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Program Title: Texas Traffic Light Synchronization (TLS) Grant Program I
This program was conducted in cooperation with the Texas Governor's Energy Office and the U.S. Department of Energy.

16. Abstract

The Texas Department of Transportation (TxDOT) was the administering agency for the Traffic Light Synchronization (TLS) Program, