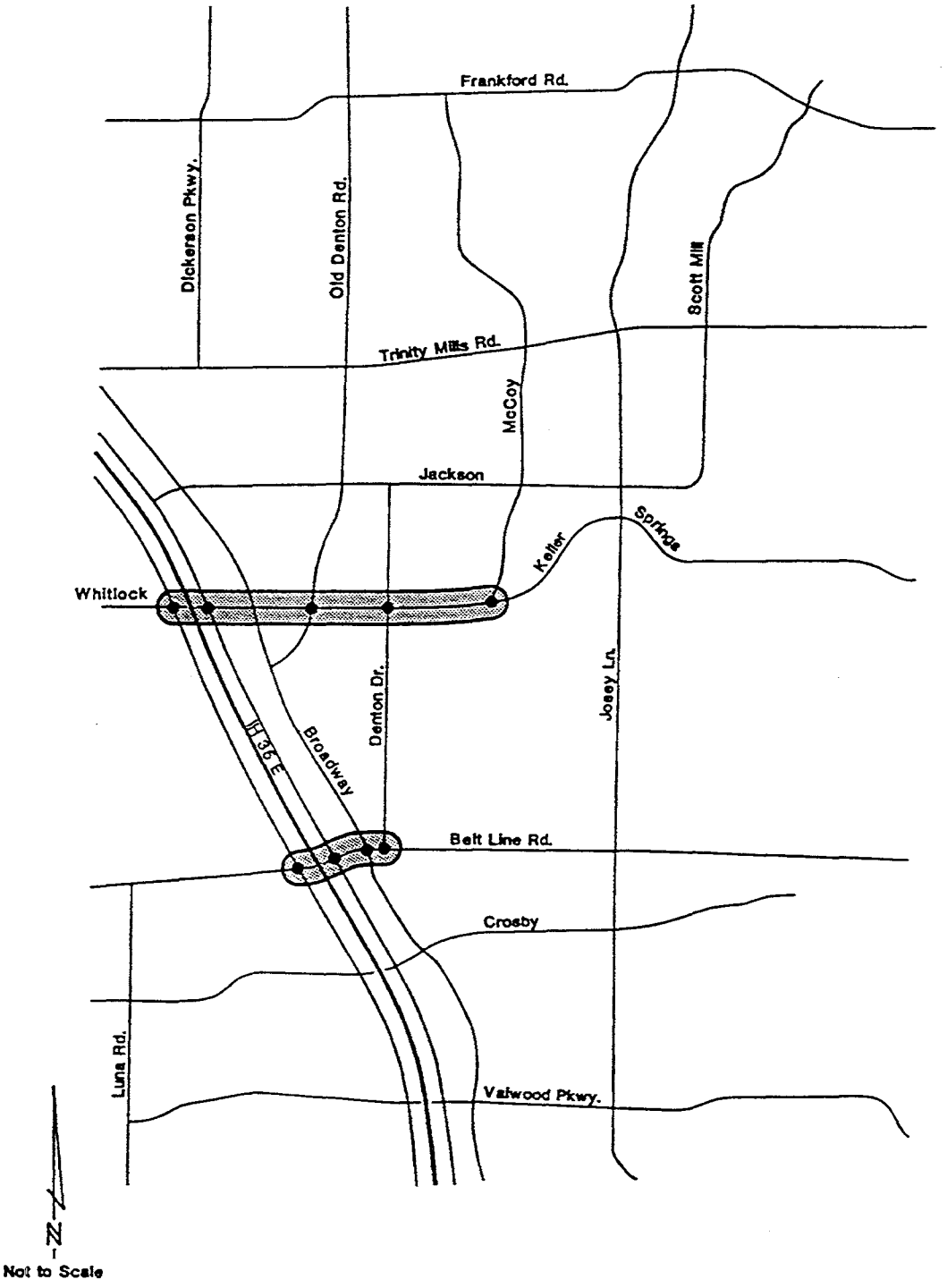


Figure E-5. Project Network for Carrollton Signal System - Carrollton.

Oak/Hickory System

The city of Denton Department of Public Works and Transportation worked on the following project. System 1 includes West Oak Street and West Hickory Street. This couplet is located on the north side of the University of North Texas campus and provides access to and from the downtown area. The system is composed of five intersections, two on West Oak Street at the intersections of Fry Street and Jagoe Street, and three along West Hickory Street at Avenue A, Avenue B, and Welch Avenue. West Oak and West Hickory Streets are both one-way arterials. The attached figure shows the project network, cross streets, and link distances.

All five intersections in the system operated as a time-based coordinated system with common background cycles of 45 seconds throughout the majority of the day, except for nighttime flashing hours. It was the desire of the city of Denton to place the signals in this system as well as the Welch Avenue System under the same master controller. Because of this, a new master controller and hardware interconnect were provided as part of this project. The new system coordination is provided through a hardwire interconnect and utilizes Transyt controllers model 1880EL. All installations utilize mast arms and poles along with protected/permissive left turn phasing and pedestrian controls at selected intersections.

In order to evaluate the performance, field data was collected in the "before" and "after" TLS traffic conditions. The data included traffic volumes, travel times, signal timings and phasing, arterial data, intersection geometrics, travel delays, and an operating cost study. Optimum cycle lengths were determined using PASSER II-90 for each of the AM, NOON, and PM peak periods. Travel time information was obtained by the floating car technique. Six runs were made on each link in each time period (AM peak, NOON peak, and PM peak), and the mean travel times were determined.

Average travel times on West Hickory Street decreased in the AM and PM peak periods and increased slightly during the NOON peak period. West Oak Street travel times increased in each time period.

Based on the PASSER II-90 simulation, the project resulted in an estimated $79,932 savings per year on total operating cost, a direct benefit to motorists using these routes. This operating cost savings included a total annual savings of 3,228,000 stops (a 24.8 percent reduction), a total annual fuel savings of 23,340 gallons (a 15.8 percent reduction), and a delay annual savings of 1,140 veh-hrs (a 2.5 percent reduction). The total cost of the project was $57,067.63 and the resultant benefit-to-cost ratio was 1.5 to 1.

Table E-12. Summary of Benefits for Oak/Hickory System - City of Denton

		STOPS		TOTAL SYSTEM DELAY(veh-hrs)		FUEL(gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	AM	2337	1838	8.6	8.1	26.1	22.1
	PM	3769	2828	13.0	12.6	42.5	35.6
	OFF	3116	2328	10.8	10.6	35.4	29.8
DIFFERENCES	AM		499		0.5		4.0
	OFF		941		0.4		6.9
	PM		788		0.2		5.6
HRS/DAY	AM		2		2		2
	OFF		2		2		2
	PM		10		10		10
DAILY TOTALS	AM		998		1.0		8.0
	OFF		1882		0.8		13.8
	PM		7880		2.0		56.0
	TOTAL		10760		3.8		77.8
UNIT VALUES			$0.014		$10.00		$1.00
ANNUAL SAVINGS			$45,192		$11,400		$23,340
PROJECT COST:			$57,067.63	TOTAL ANNUAL SAVINGS:			$79,932
BENEFIT/COST RATIO:			1.5				

Table E-13. Summary of Travel Time for Oak/Hickory System - City of Denton

Project Type	Arterial / Link	Length (ft)	Time Period	Before Travel Time (sec)		After Travel Time (sec)		Percentage Travel Time Savings
				EB	WB	EB	WB	
06	Oak/Hickory System	2560	AM	48.2	33.7	45.0	47.0	-30.4
			NOON	53.7	39.7	55.2	45.5	-14.4
			OFF	55.3	32.0	51.0	48.8	-27.0

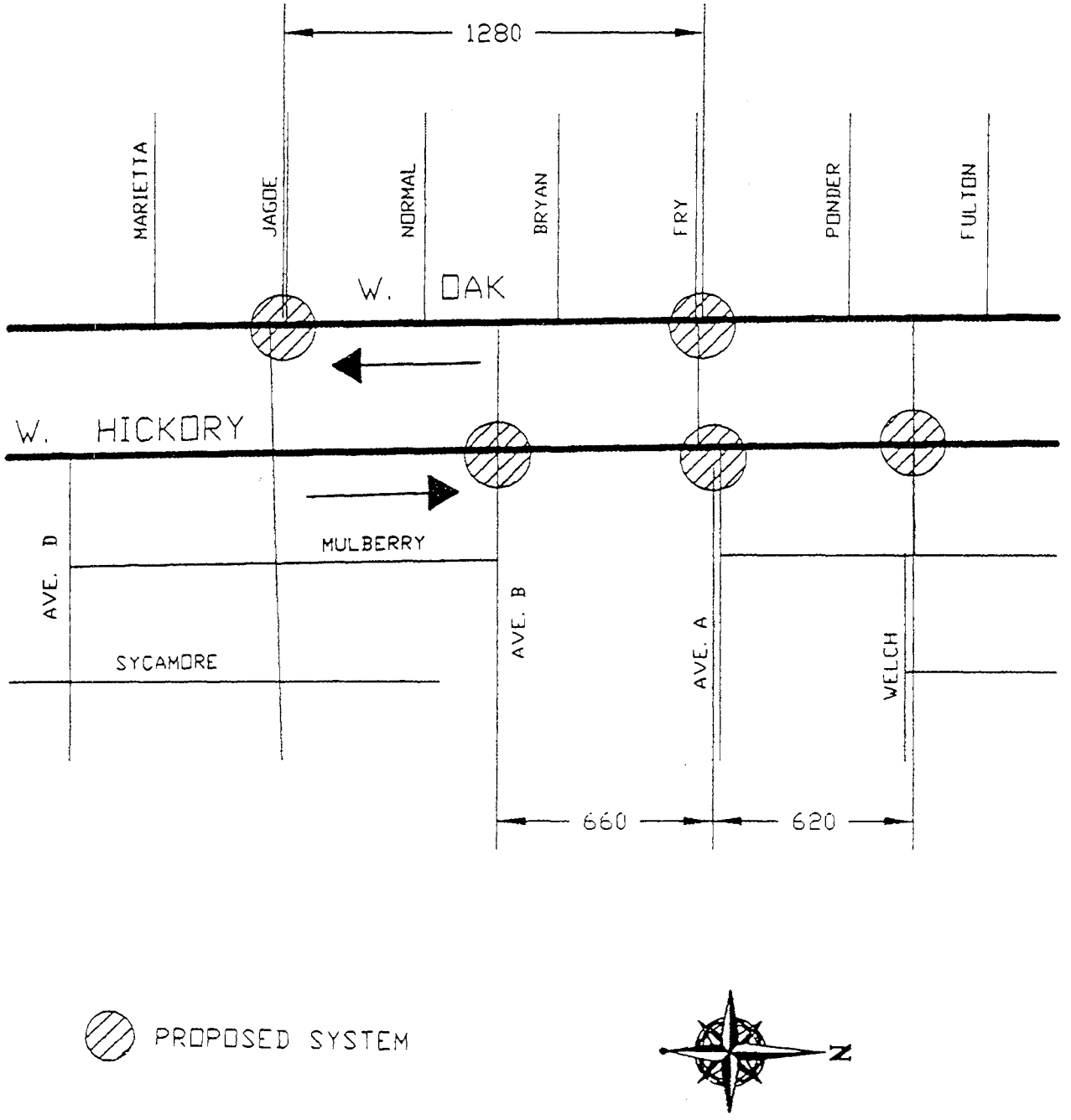


Figure E-6. Project Network for Oak/Hickory System - Denton.

Welch Street System

The city of Denton Department of Public Works and Transportation worked on the following project. System 2 includes Welch Street between Eagle Drive and West Hickory Street. Welch Street is a major arterial running north-south through the City and serving the University of North Texas. Five intersections comprise this system including Eagle Drive, Highland Street, Praire Street, Chestnut Street, and West Hickory Street. After the completion of the "before" report, it was decided to drop the Eagle Drive intersection for the project. Thus, only four intersections were considered in the final analysis. The attached figure shows the project network, cross streets, and link distances.

The three interior signals in the system previously operated in a coordinated system with three timing plans, two of which were 60 second cycles and the third 80 second cycle. The signal at Eagle Drive was coordinated with signals along that arterial while Chestnut Street was operated in a time-based mode with signals along that street. It was the desire of the city of Denton to place the signals in this system along with the Oak/Hickory System under the same master controller. Because of this, a new master controller and hardware interconnect were provided as part of this project. The new system coordination is provided through a hardwire interconnect and utilizes Transyt controllers model 1880EL. All installations utilize mast arms and poles along with protected/permissive left turn phasing and pedestrian controls at selected intersections.

In order to evaluate the performance, field data was collected in the "before" and "after" TLS traffic conditions. The data included traffic volumes, travel times, signal timings and phasing, arterial data, intersection geometrics, travel delays, and an operating cost study. Optimum cycle lengths were determined using PASSER II-90 for each of the AM, NOON, and PM peak periods. Travel time information was obtained by the floating car technique. Six runs were made on each link in each time period (AM peak, NOON peak, and PM peak), and the mean travel times were determined.

The percent travel times savings was not computed because of the elimination of the Eagle Street intersection from the project.

Based on the PASSER II-90 simulation, the project resulted in an estimated $57,305 increase per year on total operating cost. This operating cost savings included a total annual increase of 1,453,200 stops (a 14.2 percent increase), a total annual fuel increase of 5,760 gallons (a 4.6 percent increase), and a delay annual increase of 3,120 veh-hrs (a 7.0 percent increase). The total cost of the project was $54,305.80 and the resultant benefit-to-cost ratio was 0 to 1.

Table E-14. Summary of Benefits for Welch Street System - City of Denton

		STOPS		TOTAL SYSTEM DELAY(veh-hrs)		FUEL(gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	AM	1683	1994	6.6	5.8	19.2	19.6
	OFF	2530	2929	11.2	11.8	31.0	32.4
	PM	2751	2867	11.6	14.6	32.6	34.8
DIFFERENCES	AM		-311		0.8		-0.4
	OFF		-399		-0.6		-1.4
	PM		-116		-3		-2.2
HRS/DAY	AM		2		2		2
	OFF		10		10		10
	PM		2		2		2
DAILY TOTALS	AM		-622		1.6		-0.8
	OFF		-3990		-6.0		-14.0
	PM		-232		-6.0		-4.4
	TOTAL		-4844		-10.4		-19.2
UNIT VALUES			$0.014		$10.00		$1.00
ANNUAL SAVINGS			($20,345)		($31,200)		($5,760)
PROJECT COST:			$54,305.80	TOTAL ANNUAL SAVINGS:			($57,305)
BENEFIT/COST RATIO:			0				

Table E-15. Summary of Travel Time for Welch Street System - City of Denton

Project Type	Arterial / Link	Length (ft)	Time Period	Before Travel Time (sec)		After Travel Time (sec)		Percentage Travel Time Savings
				NB	SB	NB	SB	
06	Welch Street System	2890	AM	86.2	80.5	75.2	75.2	-
			NOON	85.0	84.2	86.2	86.2	-
			PM	104.8	67.8	76.2	76.2	-

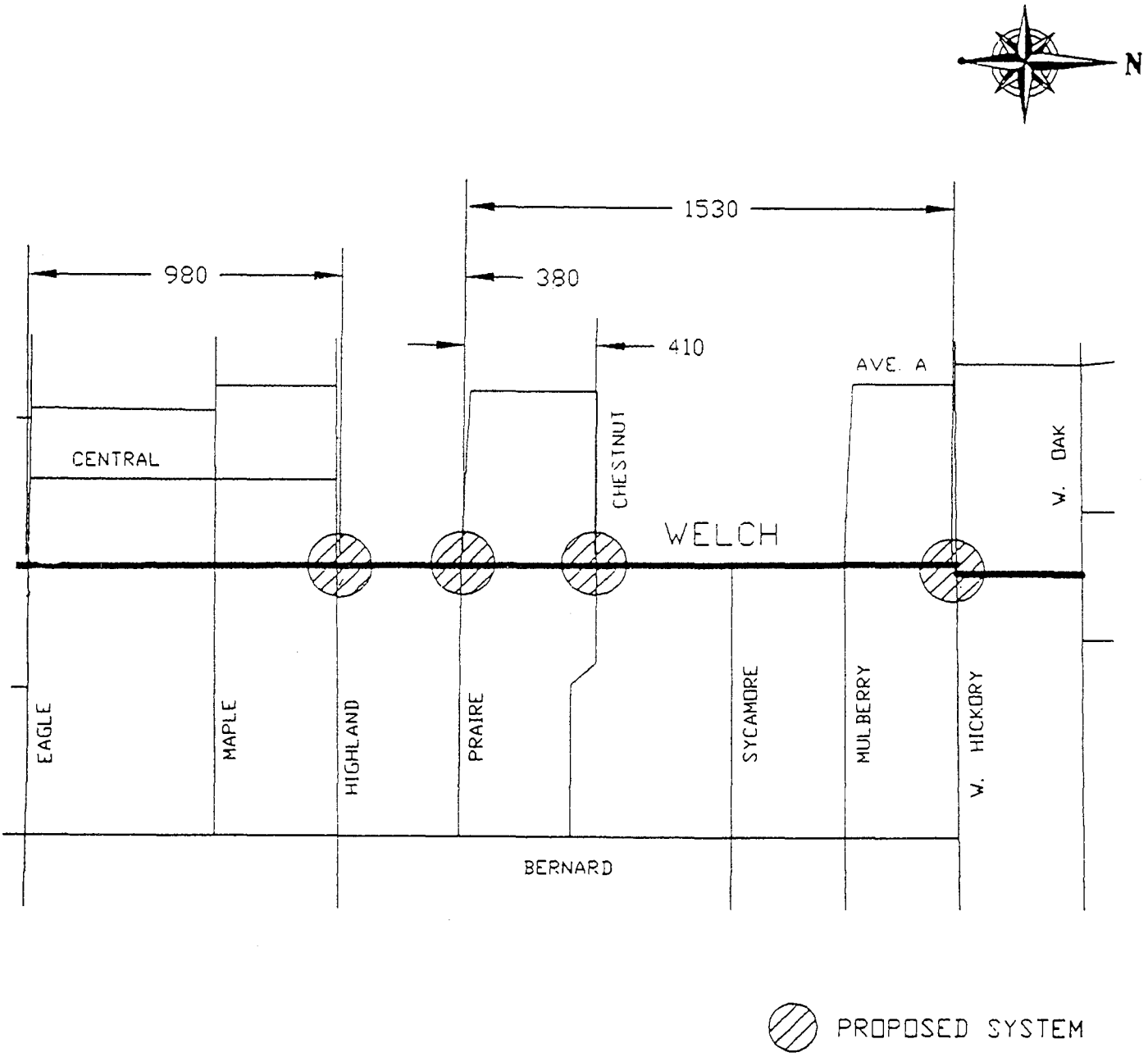


Figure E-7. Project Network for Welch Street System - Denton.

Fort Hood Street

The city of Killeen Department of Public Works and Transportation worked on the following project. Fort Hood Street, between Jasper Drive and Hallmark Avenue, is a major thoroughfare which carries traffic from south of Killeen to the East Gate of Fort Hood. This project includes intersections with Jasper Drive, the north and south Frontage Roads of US 190 (Central Texas Expressway), the K-Mart entrance, and Hallmark Avenue. The attached figure shows the project network and cross streets.

This project included a total of 5 intersections. The current system operated with 90 second cycle lengths, except for Hallmark Street intersection which had a 85 second cycle.

In order to evaluate the performance, field data was collected in the "before" and "after" TLS traffic conditions. The data included traffic volumes, travel times, signal timings and phasing, arterial data, intersection geometrics, travel delays, and an operating cost study. Optimum cycle lengths were determined using PASSER II-90 for each of the AM, NOON, and PM peak periods. PASSER III was used to determine optimal cycle lengths at the Central Texas Expressway Frontage Roads.

Cycle lengths were set at 100 seconds. Due to continued problems at the Central Texas Expressway Frontage Roads, the offsets were adjusted. The South Frontage Road was changed by implementing less time for cross-street traffic. The North Frontage Road changed the left-turn sequence from leading to lagging. Average travel time improved by 33 percent with the implementation of the new timing plan and these adjustments.

Due to problems with the field data collection methods, travel times were obtained only in the PM peak period. Overall travel times on Fort Hood Street showed significant savings although the CTE South Street to Jasper Street leg did realize a slight increase. Travel time on the Hallmark Street to K-Mart Street leg of Fort Hood Street during the PM peak period declined by over 67 percent.

Based on the PASSER II-90 and PASSER III simulation, the project resulted in an estimated $1,845,930 savings per year on total operating cost, a direct benefit to motorists using these routes. This operating cost savings included a total annual savings of 14,727,000 stops (a 44.6% percent reduction), a total annual fuel savings of 273,406 gallons (a 43.8 percent reduction), and a delay annual savings of 136,635 veh-hrs (a 49.3 percent reduction). The total cost of the project was $20,002.23, and the resultant benefit-to-cost ratio was 92 to 1.

Table E-16. Summary of Benefits for Fort Hood Street - City of Killeen

		STOPS		TOTAL SYSTEM DELAY(veh-hrs)		FUEL(gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	AM*	13713	7327	120.10	60.85	270.89	152.33
	NOON*	18235	9743	159.71	80.92	360.23	202.57
	PM	20755	11089	181.78	92.10	410.01	230.56
DIFFERENCES	AM		6386		59.25		118.56
	NOON		8493		78.79		157.66
	PM		9666		89.68		179.45
HRS/DAY	AM		2		2		2
	NOON		2		2		2
	PM		2		2		2
DAILY TOTALS	AM		12773		118.50		237.13
	NOON		16985		157.59		315.33
	PM		19332		179.36		358.90
	TOTAL		49090		455.45		911.35
UNIT VALUES			$0.014		$10.00		$1.00
ANNUAL SAVINGS			$206,177		$1,366,347		$273,406
PROJECT COST:			$20,002.23	TOTAL ANNUAL SAVINGS:			$1,845,930
BENEFIT/COST RATIO:			92				

*AM and NOON peak hourly values are estimated.

Table E-17. Summary of Travel Time for Fort Hood Street - City of Killeen

Project Type	Arterial / Link	Length (ft)	Time Period	Before Travel Time (sec)		After Travel Time (sec)		Percentage Travel Time Savings
				NB	SB	NB	SB	
01	Fort Hood Street							
	Hallmark St. to K-Mart St.	1322	AM	-	-	-	-	-
			NOON	-	-	-	-	-
			PM	70.7	49.0	21.7	17.3	67.4
	K-Mart St. to CTE North St.	1077	AM	-	-	-	-	-
			NOON	-	-	-	-	-
			PM	31.3	77.7	21.3	43.0	41.0
	CTE North St. to CTE South St.	476	AM	-	-	-	-	-
			NOON	-	-	-	-	-
			PM	22.7	13.0	14.3	13.7	21.6
	CTE South St. to Jasper St.	2022	AM	-	-	-	-	-
			NOON	-	-	-	-	-
			PM	65.7	39.0	89.7	35.7	-19.7

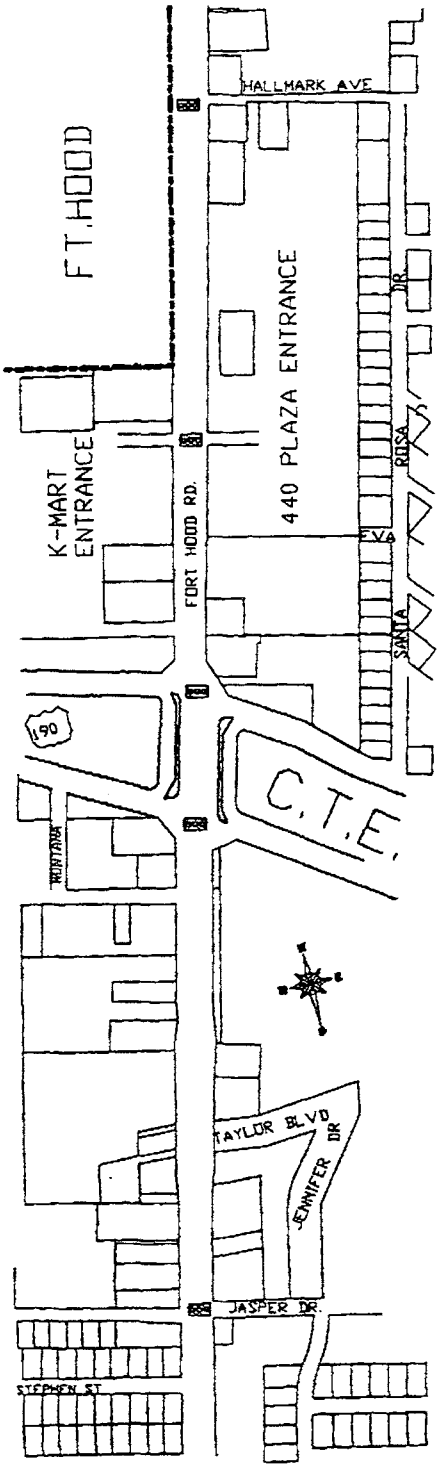


Figure E-8. Project Network for Fort Hood Street – Killeen.

IH 35 Frontage Roads

The city of Laredo Department of Public Works and Transportation worked on a project on the IH 35 corridor between Calton Road and Scott Street. IH 35 divides the western area of Laredo, including the business district and industrial area, from the rest of the city. Six signalized diamond interchanges and one 4-way stop interchange comprise the traffic signal network. These interchanges are located along the service road of IH 35 and include Calton Road, Chicago Street, Jefferson Street, Lafayette Street, Park Street, Sanchez Street, and Scott Street. Chicago Street was not signalized at the time of the "before" study but was completed and included in the "after" study analysis. The total roadway segment included in this project is approximately 2.3 miles. The posted speed limit is 30 mph between Scott Street and Chicago Street and 45 mph between Chicago Street and Calton Road. The following figure shows the project network, cross streets, posted speeds, and link distances.

The cycle lengths throughout the system varied at the time of the "before" study. Calton Road, Jefferson Street, and Scott Street had only one timing plan each (85 seconds, 60 seconds, and 60 seconds, respectively) and Lafayette Street, Park Street, and Sanchez Street each had three timing plans ranging from 60 to 100 seconds.

In order to evaluate the performance, field data was collected in the "before" and "after" TLS traffic conditions. The data included traffic volumes, travel times, signal timings and phasing, arterial data, intersection geometrics, travel delays, and an operating cost study. Timing plans were developed using PASSER III. Travel time information was obtained by the floating car technique. Six runs were made on each link in each time period (AM peak, OFF peak, and PM peak), and the mean travel times were determined.

The changes in traffic conditions between the "before" and "after" study also caused increases in the overall travel times. Only the Lafayette Street to Jefferson Street PM peak travel time showed a time savings.

Based on the PASSER III simulation, the project resulted in an estimated $751,523 increase per year on total operating cost. This operating cost increase included a total annual savings of 1,461,900 stops (an 8.2 percent reduction), a total annual fuel increase of 44,940 gallons (a 4.2 percent increase), and an annual delay increase of 72,705 veh-hrs (an 8.1 percent increase). The total cost of the project was $115,854.00, and the resultant benefit-to-cost ratio was reported as 0. Recent changes in traffic patterns on IH 35 in the Laredo area, after the completion of the "before" study, are the primary factors in the cost increases reported.

Table E-18. Summary of Benefits for IH 35 Frontage Road - City of Laredo

		STOPS		TOTAL SYSTEM DELAY(veh-hrs)		FUEL(gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	AM	15667	15287	891.36	945.98	1015.34	1053.57
	NOON	18744	17720	952.98	1096.32	1096.47	1218.00
	PM	24999	21530	1160.74	1205.13	1441.72	1431.76
DIFFERENCES	AM		380		-54.62		-38.23
	NOON		1024		-143.34		-121.53
	PM		3469		-44.39		9.96
HRS/DAY	AM		1		1		1
	NOON		1		1		1
	PM		1		1		1
DAILY TOTALS	AM		380		-54.62		-38.23
	NOON		1024		-143.34		-121.53
	PM		3469		-44.39		9.96
	TOTAL		4873		-242.35		-149.80
UNIT VALUES			$0.014		$10.00		$1.00
ANNUAL SAVINGS			$20,467		($727,050)		($44,940)
PROJECT COST:			$115,854.00	TOTAL ANNUAL SAVINGS:			($751,523)
BENEFIT/COST RATIO:			0				

Table E-19. Summary of Travel Time for IH 35 Frontage Road - City of Laredo

Project Type	Arterial / Link	Length (ft)	Time Period	Before Travel Time (sec)		After Travel Time (sec)		Percentage Travel Time Savings
				NB	SB	NB	SB	
14	Calton Rd. - Chicago St.	2400	AM	81.0	57.0	123.0	59.0	-31.9
			OFF	62.0	54.0	100.0	88.0	-62.1
			PM	77.0	54.0	75.0	105.0	-37.4
	Chicago St. - Lafayette St.	2350	AM	56.0	77.0	79.0	91.0	-27.8
			OFF	54.0	87.0	59.0	203.0	-85.8
			PM	79.0	83.0	81.0	173.0	-56.8
	Lafayette St. - Jefferson St.	2650	AM	104.0	95.0	134.0	172.0	-53.8
			OFF	69.0	108.0	111.0	161.0	-53.7
			PM	105.0	90.0	85.0	75.0	17.9
	Jefferson St. - Park St.	2360	AM	90.0	74.0	184.0	103.0	-75.0
			OFF	102.0	68.0	126.0	129.0	-50.0
			PM	94.0	93.0	125.0	196.0	-71.7
	Park St. - Sanchez St.	340	AM	34.0	14.0	76.0	16.0	-91.7
			OFF	11.0	13.0	110.0	88.0	-725.0
			PM	16.0	15.0	101.0	36.0	-341.9
	Sanchez St. - Scott St.	2005	AM	76.0	59.0	148.0	184.0	-145.9
			OFF	63.0	64.0	93.0	153.0	-93.7
			PM	90.0	90.0	105.0	164.0	-49.4

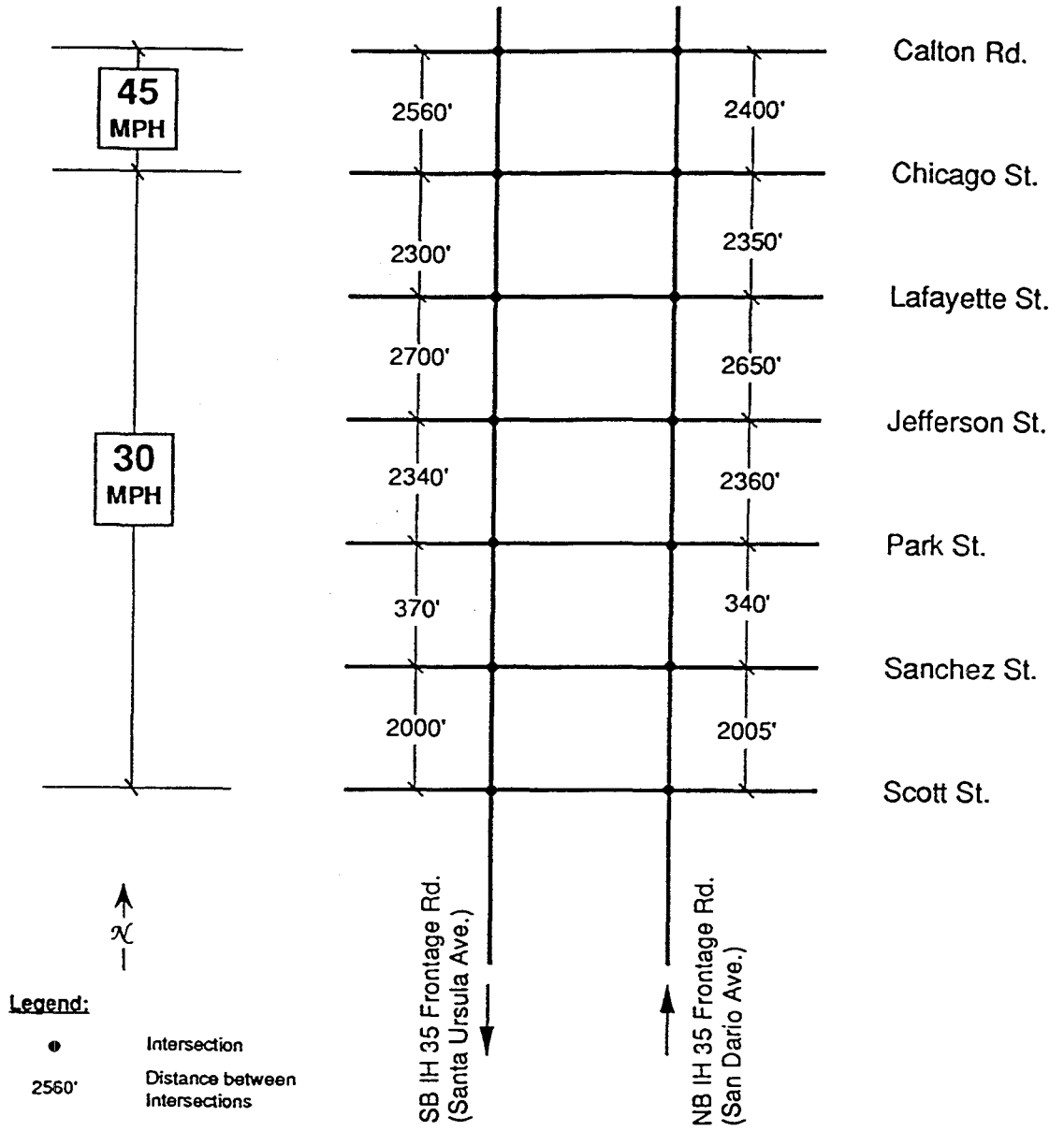


Figure E-9. Project Network for IH 35 Frontage Roads - Laredo.

Central Business District System

The city of Longview Department of Public Works and Transportation worked on the following project. The portion of the Central Business District involved in this project is a grid system consisting of east-west Whaley Street from Center Street to Second Street, east-west Methvin Street from Center Street to First Street, east-west Tyler Street from Center Street to Green Street, north-south Center Street, Fredonia and Green Streets from Whaley to Tyler Street, and north-south First Street from Whaley Street to Methvin Street. The attached figure shows the project network, cross streets, and link distances.

This traffic system contained twelve intersections equipped with variable induction motor controllers operating in a hardwire-interconnected pretimed mode. This project converted the twelve intersections into one coordinated closed-loop traffic signal system. New controllers were installed at each intersection. Each intersection included pedestrian actuated control.

In order to evaluate the performance, field data was collected in the "before" and "after" TLS traffic conditions. The data included traffic volumes, travel times, signal timings and phasing, arterial data, intersection geometrics, travel delays, and an operating cost study. Optimum cycle lengths were determined using TRANSYT-7F for each of the AM peak, NOON, and PM peak periods. Travel time information was obtained by the test car technique. Six runs were made on each link in each time period (AM peak, NOON peak, and PM peak), and the mean travel times were determined. All controllers were changed from pretimed to actuated control as part of this project. The results of the TRANSYT-7F runs were implemented in the field using a 64-second dial for weekday periods between 7:30 a.m. and 5:30 p.m. All other times utilized a 60-second dial.

Although costs did not prove favorable on this project, overall travel times in the off-peak time period were reduced by an average of 40 percent.

Based on the TRANSYT-7F simulation, the project resulted in an estimated $2,412 increase per year in total operating cost. This negative change in operating costs was caused by an increase in total annual delay of 1,200 veh-hrs (a 1.5 percent increase). The operating cost included a total annual savings of 492,000 stops (a 3.3 percent reduction) and a total annual fuel savings of 2,700 gallons (a 1.2 percent reduction). The total cost of the project was $96,987.41, and the resultant benefit-to-cost ratio computed to be 0 because of the net increase in annual costs.

Table E-20. Summary of Benefits for Central Business District System - City of Longview

		STOPS		TOTAL SYSTEM DELAY(veh-hrs)		FUEL(gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	AM	3868	3724	20.0	20.0	57.0	56.0
	NOON	5869	5694	33.0	34.0	88.0	87.0
	PM	5502	5361	30.0	31.0	82.0	82.0
DIFFERENCES	AM		144		0.0		1.0
	NOON		175		-1.0		1.0
	PM		141		-1.0		0.0
HRS/DAY	AM		7		7		7
	NOON		2		2		2
	PM		2		2		2
DAILY TOTALS	AM		1008		0.0		7.0
	NOON		350		-2.0		2.0
	PM		282		-2.0		0.0
	TOTAL		1640		-4.0		9.0
UNIT VALUES			$0.014		$10.00		$1.00
ANNUAL SAVINGS			$6,888		($12,000)		$2,700
PROJECT COST:			$96,987.41	TOTAL ANNUAL SAVINGS:			($2,412)
BENEFIT/COST RATIO:			0				

Table E-21. Summary of Travel Time for Central Business District System - City of Longview

Project Type	Arterial / Link	Length (ft)	Time Period	Before Travel Time (sec)		After Travel Time (sec)		Percentage Travel Time Savings
				NB	SB	NB	SB	
12	Center St.	865	OFF	53.5	83.0	40.0	54.0	31.1
	Fredonia St.	866	OFF	43.5	69.5	30.0	38.0	39.8
	Green St.	876	OFF	45.5	60.0	38.0	34.0	31.8
	First St.	437	OFF	29.5	31.0	13.0	12.0	58.7
				EB	WB	EB	WB	
	Whaley St.	1791	OFF	100.5	95.5	64	90	21.4
	Methvin St.	1608	OFF	129.5	91.5	67	53	45.7
	Tyler St.	1007	OFF	75.5	111	34	48	56.0

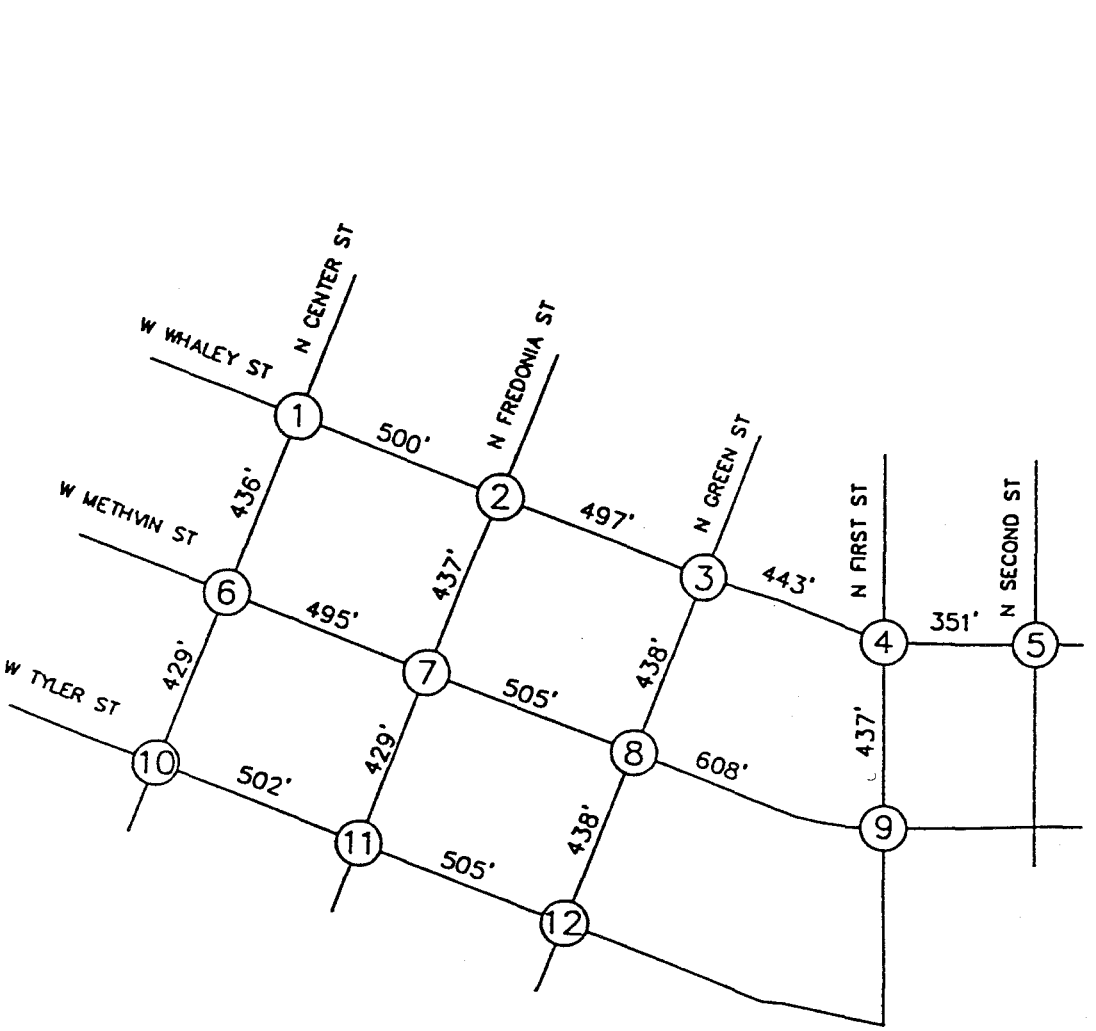


Figure E-10. Project Network for Central Business District System - Longview.

Bryan-Belt Line Road/Galloway Avenue

The city of Mesquite Department of Public Works and Transportation worked on the following project. System "A" consists of Galloway Avenue between Grubb Street and Gross Street and Bryan-Belt Line Road between Kearney Street and Gross Street. This system has nine non-coordinated, tightly spaced intersections that operate fully-actuated. This system is considered the most critical portion of the Galloway Avenue corridor and is part of the central business district. Posted speed limits vary between 30 and 35 mph. The following figure shows the project network, cross streets, link distances, and speed limits.

System "A" along Galloway Avenue and Belt Line Road in Mesquite's downtown district had a number of traffic control devices installed as part of this project. Eight traffic controllers were replaced with Econolite ASC/2-2000's. In addition, 4 NEMA cabinets were installed which provide interconnect capabilities. All eight cabinets were retrofitted with a hardwired interconnect communication panel. Inductive loop detectors and interconnect cable were also installed.

In order to evaluate the performance, field data was collected in the "before" and "after" TLS traffic conditions. The data included traffic volumes, travel times, signal timings and phasing, arterial data, intersection geometrics, travel delays, and an operating cost study. Optimum cycle lengths were determined using PASSER-II 90 or TRANSYT-7F for each of the AM peak, NOON, and PM peak periods. Travel time information was obtained by the floating car technique. Six runs were made on each link in each time period (AM peak, NOON peak, and PM peak), and the mean travel times were determined.

Overall travel times were improved on both Bryan-Belt Line Road and Galloway Avenue in the Noon peak and PM peak time periods. The AM peak "after" travel time was not completed due to construction. Average travel times within the system were reduced by approximately 20 percent.

Based on the PASSER-II 90 and TRANSYT-7F simulation, the project resulted in an estimated $792,119 savings per year on total operating cost, a direct benefit to motorists using these routes. This operating cost savings included a total annual savings of 964,200 stops (a 5.4 percent reduction), a total annual fuel savings of 297,420 gallons (a 50.0 percent reduction), and a delay annual savings of 48,120 veh-hrs (a 29.2 percent reduction). The total cost of the project was $102,602.55, and the resultant benefit-to-cost ratio was 8 to 1.

Table E-22. Summary of Benefits for Bryan-Belt Line Road/Galloway Avenue - City of Mesquite

		STOPS		TOTAL SYSTEM DELAY(veh-hrs)		FUEL(gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	AM	10544	10904	89.65	67.77	196.36	177.30
	NOON	6869	6388	54.91	39.09	134.94	112.50
	PM	12354	10868	129.75	87.25	659.70	205.50
DIFFERENCES	AM		-360		21.88		19.06
	NOON		481		15.82		22.44
	PM		1486		42.50		454.20
HRS/DAY	AM		2		2		2
	NOON		2		2		2
	PM		2		2		2
DAILY TOTALS	AM		-720		43.76		38.12
	NOON		962		31.64		44.88
	PM		2972		85.00		908.40
	TOTAL		3214		160.40		991.40
UNIT VALUES			$0.014		$10.00		$1.00
ANNUAL SAVINGS			$13,499		$481,200		$297,420
PROJECT COST:			$102,602.55	TOTAL ANNUAL SAVINGS:			$792,119
BENEFIT/COST RATIO:			8				

Table E-23. Summary of Travel Time for Bryan-Belt Line Rd./Galloway Avenue - City of Mesquite

Project Type	Arterial / Link	Length (ft)	Time Period	Before Travel Time (sec)		After Travel Time (sec)		Percentage Travel Time Savings
				NB	SB	NB	SB	
10	Bryan-Belt Line Road	2225	AM	102.2	90.7	-	-	-
			NOON	89.5	100.5	64.0	72.2	28.3
			PM	105.7	94.9	76.3	85.0	19.6
	Galloway Ave. (CBD)	4175	AM	146.6	112.9	-	-	-
			NOON	151.8	133.6	121.5	120.3	15.3
			PM	159.5	133.7	130.2	115.7	16.1

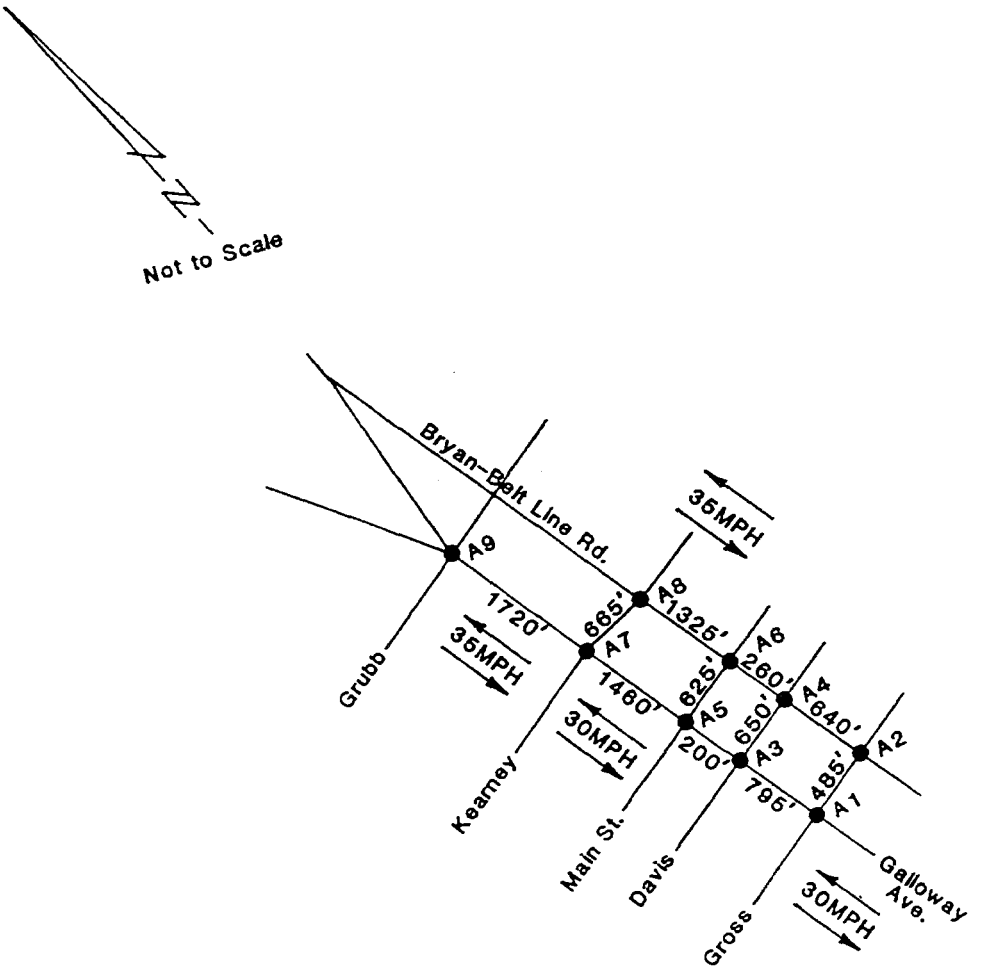


Figure E-11. Project Network for Bryan-Beltline Road/Galloway Avenue - Mesquite.

Galloway Avenue

The city of Mesquite Department of Public Works and Transportation worked on the following project. System "B" consists of Galloway Avenue between Town East Boulevard and Range Street. This system has eight non-coordinated intersections that operate fully-actuated. This system is approximately 2.1 miles long and carries the highest volume of traffic along the Galloway corridor. Posted speed limit is 35 mph. The following figure shows the project network, cross streets, link distances, and speed limit.

This system had several traffic control devices installed as part of this project. A new NEMA cabinet and controller replaced the metal house and two uncoordinated controllers at US 80. Inductance loop detectors were installed at various locations. Four existing Traftech AC800 traffic controllers were replaced with NEMA based controllers with internal time-based coordination capabilities.

In order to evaluate the performance, field data was collected in the "before" and "after" TLS traffic conditions. The data included traffic volumes, travel times, signal timings and phasing, arterial data, intersection geometrics, travel delays, and an operating cost study. Optimum cycle lengths were determined using PASSER-II 90 or TRANSYT-7F for each of the AM peak, NOON, and PM peak periods. Travel time information was obtained by the floating car technique. Six runs were made on each link in each time period (AM peak, NOON peak, and PM peak), and the mean travel times were determined.

Overall travel times on Galloway Avenue improved in the AM peak and NOON peak periods by 15.7 and 7.7 percent, respectively. The PM peak travel time experienced a slight increase in travel time.

Based on the PASSER II-90 and TRANSYT-7F simulation, the project resulted in an estimated $1,474,698 savings per year on total operating cost, a direct benefit to motorists using these routes. This operating cost savings included a total annual savings of 3,240,000 stops (a 14.6 percent reduction), a total annual fuel savings of 120,498 gallons (a 18.8 percent reduction), and a delay annual savings of 130,884 veh-hrs (a 38.8 percent reduction). The total cost of the project was $34,208.99 and the resultant benefit-to-cost ratio was 43 to 1.

Table E-24. Summary of Benefits for Galloway Avenue - City of Mesquite

		STOPS		TOTAL SYSTEM DELAY(veh-hrs)		FUEL(gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	AM	10764	8932	93.60	91.65	257.34	242.00
	NOON	9696	8138	80.80	74.52	240.96	224.70
	PM	16585	14575	387.11	177.20	572.63	403.40
DIFFERENCES	AM		1832		1.95		15.34
	NOON		1558		6.28		16.26
	PM		2010		209.91		169.23
HRS/DAY	AM		2		2		2
	NOON		2		2		2
	PM		2		2		2
DAILY TOTALS	AM		3664		3.90		30.68
	NOON		3116		12.56		32.52
	PM		4020		419.82		338.46
	TOTAL		10800		436.28		401.66
UNIT VALUES			$0.014		$10.00		$1.00
ANNUAL SAVINGS			$45,360		$1,308,840		$120,498
PROJECT COST:			$34,208.99	TOTAL ANNUAL SAVINGS:			$1,474,698
BENEFIT/COST RATIO:			43				

Table E-25. Summary of Travel Time for Galloway Avenue - City of Mesquite

Project Type	Arterial / Link	Length (ft)	Time Period	Before Travel Time (sec)		After Travel Time (sec)		Percentage Travel Time Savings
				NB	SB	NB	SB	
04	Galloway Avenue	11345	AM	308.0	364.5	277.7	289.0	15.7
			NOON	328.6	338.6	301.1	314.9	7.7
			PM	304.4	392.2	306.7	402.2	-1.8

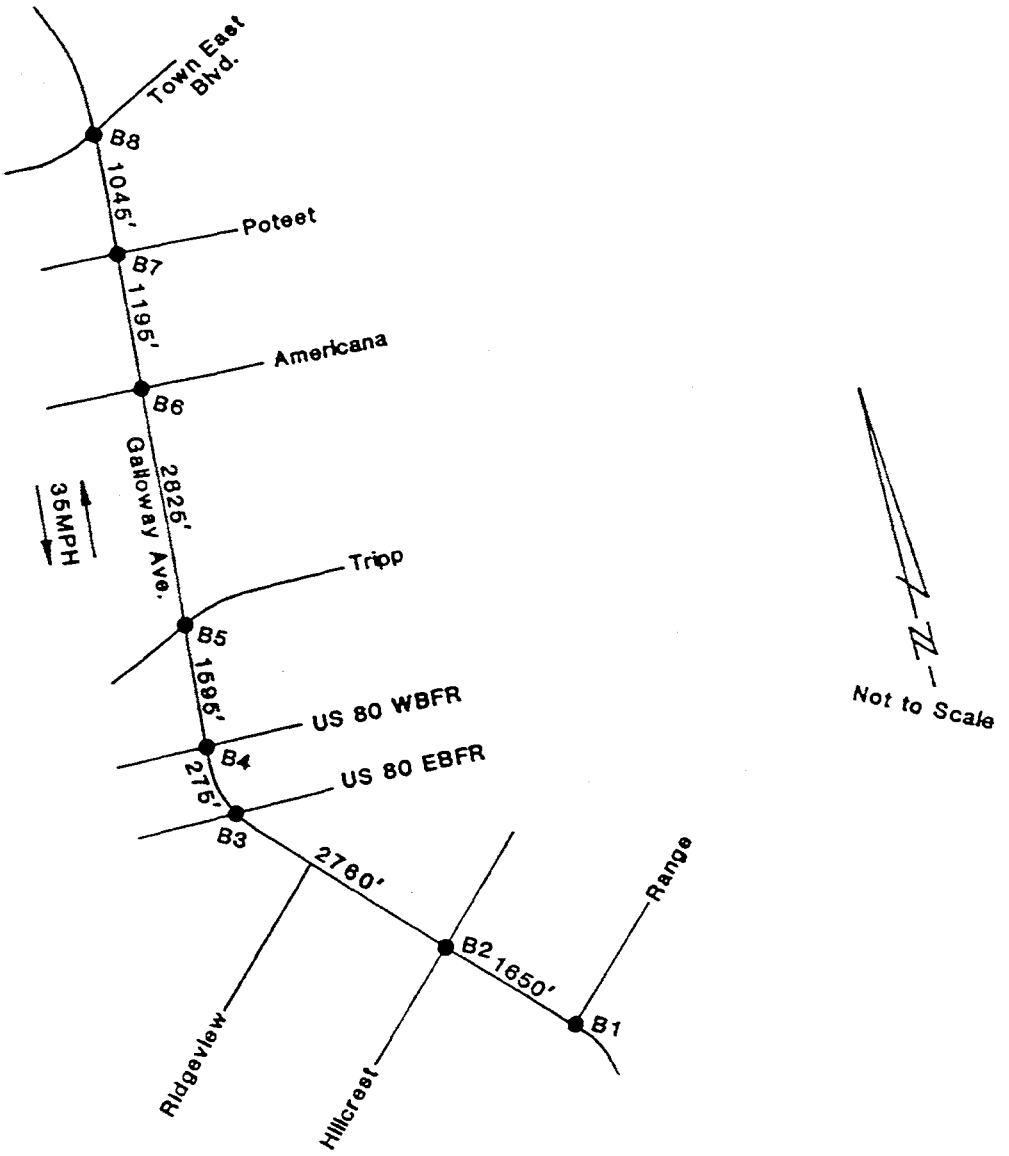


Figure E-12. Project Network for Galloway Avenue – Mesquite.

Central Business District I

The city of Midland Traffic Engineering Division worked on the following project. Eighteen intersections are included in this project all located in the Central Business District. The intersections are located on three arterials which traverse the downtown area. Big Spring Street is a two-way arterial which runs north-south with eight intersecting arterials. "A" Street is a two-way arterial that runs north-south on the west side of the downtown grid with seven intersecting arterials. Wall Street is a two-way east-west arterial with six intersecting arterials. The following figure shows the project network and cross streets.

The existing traffic controllers include Eagle EF-70, Eagle EF-20, Eagle EPAC 3608, Crouse-Hinds dm-400, Naztec NT-900, and Automatic Signal LFE-118. All intersections have between two and eight signal phases.

In order to evaluate the performance, field data was collected in the "before" and "after" TLS traffic conditions. The data included traffic volumes, travel times, signal timings and phasing, arterial data, intersection geometrics, travel delays, and an operating cost study. Optimum cycle lengths were determined using PASSER II-90 for each of the AM, OFF, and PM peak periods. TRANSYT-7F was then used to optimize the entire grid using phasing sequences from PASSER II. The travel time information was obtained by the test car method. Six runs were made during each of the three time periods (AM peak, OFF peak, and PM peak), and the mean travel times and delays were determined.

Overall travel times significantly improved on each arterial in each peak time period. Average travel times within the system declined by approximately 44 percent.

Based on PASSER II-90 and TRANSYT-7F simulation, the project resulted in an estimated $2,186,343 savings per year on total operating cost, a direct benefit to motorists using these routes. This operating cost savings included a total annual savings of 19,497,000 stops (a 30.9 percent reduction), a total annual fuel savings of 225,390 gallons (an 18.3 percent reduction), and an annual delay savings of 168,800 veh-hrs (a 40.5 percent reduction). The total cost of the project was $100,861.77, and the resultant benefit-to-cost ratio was 22 to 1.

Table E-26. Summary of Benefits for Central Business District I - City of Midland

		STOPS		TOTAL SYSTEM DELAY(veh-hrs)		FUEL(gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY	AM	14909	9301	109.20	57.32	276.52	209.30
	OFF	10218	7180	64.20	37.78	200.33	165.09
	PM	14634	10652	100.30	69.98	300.18	257.29
DIFFERENCES	AM		5608		51.88		67.22
	OFF		3038		26.42		35.24
	PM		3982		30.32		42.89
HRS/DAY	AM		3		3		3
	OFF		12.25		12.25		12.25
	PM		2.75		2.75		2.75
DAILY TOTALS	AM		16824		155.64		201.66
	OFF		37216		323.65		431.69
	PM		10951		83.38		117.95
	TOTAL		64990		562.67		751.30
UNIT VALUES			$0.014		$10.00		$1.00
ANNUAL SAVINGS			$272,958		$1,687,995		$225,390
PROJECT COST:			$100,861.77	TOTAL ANNUAL SAVINGS:			$2,186,343
BENEFIT/COST RATIO:			22				

Table E-27. Summary of Travel Time for Central Business District I - City of Midland

Project Type	Arterial / Link	Length (ft)	Time Period	Before Travel Time (sec)		After Travel Time (sec)		Percentage Travel Time Savings
				NB	SB	NB	SB	
11	Big Spring	N.A.(1)	AM	229.7	164.9	92.7	100.7	51.0
			OFF	192.6	186.2	94.0	104.5	47.6
			PM	208.2	263.0	119.5	131.9	46.7
	"A" Street	N.A.	AM	193.5	140.0	87.7	95.3	45.1
			OFF	160.9	183.3	91.2	107.4	42.3
			PM	169.8	222.4	94.6	145.3	38.8
				EB	WB	EB	WB	
	Wall Street	N.A.	AM	104.9	137.6	69.9	78.7	38.7
			OFF	95.4	166.0	69.9	65.9	48.0
			PM	141.2	106.7	88.0	69.4	36.5

(1) Not Available

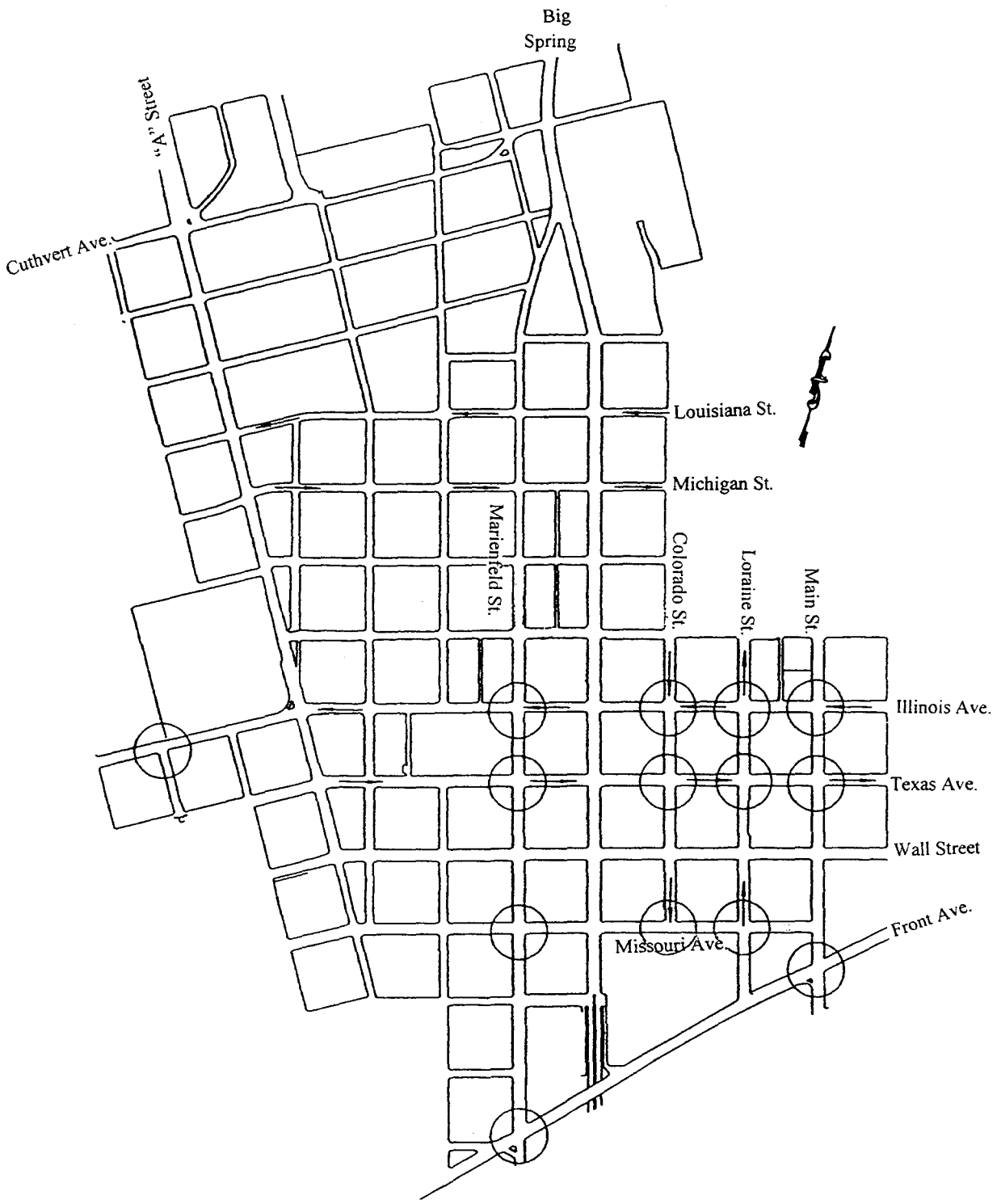


Figure E-13. Project Network for Central Business District I - Midland.

Central Business District II

The city of Midland Traffic Engineering Division worked on the following project in the Central Business District. The project included fifteen intersections. The intersections are located on four arterials which traverse the downtown area in an east-west direction. Illinois Avenue is a one-way westbound arterial with seven intersecting arterials. Texas Avenue is a one-way eastbound arterial with six intersecting arterials. Missouri Avenue is a two-way east-west arterial with five intersecting arterials. Front Street is a two-way east-west arterial with two intersecting arterials. The following figure shows the project network and cross streets.

The existing traffic controllers include TRANSYT 1800, Eagle EF-70, Eagle EF-20, Eagle EPAC 3608, Kentron KST, Multisonics AC800 and Crouse-Hinds dm-400. All intersections had between two and three signal phases except for Front Street and Marienfeld Street intersection and Front Street and Main Street intersection which had 8 phases each. Various pieces of new equipment were installed as part of this project.

In order to evaluate the performance, field data was collected in the "before" and "after" TLS traffic conditions. The data included traffic volumes, travel times, signal timings and phasing, arterial data, intersection geometrics, travel delays, and an operating cost study. Optimum cycle lengths were determined using PASSER II-90 for each of the AM, OFF, and PM peak periods. TRANSYT-7F was then used to optimize the entire grid using phasing sequences from PASSER II. The travel time information was obtained by the test car method. Six runs were made during each of the three time periods (AM peak, OFF peak, and PM peak), and the mean travel times and delays were determined.

Overall travel times improved on each arterial in each peak time period. Travel time savings ranged from 3.7 percent on Louisiana Street in the OFF peak period to 65 percent on Colorado Street during the PM peak period.

Based on the simulation, the project resulted in an estimated $428,965 savings per year on total operating cost, a direct benefit to motorists using these routes. This operating cost savings included a total annual savings of 2,725,725 stops (a 14.1 percent reduction), a total annual fuel savings of 49,824 gallons (a 12.1 percent reduction), and an annual delay savings of 34,098 veh-hrs (a 28.0 percent reduction). The total cost of the project was $87,030.91, and the resultant benefit-to-cost ratio was 5 to 1.

Table E-28. Summary of Benefits for Central Business District II - City of Midland

		STOPS		TOTAL SYSTEM DELAY(veh-hrs)		FUEL(gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	AM	4139	2963	27.18	17.41	87.14	72.35
	OFF	3090	3013	19.20	15.08	69.24	63.59
	PM	5201	3523	32.62	20.30	97.82	78.73
DIFFERENCES	AM		1176		9.77		14.79
	OFF		77		4.12		5.65
	PM		1678		12.32		19.09
HRS/DAY	AM		3		3		3
	OFF		12.25		12.25		12.25
	PM		2.75		2.75		2.75
DAILY TOTALS	AM		3528		29.31		44.37
	OFF		943		50.47		69.21
	PM		4615		33.88		52.50
	TOTAL		9086		113.66		166.08
UNIT VALUES			$0.014		$10.00		$1.00
ANNUAL SAVINGS			$38,161		$340,980		$49,824
PROJECT COST:			$87,030.91	TOTAL ANNUAL SAVINGS:			$428,965
BENEFIT/COST RATIO:			5				

Table E-29. Summary of Travel Time for Central Business District II - City of Midland

Project Type	Arterial / Link	Length (ft)	Time Period	Before Travel Time (sec)		After Travel Time (sec)		Percentage Travel Time Savings
				NB	SB	NB	SB	
11	Main St.	N.A. (1)	AM	96.2	90.9	39.2	41.2	57.0
			OFF	86.6	116.4	65.8	40.3	47.7
			PM	119.8	108.7	87.4	62.9	34.2
	Loraine St.	N.A.	AM	77.5	0.0	37.6	0.0	51.6
			OFF	124.2	0.0	65.5	0.0	47.2
			PM	141.8	0.0	61.6	0.0	56.5
	Colorado St.	N.A.	AM	0.0	71.5	0.0	30.8	57.0
			OFF	0.0	115.9	0.0	65.1	43.8
			PM	0.0	149.9	0.0	52.2	65.2
	Marienfeld St.	N.A.	AM	144.5	101.7	88.8	71.6	34.9
			OFF	158.8	123.2	79.5	51.4	53.6
			PM	92.2	153.0	84.6	67.1	38.1
				EB	WB	EB	WB	
	Cuthvert Ave.	N.A.	AM	93.0	82.3	47.7	50.3	44.1
			OFF	79.1	94.3	85.1	44.9	25.0
			PM	92.6	70.1	54.6	83.1	15.4
	Louisiana St.	N.A.	AM	0.0	56.1	0.0	43.5	22.5
			OFF	0.0	43.2	0.0	41.6	3.7
			PM	0.0	63.2	0.0	46.8	25.9
	Michigan St.	N.A.	AM	81.7	0.0	43.4	0.0	46.8
			OFF	42.3	0.0	38.9	0.0	8.1
			PM	91.4	0.0	83.2	0.0	9.0
	Illinois Ave.	N.A.	AM	0.0	167.7	0.0	78.1	53.4
			OFF	0.0	141.7	0.0	79.6	43.9
			PM	0.0	158.8	0.0	77.7	51.1
	Texas Ave.	N.A.	AM	104.2	0.0	68.6	0.0	34.2
			OFF	103.9	0.0	64.2	0.0	38.2
			PM	108.1	0.0	60.1	0.0	44.4
	Missouri Ave.	N.A.	AM	82.4	107.6	64.2	64.0	32.5
			OFF	79.7	132.1	56.5	45.2	52.0
			PM	150.9	98.8	81.8	81.1	34.7
	Front Ave.	N.A.	AM	55.3	51.5	31.4	30.8	41.8
			OFF	64.8	54.1	32.5	31.5	46.1
			PM	67.4	41.2	34.7	31.4	39.1

(1) Not Available

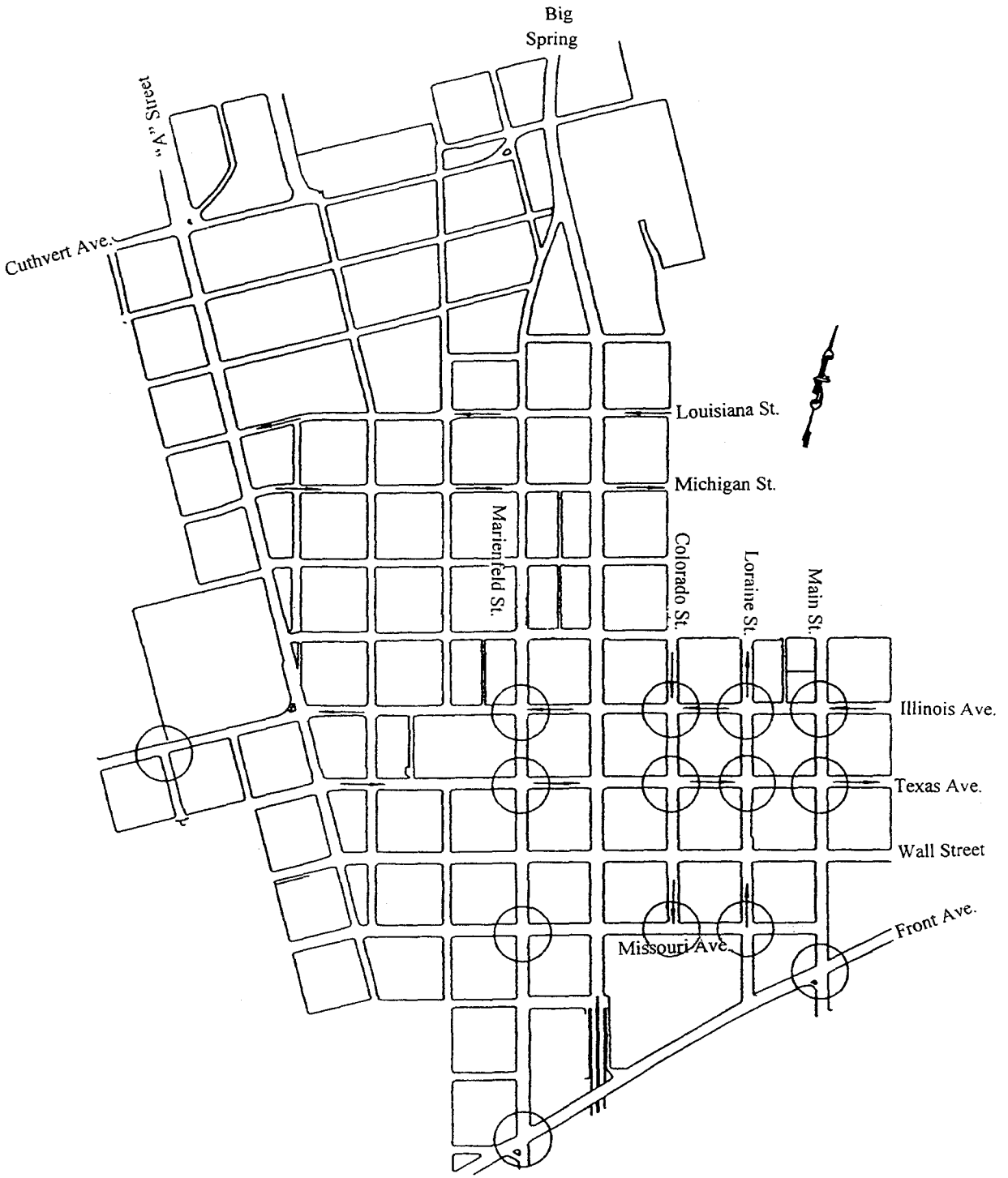


Figure E-14. Project Network for Central Business District II - Midland.

Subsystem 6 - Loop 323

The city of Tyler Department of Public Works and the Texas Department of Transportation worked on the following project. Loop 323 is a major highway which encircles the central portion of the city. This highway serves as a by-pass route for traffic passing through the Tyler area and contains intersections with many of the primary arterials serving local traffic. The project is located on west Loop 323 in the northwest section of Tyler. Loop 3232 runs north/south in this section and includes 4 intersections with Van Highway, Lion Street, West Erwin Street, and West Front Street. The attached figure shows the project network, cross streets, and link distances.

Part of the TLS III program was to upgrade the controllers at all four intersections to provide solid state menu driven units incorporated into the city's closed-loop system. These new units replaced existing electromechanical, single-dial controllers. The system was interconnected with 9 conductor communication cable and the controller located at the intersection of Loop 323 and West Erwin Street was made a master controller.

In order to evaluate the performance, field data was collected in the "before" and "after" TLS traffic conditions. The data included traffic volumes, travel times, signal timings and phasing, arterial data, intersection geometrics, travel delays, and an operating cost study. Optimum cycle lengths were determined using TRANSYT-7F for each of the AM, NOON, and PM peak periods. Six runs were made on each major link in each time period (AM peak, NOON, and PM peak), and the mean travel times and delays were determined. Travel time information was obtained by the test car method. Final travel time results were not reported as part of this project due to construction operations on the project site during the "after" data collection.

Based on the TRANSYT-7F simulation, the project resulted in an estimated $9,551,690 savings per year on total operating cost, a direct benefit to motorists using these routes. This operating cost savings included a total annual savings of 4,970,700 stops (a 15.0 percent reduction), a total annual fuel savings of 716,100 gallons (a 37.8 percent reduction), and a delay annual savings of 876,600 veh-hrs (a 69.0 percent reduction). The total cost of the project was $74,167.14, and the resultant benefit-to-cost ratio was 129 to 1.

Table E-30. Summary of Benefits for Subsystem 6 - Loop 323 - City of Tyler

		STOPS		TOTAL SYSTEM DELAY(veh-hrs)		FUEL(gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	AM	11615	10996	564.0	144.0	727.0	411.0
	OFF	8642	7116	226.0	85.0	421.0	295.0
	PM	12339	11649	1414.0	322.0	1380.0	569.0
DIFFERENCES	AM		619		420.0		316.0
	OFF		1526		141.0		126.0
	PM		690		1092.0		811.0
HRS/DAY	AM		1		1		1
	OFF		10		10		10
	PM		1		1		1
DAILY TOTALS	AM		619		420.0		316.0
	OFF		15260		1410.0		1260.0
	PM		690		1092.0		811.0
	TOTAL		16569		2922.0		2387.0
UNIT VALUES			$0.014		$10.00		$1.00
ANNUAL SAVINGS			$69,590		$8,766,000		$716,100
PROJECT COST:			$74,167.14	TOTAL ANNUAL SAVINGS:			$9,551,690
BENEFIT/COST RATIO:			129				

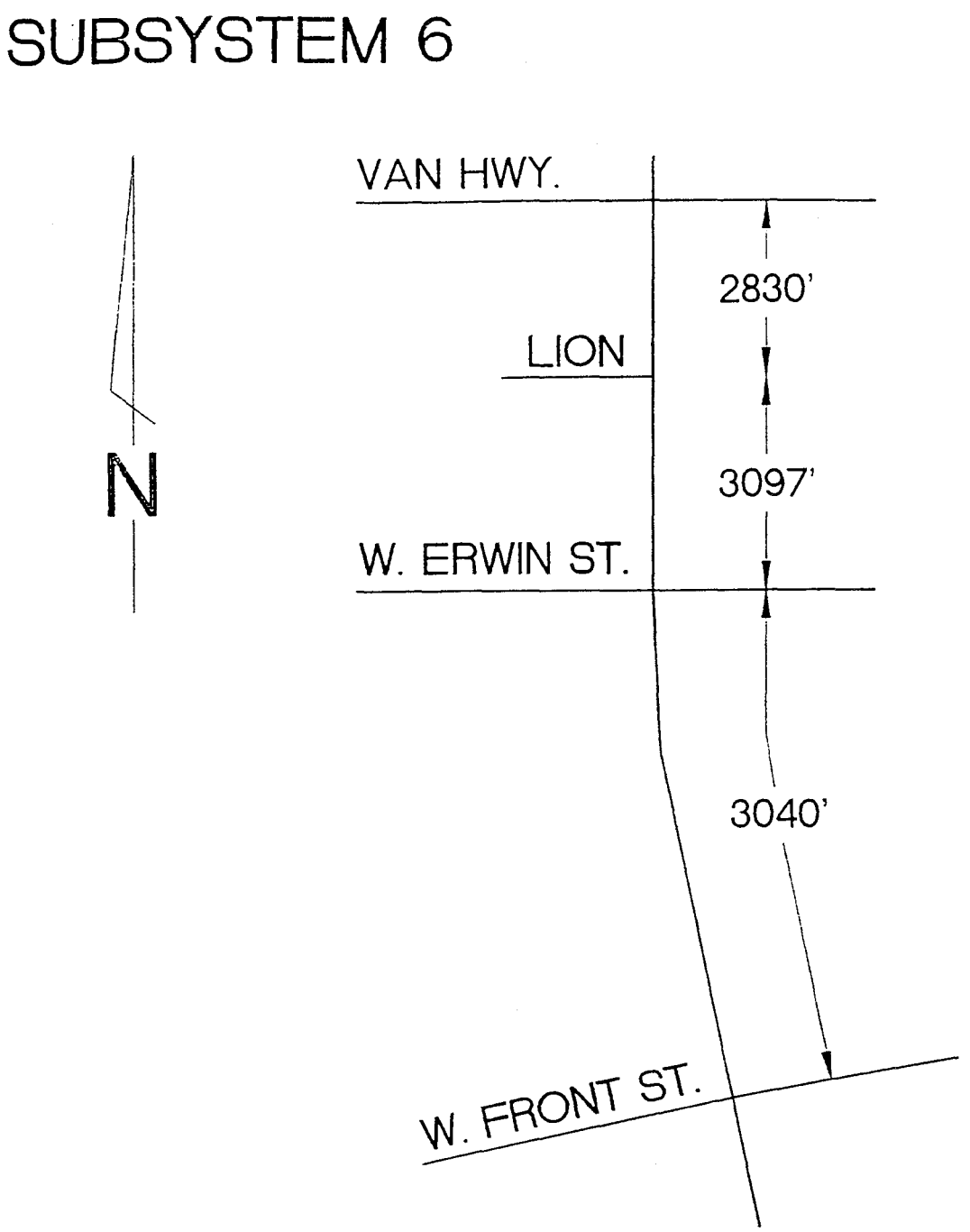


Figure E-15. Project Network for Subsystem 6 - Loop 323 - Tyler.

APPENDIX F

INDIVIDUAL PROJECT SUMMARIES

SMALL CITIES

Table F-1. Individual Project Summaries - Small Cities.

City	System	Reduction In Daily Totals			Total Savings ($)	Total Cost ($)	B/C Ratio	Page
		Stops	Delay (veh-hrs)	Fuel (gals)				
Childress	US 287	(1,249,200)	10,836.00	(26,028)	64,843	96,114.84	0.7	F-5
Hurst	Airport SH(121) Frontage Road	131,145	9,769.50	6,195.00	105,726	21,239.40	5	F-9
	North East Mall Area	1,179,600	80,655.00	65,750.00	888,814	4,903.83	181	F-14
North Richland Hills	Holiday Lane	(24,300)	12,488.00	7,767.00	132,302	13,517.93	10	F-18
	Rufe Snow Drive	1,624,275	38,887.50	47,130.00	458,745	30,761.73	15	F-22
Pharr	US BUS 53/ Cage Boulevard	(344,400)	17,100.00	8,940.00	175,118	116,807.16	1.5	F-26
Round Rock	US 79 Arterial System	1,309,200	176,520.00	139,200.00	1,922,729	15,563.25	123.5	F-30
San Benito	Sam Houston Avenue (SH 345)	156,600	4,980.00	43,869.00	91,477	59,738.74	1.5	F-34
Vernon	US 183/283	3,852,600	61,263.00	70,527.00	737,093	71,085.68	10.5	F-38

US 287

The city of Childress Department of Public Works and Transportation and Texas Department of Transportation worked on the following project. US 287 is a major arterial traversing from US 62/83 to 5th Street and contains a total of 8467 linear feet of roadway. US 287 is a four-lane facility with a continual left turn lane so that traffic traveling on this facility can move efficiently and avoid excessive delay stops and fuel consumption. The 7th Street and 5th Street signals are routes used by school buses and tend to build up a substantial queue on those streets. The posted speed limit is 35 mph and 40 mph. With commercial and business expansion, traffic is anticipated to increase from a present rate of 13,900 ADT with truck traffic nearing 30 percent of that volume. The attached figure shows the project network, cross streets, posted speeds, and average daily traffic volumes.

A total of 5 existing signals are time-based at a cycle of 70 seconds, 46 seconds on the arterial and 24 seconds on the side streets. The project included the installation of traffic loops and the radio transceiver network; the progression should show a marked improvement.

In order to evaluate the performance, field data was collected in the "before" and "after" TLS traffic conditions. The data included traffic volumes, travel times, signal timings and phasing, arterial data, intersection geometrics, travel delays, and an operating cost study. Timing plans were developed using PASSER II-90 software to simulate the time-based system and compare with the manual settings established by trial and error. Travel time data was collected using the floating-car method, and twenty (20) runs in each direction were recorded over the three study periods (AM peak, NOON peak, and PM peak) between each of the five intersections.

Since traffic volumes are consistent in each time period, a PASSER II-90 run was made only in the PM peak period. The results of this run, in both the "before" and "after" conditions, were used in the AM and NOON peak periods.

Travel times improved in the AM peak period. This was not the case in the NOON peak period as each leg of US 287, except for the 7th Street to Commerce Street segment, experienced travel time increases. No travel times during the PM peak period were obtained as part of this project.

Based on the PASSER II-90 simulation, the project resulted in an estimated $64,843 savings per year on total operating cost, a direct benefit to motorists using these routes. This operating cost savings include a total annual increase of 1,249,200 stops (a 9.7 percent increase), a total annual fuel increase of 26,028 gallons (a 9.2 percent increase), and an annual delay savings of 10,836 veh-hrs (a 32.4 percent reduction). The total cost of the project was $96,114.84, and the resultant benefit-to-cost ratio was 0.7 to 1.

Table F-2. Summary of Benefits for US 287 - City of Childress

		STOPS		TOTAL SYSTEM DELAY(veh-hrs)		FUEL(gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	AM	3592	3939	9.30	6.29	78.90	86.13
	NOON*	3592	3939	9.30	6.29	78.90	86.13
	PM*	3592	3939	9.30	6.29	78.90	86.13
DIFFERENCES	AM		-347		3.01		-7.23
	NOON		-347		3.01		-7.23
	PM		-347		3.01		-7.23
HRS/DAY	AM		4		4		4
	NOON		4		4		4
	PM		4		4		4
DAILY TOTALS	AM		-1388		12.04		-28.92
	NOON		-1388		12.04		-28.92
	PM		-1388		12.04		-28.92
	TOTAL		-4164		36.12		-86.76
UNIT VALUES			$0.014		$10.00		$1.00
ANNUAL SAVINGS			($17,489)		$108,360		($26,028)
PROJECT COST:			$96,114.84	TOTAL ANNUAL SAVINGS:			$64,843
BENEFIT/COST RATIO:			0.7				

* NOON and PM peak hourly values are estimated.

Table F-3. Summary of Travel Time for US 287 - City of Childress

Project Type	Arterial / Link	Length (ft)	Time Period	Before Travel Time (sec)		After Travel Time (sec)		Percentage Travel Time Savings
				EB	WB	EB	WB	
04	US 287							
	5th St to Commerce St.	1650	AM	63.0	67.6	64.8	58.3	5.7
			NOON/OFF	61.6	61.2	66.5	61.3	-4.1
			PM	-	-	-	-	-
	Commerce St. to 7th St	1850	AM	40.3	46.3	40.5	39.3	7.9
			NOON/OFF	39.3	36.3	41.6	37.9	-5.2
			PM	-	-	-	-	-
	7th St. to 12th St.	1900	AM	42.0	37.8	38.2	40.5	1.4
			NOON/OFF	40.6	36.5	37.4	38.3	1.8
			PM	-	-	-	-	-
	12th St. to US 62/83	3067	AM	37.8	38.0	33.0	35.7	9.4
			NOON/OFF	35.4	24.8	33.7	34.3	-13.0
			PM	-	-	-	-	-

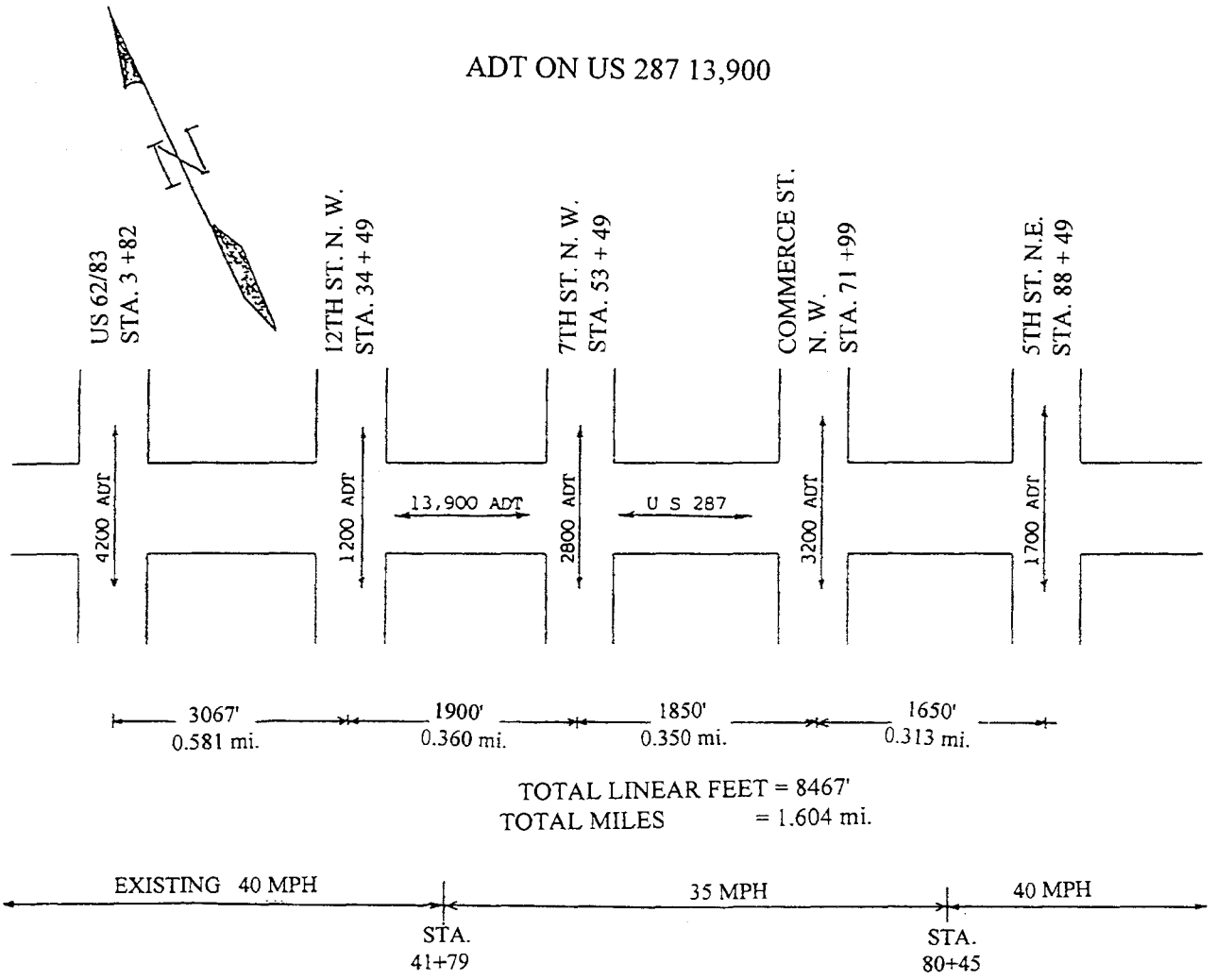


Figure F-1. Project Network for US 287 - Childress.

Airport (SH 121) Freeway Frontage Roads

The city of Hurst Department of Public Works and Transportation worked on the following project. Airport (SH 121) Freeway is a major traffic carrier providing access to a number of cities between Dallas and Fort Worth. The traffic volumes on Airport (SH 121) Freeway have grown significantly. The traffic signal network includes 3 interchanges in this project: Bedford-Euless Road, Precinct Line Road, and Norwood Drive. The Bedford-Euless Road interchange and the Precinct Line Road interchange are part of separate time-based coordinated systems. The Norwood Drive interchange is currently not part of any coordinated system. The attached figures show the three interchanges.

The objective of this project was to develop Emergency Queue Discharge (EQD) timing plans for the eastbound frontage roads at each of these interchanges. These timing plans will allow the diverted traffic to by-pass the incident (stalled car, accident, construction, etc.) creating a safer traveling environment and improving the MOE's. The project includes the installation of the appropriate inductive detector loops, conduit, cable, pull boxes, etc., required for the EQD.

In order to evaluate the performance, field data was collected in the "before" and "after" TLS traffic conditions. The data included traffic volumes, travel times, signal timings and phasing, arterial data, intersection geometrics, travel delays, and an operating cost study. A database traffic count program was developed to determine normal and incident level traffic volumes. PASSER III is used to simulate incident level traffic volumes under the EQD timing plans. Turning movements traffic counts were collected at each of the three (3) study interchanges during each of the three peak study periods (AM peak, NOON peak and PM peak).

A travel car study was not completed for this project. To meet the objectives of the project, a travel car study would have to be completed during the occurrence of incidents on the freeway in the study area. These incidents occur randomly and are not easily forecasted. Also, pending construction of the Bedford-Euless Road interchange and a delay in the installation of the EQD inductive loop detectors at the Norwood Drive interchange prevented the use of travel car study.

Based on the PASSER III simulation and an estimated 75 incidents per year, the project resulted in an estimated $105,726 savings per year on total operating cost during incidents, a direct benefit to motorists using these routes. This operating cost savings during incidents includes a total annual savings of 131,145 stops (a 24.2 percent reduction), a total annual fuel savings of 6,195 gallons (a 53.2 percent reduction), and an annual delay savings of 9,769.5 veh-hrs (a 70.1 percent reduction). The total cost of the project was $21,239.40, and the resultant benefit-to-cost ratio was 5 to 1.

Table F-4. Summary of Benefits for Airport (SH 121) Freeway - City of Hurst

		STOPS		TOTAL SYSTEM DELAY(veh-hrs)		FUEL(gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	AM	7011	5476	168.9	59.6	143.6	74.6
	OFF	7237	4620	291.6	42.9	211.7	59.1
	PM	7456	5928	150.0	58.0	138.8	77.6
DIFFERENCES	AM		1535		109.3		69.0
	OFF		2617		248.7		152.6
	PM		1528		92.0		61.2
INCIDENT HRS/YEARS	AM		30		30		30
	OFF		15		15		15
	PM		30		30		30
ANNUAL TOTALS	AM		46050		3279.0		2070.0
	OFF		39255		3730.5		2289.0
	PM		45840		2760.0		1836.0
	TOTAL		131145		9769.5		6195.0
UNIT VALUES			$0.014		$10.00		$1.00
ANNUAL SAVINGS			$1,836		$97,695		$6,195

PROJECT COST:	$21,239.40	TOTAL ANNUAL SAVINGS:	$105,726
BENEFIT/COST RATIO:	5		

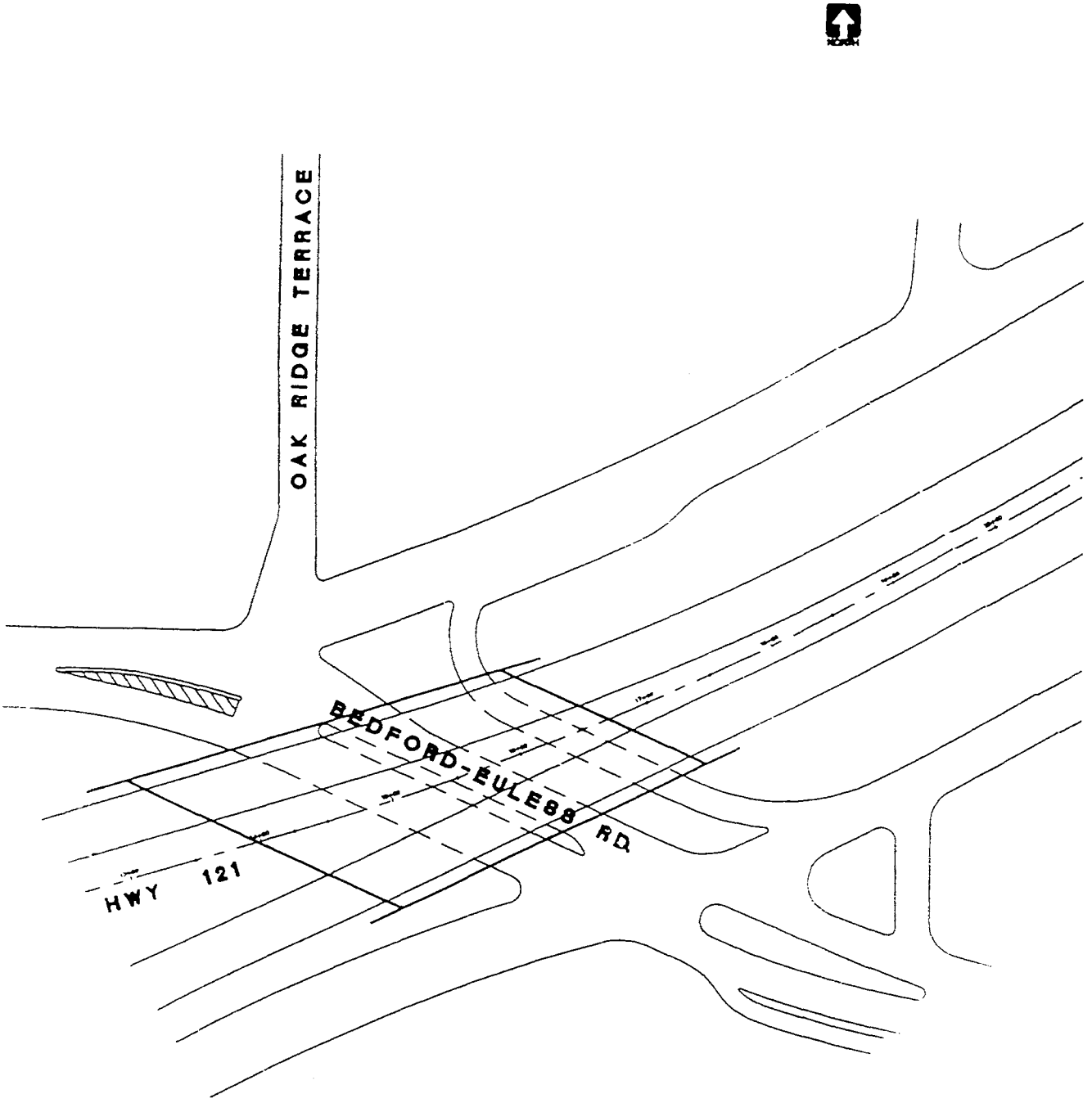


Figure F-2. Project Network for Airport (SH 121) Freeway Frontage Road (Bedford-Euless Road Interchange) - Hurst.

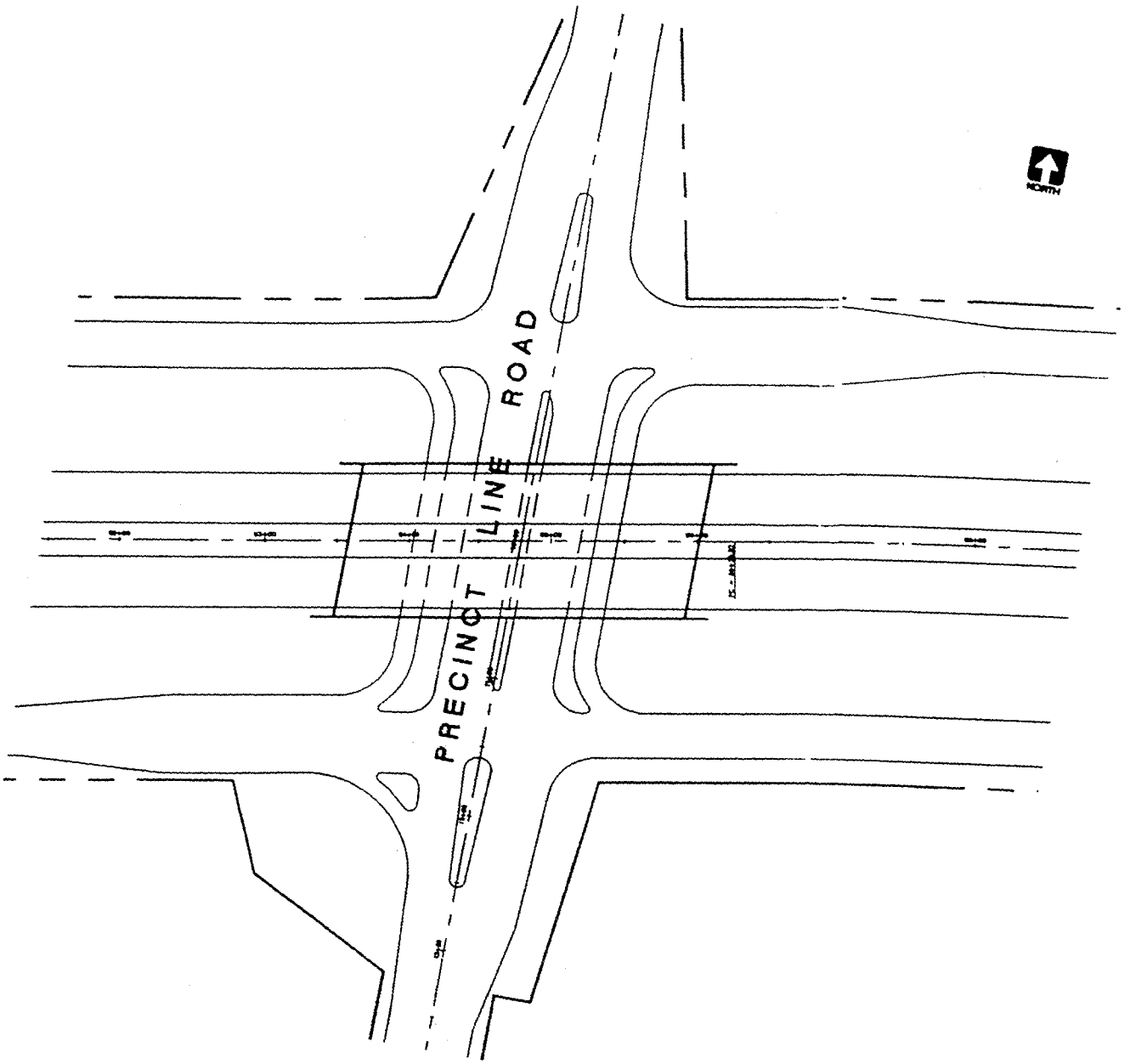


Figure F-3. Project Network for Airport (SH 121) Freeway Frontage Road (Precinct Line Road Interchange) – Hurst.

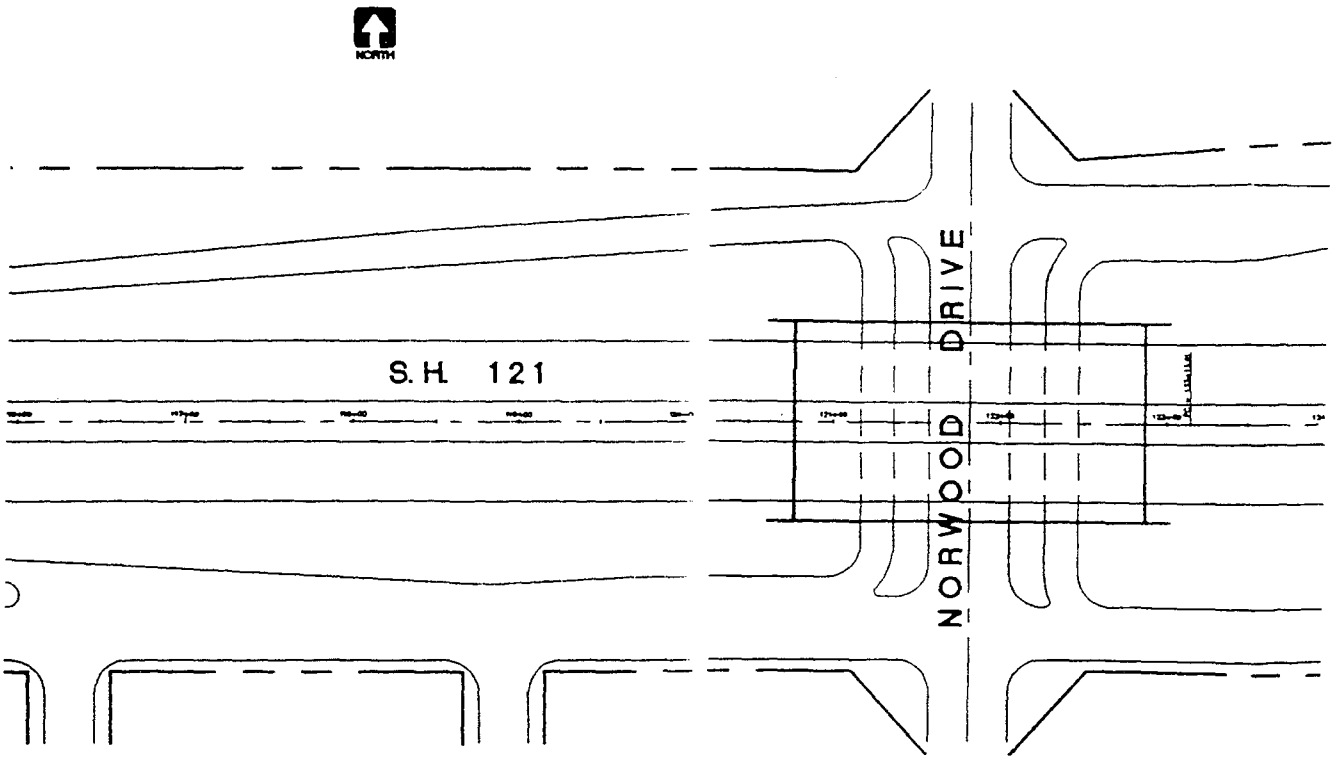


Figure F-4. Project Network for Airport (SH 121) Freeway Frontage Road (Norwood Drive Interchange) - Hurst.

North East Mall Area

The city of Hurst Department of Public Works and Transportation worked on the following project. The study network comprises Bedford-Euless Road, from Melbourne Road to the IH 820 exit and Melbourne Road from Pipeline Road to Bedford-Euless Road. Melbourne Road is the primary arterial servicing the North East Mall and includes intersections with Bedford-Euless Road, the Mall Entrance, Black Street, Cheryl Avenue, and Pipeline Road. Bedford-Euless Road contains intersections with Melbourne Road, SH 121 Airport Freeway, and the IH 820 ramp. The attached figure shows the project network, cross streets, and average daily traffic volumes.

This project included a total of eight (8) signalized intersections and one interchange. The signals are part of an existing "closed loop" system installed in 1989. The existing Eagle EPAC 300 model controllers are compatible with the MARC closed loop system. Signal timings were changed as part of this project to improve progression throughout the system. The protected left-turn phase on the east leg of the Bedford-Euless/SH 121 Airport Freeway interchange was also eliminated to improve the system efficiency and to widen the system green band.

In order to evaluate the performance, field data was collected in the "before" and "after" TLS traffic conditions. The data included traffic volumes, travel times, signal timings and phasing, arterial data, intersection geometrics, travel delays, and an operating cost study. Travel time information was obtained by the floating car technique. PASSER II-90 and PASSER III simulation/optimization computer programs were utilized to evaluate the system. A minimum of six (6) runs were conducted along the system in each time period (AM peak, NOON peak, and PM peak) and the mean travel times were determined. The simulation results provided timing plans utilizing cycle lengths between 65 and 86 seconds. Phasing changes were made to the Bedford-Euless Road and SH 121 interchange to improve traffic operations.

Travel times improved throughout the system at most locations. Isolated areas of travel time increases were experienced, but none of these increases were greater than 5 seconds.

Based on the PASSER II-90 and PASSER III simulation, the project resulted in an estimated $888,814 savings per year on total operating cost, a direct benefit to motorists using these routes. This operating cost savings include a total annual savings of 1,179,600 stops (a 3.0 percent reduction), a total annual fuel savings of 65,750 gallons (a 10.1 percent reduction), and an annual delay savings of 80,655 veh-hrs (a 21.9 percent reduction). The total cost of the project was $4,903.83, and the resultant benefit-to-cost ratio was 181 to 1.

Table F-5. Summary of Benefits for North East Mall Area - City of Hurst

		STOPS		TOTAL SYSTEM DELAY(veh-hrs)		FUEL(gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	AM	3884	4147	29.6	27.0	59.31	56.41
	OFF/NOON	13675	13243	103.1	93.9	211.05	202.38
	PM	19534	18666	306.4	172.7	404.28	301.53
DIFFERENCES	AM		-263		2.6		2.90
	OFF/NOON		432		9.2		8.67
	PM		868		133.7		102.75
HRS/DAY	AM		1.5		1.5		1.5
	OFF/NOON		7		7		7
	PM		1.5		1.5		1.5
DAILY TOTALS	AM		-395		3.9		4.35
	OFF/NOON		3024		64.4		60.69
	PM		1302		200.55		154.13
	TOTAL		3932		268.85		219.17
UNIT VALUES			$0.014		$10.00		$1.00
ANNUAL SAVINGS			$16,514		$806,550		$65,750
PROJECT COST:			$4,903.83	TOTAL ANNUAL SAVINGS:			$888,814
BENEFIT/COST RATIO:			181				

Table F-6. Summary of Travel Time for North East Mall Area - City of Hurst

Project Type	Arterial / Link	Length (ft)	Time Period	Before Travel Time (sec)	After Travel Time (sec)	Percentage Travel Time Savings
				EB/SB	EB/SB	
09	Bedford-Euless Eastbound/Melbourne Southbound					
	Airport Frwy(North)	570	AM	13.9	13.5	2.7
			NOON	15.1	14.8	1.9
			PM	14.9	13.9	7.3
	Airport Frwy(South	330	AM	11.8	8.9	24.4
			NOON	7.8	7.1	9.7
			PM	10.9	11.1	-2.2
	Melbourne Rd.	700	AM	17.6	17.0	3.2
			NOON	15.8	13.3	15.9
			PM	16.3	15.0	8.1
	Mall Entrance	940	AM	19.1	-	-
			NOON	18.4	18.4	0.4
			PM	20.6	21.5	-4.5
	Black St.	750	AM	16.0	-	-
			NOON	15.1	15.1	0.5
			PM	16.8	15.9	5.5
	Cheryl Ave.	640	AM	16.2	-	-
			NOON	13.5	13.0	3.6
			PM	14.8	14.5	2.3
	Pipeline Rd.	1210	AM	27.3	-	-
			NOON	25.0	22.9	8.1
			PM	28.6	27.3	4.4
				NB/WB	NB/WB	
	Melbourne Northbound/Bedford-Euless Westbound					
	Cheryl Ave.	1210	AM	25.2	-	-
			NOON	24.3	23.4	3.9
			PM	25.8	26.1	-1.0
	Black St.	640	AM	14.2	-	-
			NOON	15.2	12.6	17.4
			PM	14.7	14.2	3.1
	Mall Entrance	750	AM	17.0	-	-
			NOON	15.6	15.0	4.3
			PM	17.4	16.8	3.3
	Bedford-Euless	940	AM	17.0	-	-
			NOON	15.6	19.1	-21.9
			PM	17.4	22.1	-27.6
	Airport Fwy(South)	700	AM	17.8	15.0	15.6
			NOON	16.8	14.1	16.3
			PM	19.3	17.6	8.6
	Airport Fwy(North)	330	AM	13.1	9.9	24.3
			NOON	8.9	8.3	7.0
			PM	11.8	11.5	2.5
	IH 820 Ramp	570	AM	15.1	15.1	0.1
			NOON	13.7	11.9	13.8
			PM	16.5	15.1	8.6

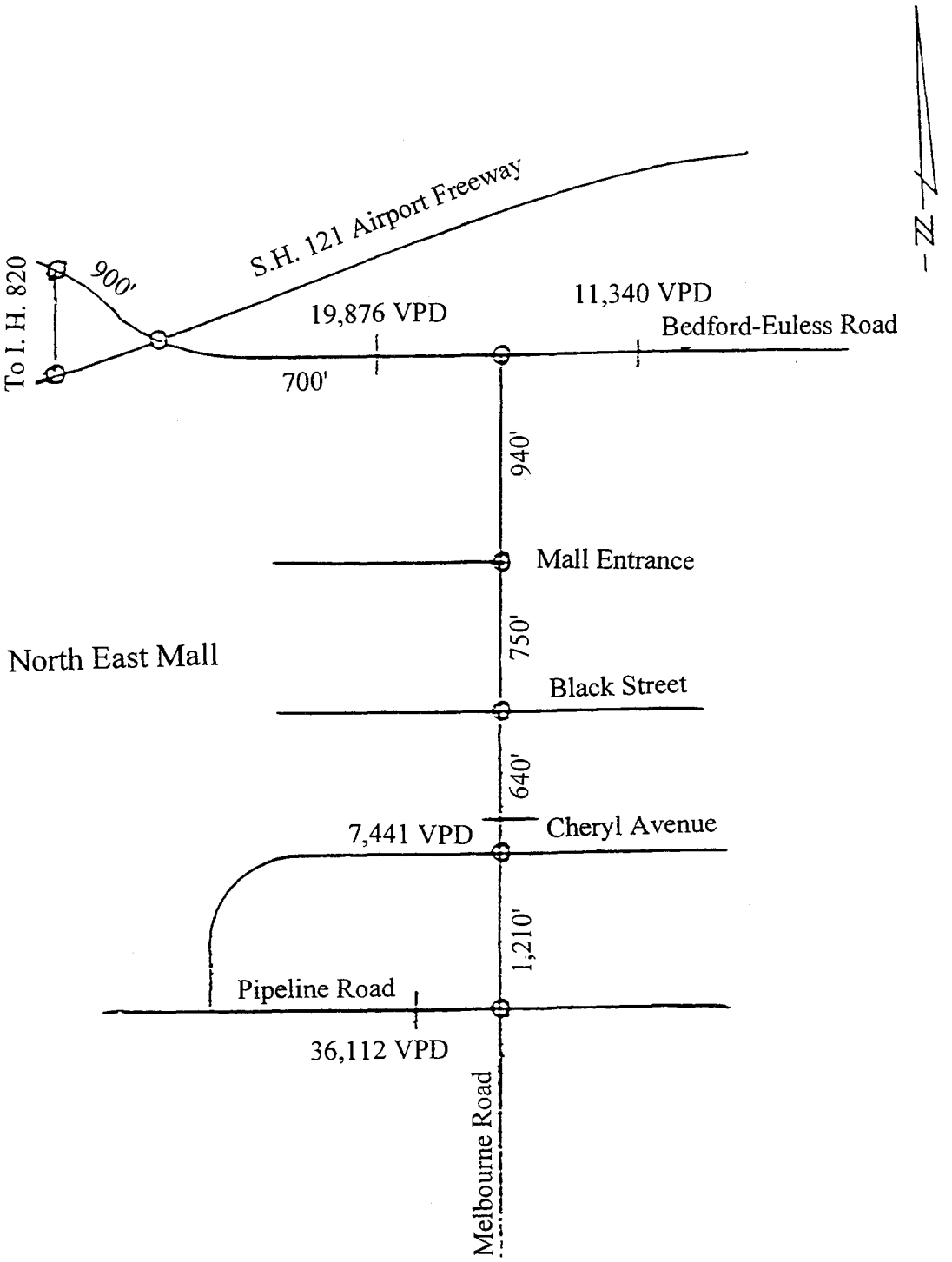


Figure F-5. Project Network for North East Mall Area - Hurst.

Holiday Lane

The city of North Richland Hills Department of Public Works and Transportation worked on the following project. Holiday Lane is a major north-south arterial that primarily serves traffic generated by area residential land uses. The 0.92 mile study section of Holiday Lane exists as a four-lane undivided roadway between IH 820 and Lewis Lane and as a three-lane roadway north of Lewis Lane to Industrial Park Boulevard. The three-lane section consists of two north-bound lanes and one south-bound lane. A speed limit of 30 mph is posted for the entire study section with a 20 mph school zone from just north of the IH 820 westbound frontage road to just north of Lewis Lane. The attached figure shows the project network and cross streets.

This project included a total of 5 signalized intersections. The signals are controlled by fixed-time actuated Eagle EPAC, Eagle DP 9000 type control units. Each signalized intersection is independently controlled. A new Eagle EPAC controller was installed at the intersection of Industrial Park Boulevard and Holiday Lane with time-based coordination capabilities. All controllers in this system now have time-based coordination capabilities.

In order to evaluate the performance, field data was collected in the "before" and "after" TLS traffic conditions. The data included traffic volumes, travel times, signal timings and phasing, arterial data, intersection geometrics, travel delays, and an operating cost study. Since all of the signals operating are actuated, analysis timing parameters were based on averages taken from field measurements. The network travel time data was collected in the field using the floating car technique. Six (6) runs in each direction during each study period (AM peak, NOON peak, and PM peak) were conducted along Holiday Lane and the mean travel times determined. PASSER II-90 and TRANSYT-7F were used to develop optimal timing plans and to evaluate the operating characteristics of the arterial. Three timing plans were developed ranging between 65 to 90 second cycle lengths.

Travel times on Holiday Lane improved by over 16 percent during the AM peak period. Travel times during the NOON peak period remained constant. PM peak travel times in the "after" condition were not obtained due to construction activities on Holiday Lane during the study day.

Based on the PASSER II-90 and TRANSYT-7F simulation, the project resulted in an estimated $132,302 savings per year on total operating cost, a direct benefit to motorists using these routes. This operating cost savings include a total annual increase of 24,300 stops (a 0.2 percent increase), a total annual fuel savings of 7,767 gallons (a 2.8 percent reduction), and an annual delay savings of 12,489 veh-hrs (a 13.4 percent reduction). The total cost of the project was $13,517.93, and the resultant benefit-to-cost ratio was 10 to 1.

Table F-7. Summary of Benefits for Holiday Lane - City of North Richland Hills

		STOPS		TOTAL SYSTEM DELAY(veh-hrs)		FUEL(gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	AM	5102	5150	41.02	37.57	111.89	113.00
	NOON	2727	2731	15.36	14.96	58.75	58.39
	PM	5555	5537	74.04	52.14	146.71	130.50
DIFFERENCES	AM		-48		3.45		-1.11
	NOON		-4		0.40		0.36
	PM		18		21.90		16.21
HRS/DAY	AM		1.5		1.5		1.5
	NOON		9		9		9
	PM		1.5		1.5		1.5
DAILY TOTALS	AM		-72		5.18		-1.66
	NOON		-36		3.60		3.24
	PM		27		32.85		24.32
	TOTAL		-81		41.63		25.89
UNIT VALUES			$0.014		$10.00		$1.00
ANNUAL SAVINGS			($340)		$124,875		$7,767
PROJECT COST:			$13,517.93	TOTAL ANNUAL SAVINGS:			$132,302
BENEFIT/COST RATIO:			10				

Table F-8. Summary of Travel Time for Holiday Lane -City of North Richland Hills

Project Type	Arterial / Link	Length (ft)	Time Period	Before Travel Time (sec)		After Travel Time (sec)		Percentage Travel Time Savings
				NB	SB	NB	SB	
04	Holiday Lane	4860	AM	160.0	197.3	149.8	148.8	16.4
			NOON	145.0	138.7	139.5	145.3	-0.4
			PM	147.5	168.5	N/A	N/A	N/A

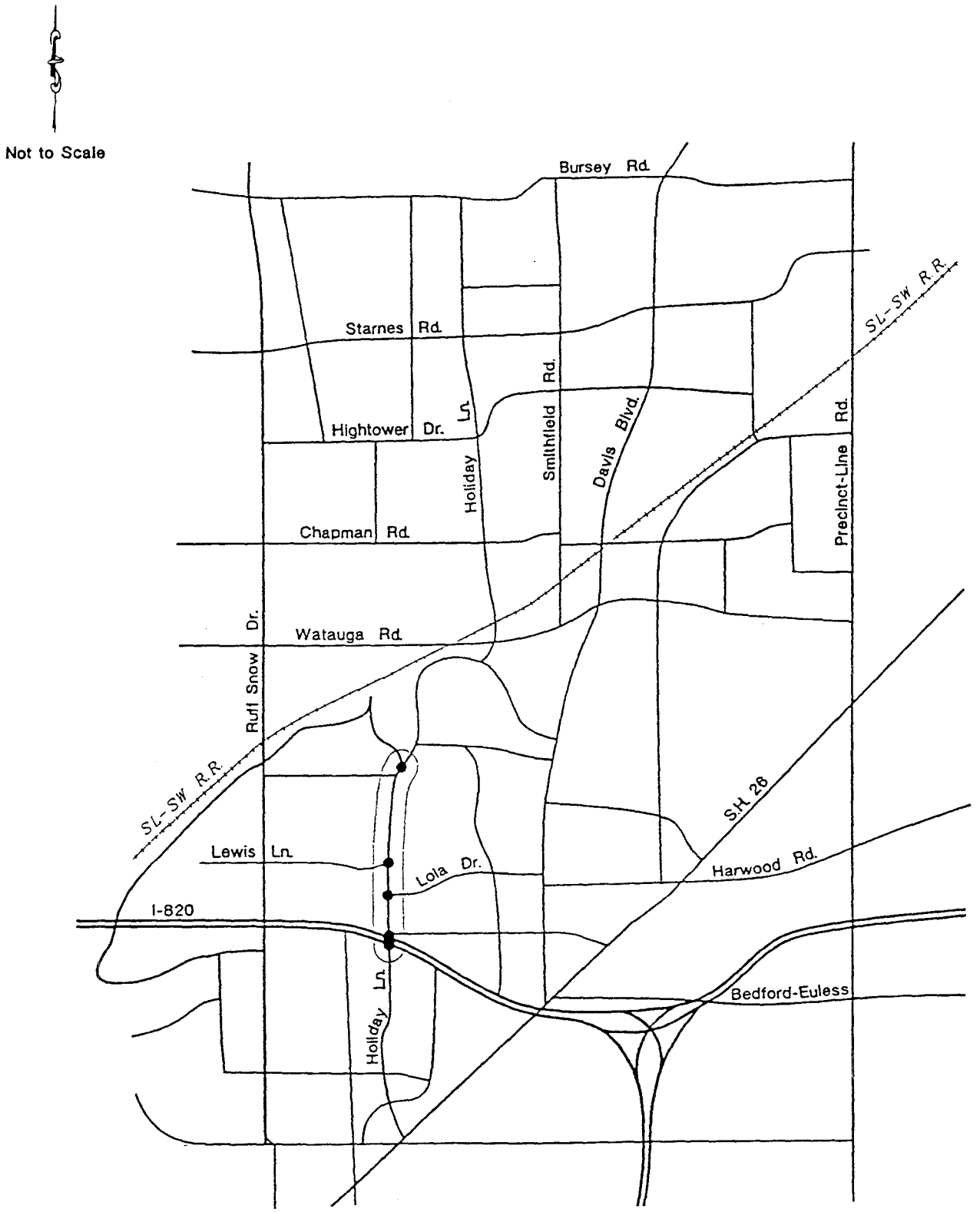


Figure F-6. Project Network for Holiday Lane - North Richland Hills.

Rufe Snow Drive

The city of North Richard Hills Department of Public Works and Transportation worked on the following project. Rufe Snow Drive is a five-lane principal arterial located north of IH-820. The 2.6 mile study section of Rufe Snow Drive, with a posted speed limit of 40 mph, serves as the main access facility for a rapidly growing area of commercial and residential development in North Richland Hills and Watauga. The attached figure shows the project network and cross streets.

This project includes a total of seven (7) signalized intersections, from Starnes Road to Lewis Drive. A closed-loop signal system was installed on Rufe Snow Drive in 1992 which included Multisonic 820A controllers, a system master controller, communications cable (6-pair #19 AWG), system detectors, and a central microcomputer station. Since that time, significant traffic growth has taken place. This project improved the timing of the seven signalized intersections to better accommodate this increased traffic volume. Also, as part of this project, the on-street master controller, all local controllers, and the system software were replaced by Eagle Control Systems equipment.

The installed signal system provides a means of coordinating traffic flow with the ability to monitor and respond to changes on a real time basis. The on-street master controller manages the functions of the local controllers by means of the interconnect cable. The microcomputer monitors the system operations via a modem and dial-up telephone communication.

In order to evaluate the performance, field data was collected in the "before" and "after" TLS traffic conditions. The data included traffic volumes, travel times, signal timing and phasing, arterial data, intersection geometrics, travel delays, and an operating cost study. Timing plans were developed using PASSER II and TRANSYT-7F. PASSER II was used to generate timing plans with optimal bandwidths, and these plans were further evaluated with TRANSYT-7F. Travel time was obtained by the floating car technique. Six runs were conducted in each direction during each time period (AM peak, NOON peak, PM peak, and Saturday) and the mean travel times were determined. Four (4) timing plans were developed to address the weekday traffic conditions and one (1) timing plan was developed for weekend operation. Cycle lengths ranged from 95 seconds to 120 seconds.

The AM peak, NOON peak, and Saturday travel times showed improvements of between 2 and 6 percent in the "after" conditions. The PM peak period experienced slight increases in travel time.

Based on the PASSER II and TRANSYT-7F simulation, the project resulted in an estimated $458,745 savings per year on total operating cost, a direct benefit to motorists using these routes. This operating cost savings include a total annual savings of 1,624,275 stops (a 4.1 percent reduction), a total annual fuel savings of 47,130 gallons (a 3.5 percent reduction), and an annual delay savings of 38,887.5 veh-hrs (an 8.2 percent reduction). The total cost of the project was $30,761.73, and the resultant benefit-to-cost ratio was 15 to 1.

Table F-9. Summary of Benefits for Rufe Snow Drive - City of North Richland Hills

		STOPS		TOTAL SYSTEM DELAY(veh-hrs)		FUEL(gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	AM	13013	11418	134.70	107.70	406.60	370.80
	NOON	9384	8870	78.50	77.20	309.70	302.90
	PM	17563	17031	345.70	278.60	659.70	604.50
	Saturday	14757	15490	260.30	258.80	550.60	555.70
DIFFERENCES	AM		1595		27.00		35.80
	NOON		514		1.30		6.80
	PM		532		67.10		55.20
	Saturday		-733		1.50		-5.10
HRS/DAY	AM		1.5		1.5		1.5
	NOON		9		9		9
	PM		1.5		1.5		1.5
	Saturday		9		9		9
DAILY TOTALS	AM		2393		40.50		53.70
	NOON		4626		11.70		61.20
	PM		798		100.65		82.80
	Saturday		-6597		13.50		-45.90
	TOTAL		1220		166.35		151.80
UNIT VALUES			$0.014		$10.00		$1.00
ANNUAL SAVINGS			$22,740		$388,875		$47,130
PROJECT COST:			$30,761.73	TOTAL ANNUAL SAVINGS:			$458,745
BENEFIT/COST RATIO:			15				

Table F-10. Summary of Travel Time for Rufe Snow Drive - City of North Richland Hills

Project Type	Arterial / Link	Length (ft)	Time Period	Before Travel Time (sec)		After Travel Time (sec)		Percentage Travel Time Savings
				NB	SB	NB	SB	
06	Rufe Snow Drive	13735	AM	327.0	395.0	331.0	373.0	2.5
			NOON	338.0	325.0	310.0	330.0	3.5
			PM	351.0	366.0	414.0	383.0	-11.2
			Saturday	341.0	411.0	327.0	383.0	5.6

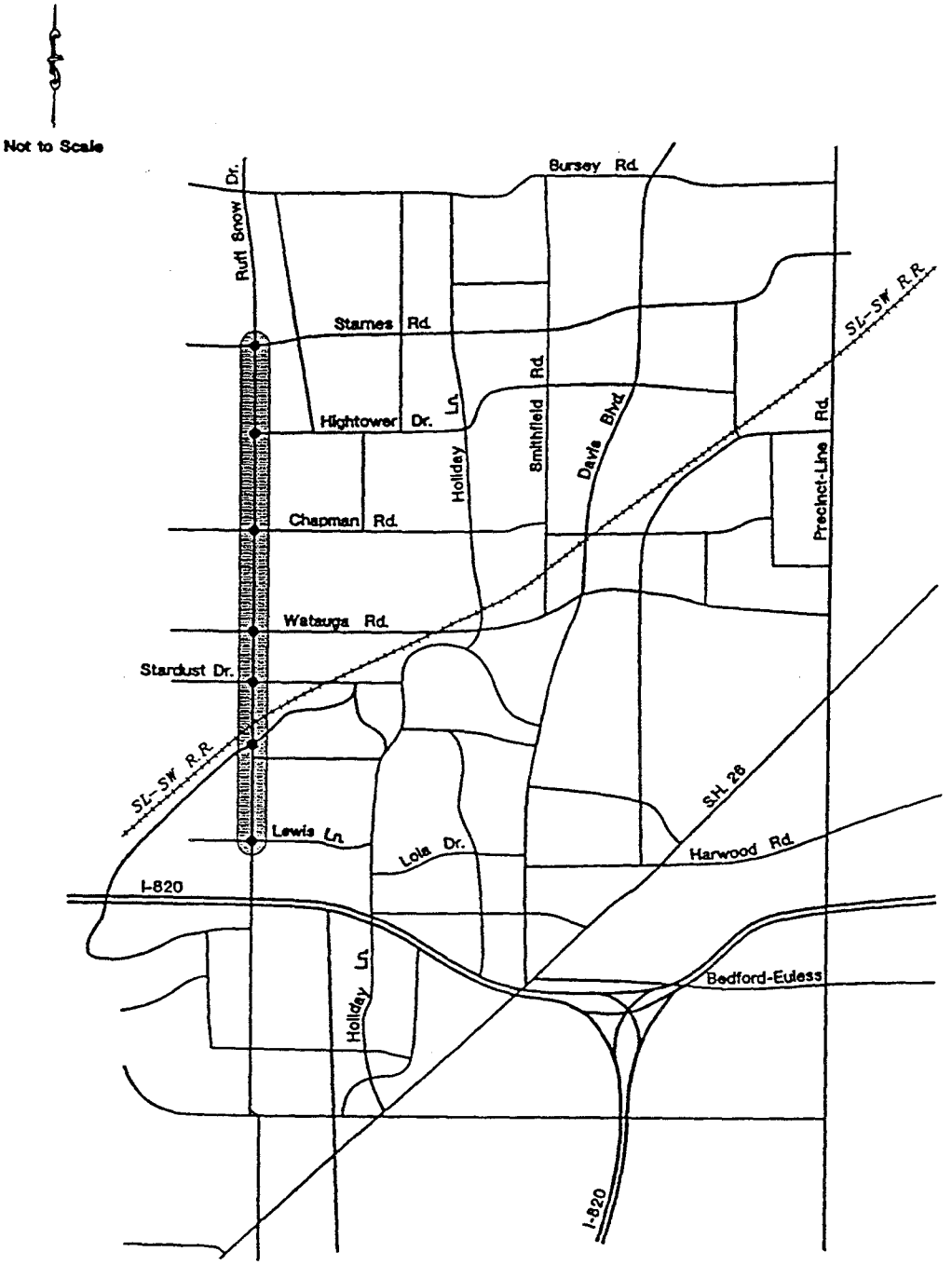


Figure F-7. Project Network for Rufe Snow Drive – North Richland Hills.

US Business 83 and Cage Boulevard

The city of Pharr Department of Public Works and Transportation worked on the following project. US Business 83, the primary east-west arterial in the city of Pharr, is a five-lane facility which includes two travel lanes in each direction and a left turn center lane between Sugar Road and "I" Road. The traffic signal system along US Business 83 contains five intersections including Sugar Road, Bluebonnet Street, Fir Street and "I" Street. US 281 (Cage Boulevard), between Ridge Road and US 83, is a five-lane facility which includes two travel lanes in each direction and a left turn center lane. Between US 83 and FM 495, US 281 becomes the frontage roads to the 281 Expressway, with three lanes in each direction. US 281 is the primary north-south arterial in the city of Pharr and contains thirteen intersections within the project. This project also contains diamond interchanges at US 281 and US 83 and at US 281 and FM 495. The attached figures show the project network, cross streets, and link distances.

This project included a total of 18 signalized intersections. These intersections are equipped with solid state NEMA controllers, electromechanical controllers, either fully actuated or semi-actuated, and currently running in isolated mode. Pedestrian detectors were installed as part of the project at all intersections along Cage Boulevard. Inductance loop vehicle detectors were also installed along Cage Boulevard on all crossing streets between Sam Houston Street and Polk Street and on all dedicated left-turn lanes on Cage Boulevard. New controllers were placed at each intersection on Cage Boulevard, the diamond interchange controllers were upgraded, and a master controller was added to complete the closed loop operation. Old interconnect cable was replaced with new communication cable.

In order to evaluate the performance, field data was collected in the "before" and "after" TLS traffic conditions. The data included traffic volumes, travel times, signal timings and phasing, arterial data, intersection geometrics, travel delays , and an operating cost study. Signal timings and phasing were obtained from direct reading in the field to ensure use of up-to-date information. PASSER II-90 and PASSER III were used to evaluate existing traffic signal timings and to develop new signal timing plans. Travel time was obtained by the floating car technique. Six runs were conducted in each direction during each time period (AM peak, NOON peak, PM peak, and Saturday), and the mean travel times were determined.

Travel times improved significantly in the "after" conditions. This included travel time savings on Cage Boulevard of 40 percent in the AM and PM peak periods.

Based on the PASSER II-90 and PASSER III simulation, the project resulted in an estimated $175,118 savings per year on total operating cost, a direct benefit to motorists using these routes. This operating cost savings include a total annual increase of 344,400 stops (a 0.7 percent increase), a total annual fuel savings of 8,940 gallons (a 0.8 percent reduction), and an annual delay savings of 17,100 veh-hrs (a 5.4 percent reduction). The total cost of the project was $116,807.16, and the resultant benefit-to-cost ratio was 1.5 to 1.

Table F-11. Summary of Benefits for US Business 83 and Cage Boulevard- City of Pharr

		STOPS		TOTAL SYSTEM DELAY(veh-hrs)		FUEL(gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	AM	16448	16678	118.7	110.2	345.8	342.0
	OFF	15608	15871	92.6	91.2	337.8	340.0
	PM	19758	19313	133.1	117.3	420.3	402.6
DIFFERENCES	AM		-230		8.5		3.8
	OFF		-263		1.4		-2.2
	PM		445		15.8		17.7
HRS/DAY	AM		2		2		2
	OFF		6		6		6
	PM		2		2		2
DAILY TOTALS	AM		-460		17.0		7.6
	OFF		-1578		8.4		-13.2
	PM		890		31.6		35.4
	TOTAL		-1148		57.0		29.8
UNIT VALUES			$0.014		$10.00		$1.00
ANNUAL SAVINGS			($4,822)		$171,000		$8,940
PROJECT COST:			$116,807.16	TOTAL ANNUAL SAVINGS:			$175,118
BENEFIT/COST RATIO:			1.5				

Table F-12. Summary of Travel Time for US Business 83 and Cage Boulevard - City of Pharr

Project Type	Arterial / Link	Length (ft)	Time Period	Before Travel Time (sec)		After Travel Time (sec)		Percentage Travel Time Savings
				NB	SB	NB	SB	
10	Cage Blvd.	11400	AM	430.0	430.0	62.0	258.0	40.0
			OFF	386.0	386.0	56.0	248.0	35.8
			PM	452.0	452.0	86.0	268.0	40.7
				EB	WB	EB	WB	
	US Business 83	9360	AM	259.0	259.0	166.0	230.0	11.2
			OFF	246.0	246.0	153.0	203.0	17.5
			PM	248.0	248.0	157.0	211.0	14.9

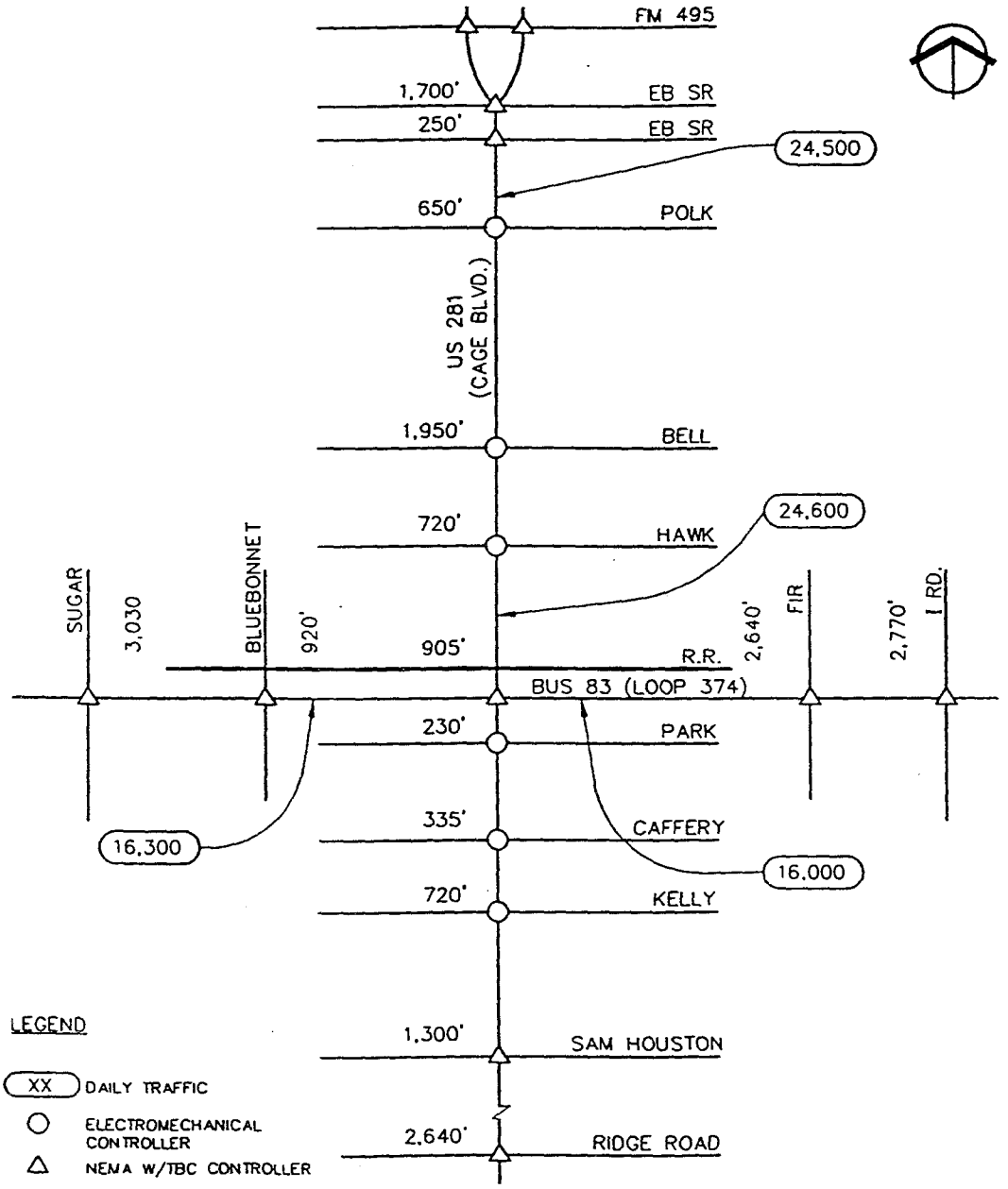


Figure F-8. Project Network for US Business 83 and Cage Boulevard - Pharr.

US 79 Arterial System

The city of Round Rock Department of Pubic Works and Transportation worked on the following project. A total of seven (7) signalized intersections are covered in this project on US 79 (Sam Bass Road, west of IH 35; Palm Valley Boulevard, east of IH 35). Two of the intersections are at the IH 35 interchange East and West Frontage Roads while the five remaining intersections are Chisholm Trail, located west of the IH 35 West Frontage Road, and Mays Street, Egger Avenue, Georgetown Street, and Sunrise Road located east of the IH 35 East Frontage Road. The attached figure shows the project network and cross streets.

Except for the Eagle traffic signal controller at Chisholm Trail, all traffic signal controllers in this system are Naztec traffic-actuated, with interconnection between IH 35 East and West Frontage Roads and between Egger Avenue and Sunrise Road. The Chisholm Trail and IH 35 Frontage Road controllers include pedestrian control.

In order to evaluate the performance, field data was collected in the "before" and "after" TLS traffic conditions. The data included traffic volumes, travel times, signal timings and phasing, arterial data, intersection geometrics, travel delays, and an operating cost study. PASSER III was used to determine the cycle length for the entire system, and PASSER II-90 was used to optimize the signal timing plan. The speed/travel time information was obtained by the test car method. Existing speed and delay information were collected for all arterial links. Six (6) runs were made on the system during three time periods (AM peak, PM peak, and OFF peak) and the mean travel times and delays were determined.

Travel times on the US 79 Arterial System improved significantly, at many locations and time periods by over 40 percent. Isolated AM peak periods near Egger Avenue, Georgetown Street, and Sunrise Road experienced slight increases in travel times; however, increases were 8 seconds or less.

Based on the PASSER II-90 and PASSER III simulation, the project resulted in an estimated $1,922,729 savings per year on total operating cost, a direct benefit to motorists using these routes. This operating cost savings include a total annual savings of 1,309,200 stops (a 9.6 percent reduction), a total annual fuel savings of 139,200 gallons (a 28.8 percent reduction), and an annual delay savings of 176,520 veh-hrs (a 63.5 percent reduction). The total cost of the project was $15,563.25, and the resultant benefit-to-cost ratio was 123.5 to 1.

Table F-13. Summary of Benefits for US 79 Arterial System - City of Round Rock

		STOPS		TOTAL SYSTEM DELAY(veh-hrs)		FUEL(gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	AM	6689	6171	119.6	45.3	239.0	181.0
	OFF	6516	5757	176.2	47.5	255.0	155.0
	PM	9542	8637	167.6	76.4	311.0	237.0
DIFFERENCES	AM		518		74.3		58.0
	OFF		759		128.7		100.0
	PM		905		91.2		74.0
HRS/DAY	AM		2		2		2
	OFF		2		2		2
	PM		2		2		2
DAILY TOTALS	AM		1036		148.6		116.0
	OFF		1518		257.4		200.0
	PM		1810		182.4		148.0
	TOTAL		4364		588.4		464.0
UNIT VALUES			$0.014		$10.00		$1.00
ANNUAL SAVINGS			$18,329		$1,765,200		$139,200
PROJECT COST:			$15,563.25	TOTAL ANNUAL SAVINGS:			$1,922,729
BENEFIT/COST RATIO:			123.5				

Table F-14. Summary of Travel Time for US 79 Arterial System - City of Round Rock

Project Type	Arterial / Link	Length (ft)	Time Period	Before Travel Time (sec)		After Travel Time (sec)		Percentage Travel Time Savings
				EB	WB	EB	WB	
08	Chisholm Trail	-	AM	0.0	23.0	0.0	16.0	30.4
			OFF	0.0	54.0	0.0	17.0	68.5
			PM	0.0	57.0	0.0	18.0	68.4
	IH 35 West Frontage Road	630	AM	42.0	10.0	14.0	14.0	46.2
			OFF	30.0	17.0	15.0	10.0	46.8
			PM	63.0	11.0	18.0	13.0	58.1
	IH 35 East Frontage Road	570	AM	12.0	46.0	10.0	29.0	32.8
			OFF	14.0	48.0	10.0	32.0	32.3
			PM	11.0	47.0	13.0	41.0	6.9
	Mays Street	1430	AM	53.0	49.0	32.0	46.0	23.5
			OFF	61.0	74.0	28.0	41.0	48.9
			PM	55.0	88.0	39.0	33.0	49.7
	Egger Avenue	3090	AM	50.0	14.0	52.0	19.0	-10.9
			OFF	59.0	14.0	46.0	13.0	19.2
			PM	53.0	15.0	32.0	13.0	33.8
	Georgetown Street	830	AM	14.0	20.0	13.0	28.0	-20.6
			OFF	16.0	23.0	14.0	19.0	15.4
			PM	15.0	20.0	9.0	17.0	25.7
	Sunrise Road	940	AM	20.0	0.0	21.0	0.0	-5.0
			OFF	19.0	0.0	15.0	0.0	21.1
			PM	18.0	0.0	19.0	0.0	-5.6

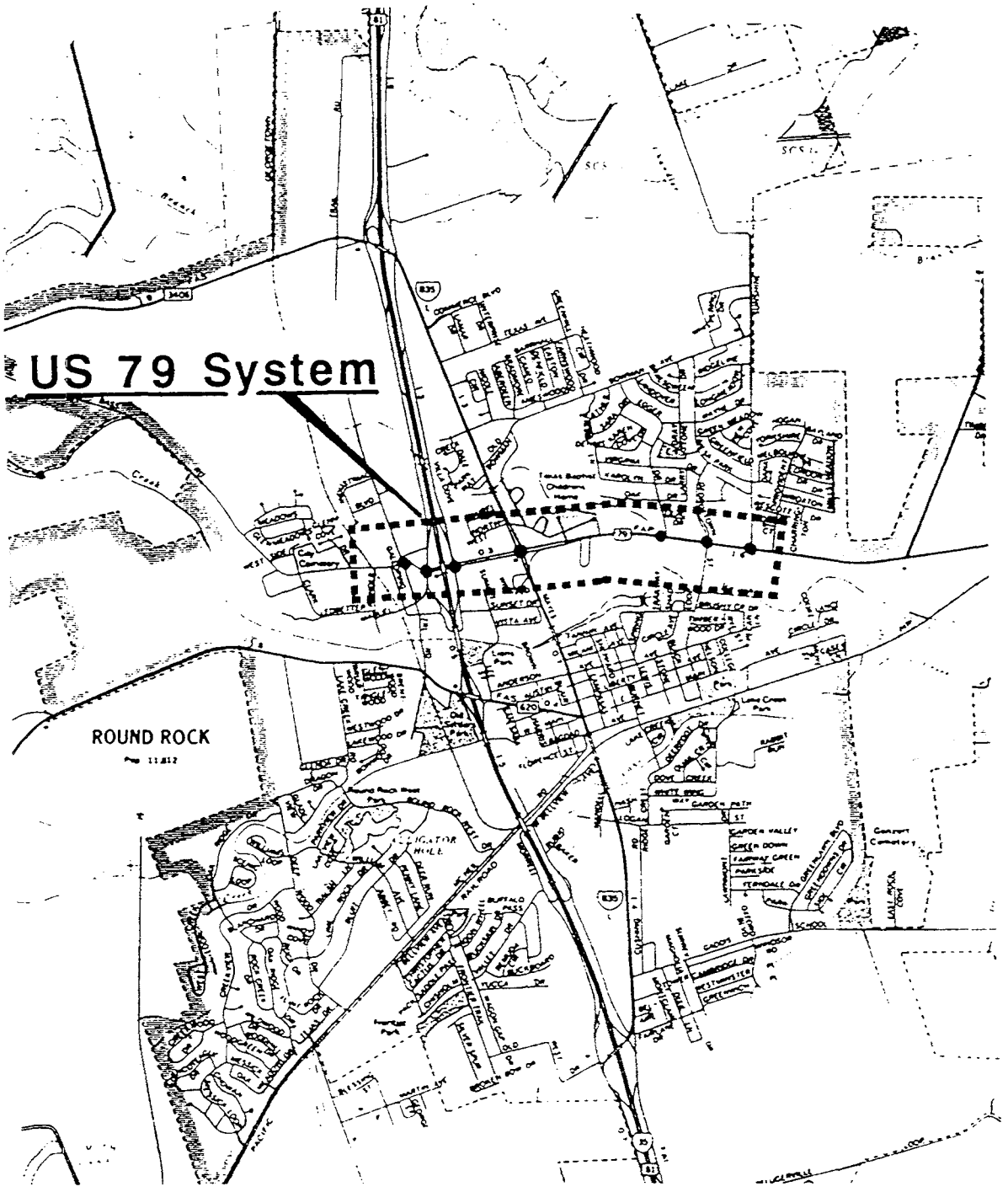


Figure F-9. Project Network for US 79 Arterial System - Round Rock.

Sam Houston Avenue (SH 345)

The city of San Benito Department of Public Works and Transportation worked on the following project. Sam Houston Avenue (SH 345) is a major arterial connecting US 77/83 and Business 77. This project includes three intersections: Robertson Street, Stenger Street, and Business US 77. Sam Houston Avenue at Robertson and Stenger Streets is 68 feet wide and has two 12 foot lanes in each direction. Ten feet on each side of the roadway are dedicated for parallel parking. Sam Houston Avenue at Business US 77 is 68 feet wide and has two 10 foot lanes in each direction with a 12 foot center median. Eight feet on each side of the roadway are dedicated for parallel parking. The attached figure shows the project network and cross streets.

NEMA standard traffic actuated controllers were installed as part of this project to replace the electromechanical controllers. Inductive loop detectors were installed on Robertson Street and Stenger Street and at all four approaches of Sam Houston Avenue and Business US 77 intersection. In addition, 6-pair communication cable was installed along Sam Houston Avenue from Stenger Street to the US 83 Expressway to provide system interconnection between these intersections.

In order to evaluate the performance, field data was collected in the "before" and "after" TLS traffic conditions. The data included traffic volumes, travel times, signal timings and phasing, arterial data, intersection geometrics, travel delays, and an operating cost study. The saturation flow, lost time and extension of effective green were estimated by using PASSER II-90. Six (6) travel time runs were made on the arterial in each time period (AM peak, PM peak, and OFF peak) and the mean travel times and delays were determined.

Travel times in each time period decreased substantially on Sam Houston Avenue. Travel time savings included an 11 second decrease in the OFF peak period and a 27 second savings in the AM peak period.

Based on the PASSER II-90 simulation, the project resulted in an estimated $91,477 savings per year on total operating cost, a direct benefit to motorists using these routes. This operating cost savings include a total annual increase of 156,600 stops (a 1.0 percent increase), a total annual fuel savings of 43,869 gallons (a 19.4 percent reduction), and an annual delay savings of 4,980 veh-hrs (an 8.6 percent reduction). The total cost of the project was $59,738.74, and the resultant benefit-to-cost ratio was 1.5 to 1.

Table F-15. Summary of Benefits for Sam Houston Avenue (SH 345) - City of San Benito

		STOPS		TOTAL SYSTEM DELAY(veh-hrs)		FUEL(gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	AM	5088	5000	20.7	17.6	72.08	69.32
	OFF	3359	3425	11.5	10.7	49.41	33.96
	PM	5574	5626	24.4	22.8	83.33	82.50
DIFFERENCES	AM		88		3.1		2.76
	OFF		-66		0.8		15.45
	PM		-52		1.6		0.83
HRS/DAY	AM		2		2		2
	OFF		9		9		9
	PM		2		2		2
DAILY TOTALS	AM		176		6.2		5.52
	OFF		-594		7.2		139.05
	PM		-104		3.2		1.66
	TOTAL		-522		16.6		146.23
UNIT VALUES			$0.014		$10.00		$1.00
ANNUAL SAVINGS			($2,192)		$49,800		$43,869
PROJECT COST:			$59,738.74	TOTAL ANNUAL SAVINGS:			$91,477
BENEFIT/COST RATIO:			1.5				

Table F-16. Summary of Travel Time for Sam Houston Avenue (SH 345) - City of San Benito

Project Type	Arterial / Link	Length (ft)	Time Period	Before Travel Time (sec)		After Travel Time (sec)		Percentage Travel Time Savings
				NB	SB	NB	SB	
04	Sam Houston:							
	Robertson to Business 77	3485	AM	163.0	163.0	136.0	136.0	16.6
			PM	177.0	177.0	150.0	150.0	15.3
			OFF	167.0	167.0	156.0	156.0	6.6

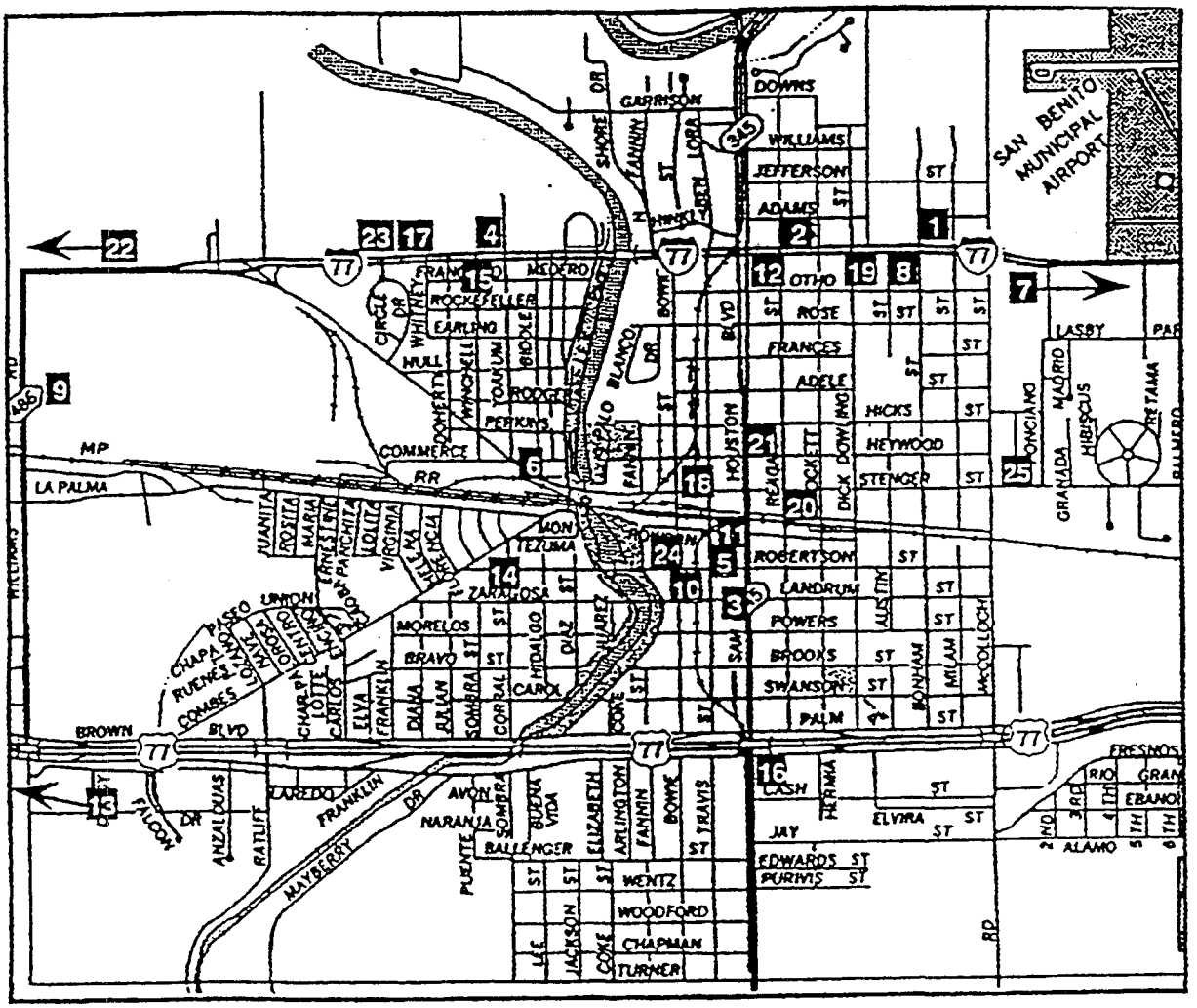


Figure F-10. Project Network for Sam Houston Avenue (SH 345) - San Benito.

US 183/283

The city of Vernon Department of Public Works and Transportation and the Texas Department of Transportation worked on the following project. US 183/283 is a four-lane undivided facility with angle parking and no protected left turn bays. The project contains 4 signalized intersections at Texas Street, Pease Street, Wilbarger Street, and Paradise Street. The attached figure shows the project network and cross streets.

An Eagle closed-loop signal system was installed as part of this project. Eagle Genesis EPAC 300 controllers were installed with modifications made to upgrade the controllers to system status. Each controller was retrofitted with modified communication panels, short-haul modems, and system detector panels. Inductance loop detectors were also installed at various locations.

In order to evaluate the performance, field data was collected in the "before" and "after" TLS traffic conditions. The data included traffic volumes, travel times, signal timings and phasing, arterial data, intersection geometrics, travel delays and an operating cost study. The floating car method was utilized during travel times studies. PASSER II-90 was used to evaluate signal timing plans. Four (4) runs in each direction were recorded over the four study time periods (AM peak, NOON peak, PM peak, OFF peak) between each of the four intersections, and the mean travel times and delays were determined.

Travel times improved in each time period on US 183/283. This includes a travel time savings of over 20 percent during the NOON peak period.

Based on the PASSER II-90 simulation, the project resulted in an estimated $737,093 savings per year on total operating cost, a direct benefit to motorists using these routes. This operating cost savings include a total annual savings of 3,852,600 stops (a 27.5 percent reduction), a total annual fuel savings of 70,527 gallons (a 31.5 percent reduction), and an annual delay savings of 61,263 veh-hrs (a 40.6 percent reduction). The total cost of the project was $71,085.68, and the resultant benefit-to-cost ratio was 10.5 to 1.

Table F-17. Summary of Benefits for US 183/283 - City of Vernon

		STOPS		TOTAL SYSTEM DELAY(veh-hrs)		FUEL(gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	AM	5608	3567	57.40	32.50	85.38	54.28
	NOON	12040	4955	285.70	55.09	290.80	80.87
	OFF	2761	2471	14.90	20.30	35.27	36.55
	PM	4261	3155	25.80	28.50	53.78	48.20
DIFFERENCES	AM	2041		24.90		31.10	
	NOON	7085		230.61		209.93	
	OFF	290		-5.40		-1.28	
	PM	1106		-2.70		5.58	
HRS/DAY	AM	1		1		1	
	NOON	1		1		1	
	OFF	9		9		9	
	PM	1		1		1	
DAILY TOTALS	AM	2041		24.90		31.10	
	NOON	7085		230.61		209.93	
	OFF	2610		-48.60		-11.52	
	PM	1106		-2.70		5.58	
	TOTAL	12842		204.21		235.09	
UNIT VALUES		$0.014		$10.00		$1.00	
ANNUAL SAVINGS		$53,936		$612,630		$70,527	
PROJECT COST:		$71,085.68		TOTAL ANNUAL SAVINGS:		$737,093	
BENEFIT/COST RATIO:		10.5					

Table F-18. Summary of Travel Time for US 183/283 - City of Vernon

Project Type	Arterial / Link	Length (ft)	Time Period	Before Travel Time (sec)		After Travel Time (sec)		Percentage Travel Time Savings
				NB	SB	NB	SB	
04	US 183/283	1390	AM	97.0	81.0	77.0	70.0	17.4
			NOON	104.0	95.0	88.0	71.0	20.1
			PM	96.0	84.0	78.0	72.0	16.7
			OFF	87.0	78.0	74.0	74.0	10.3

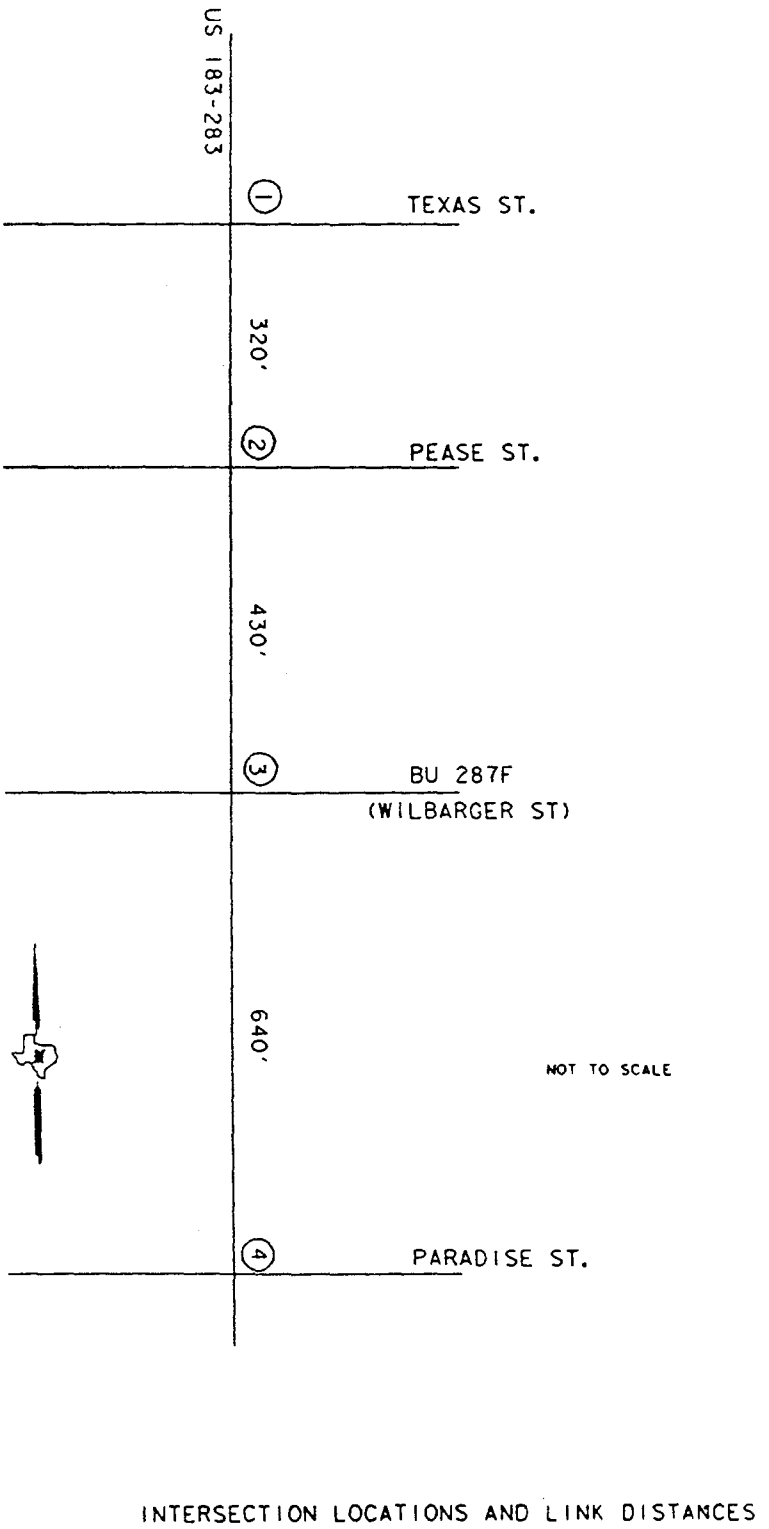


Figure F-11. Project Network for US 183/283 - Vernon.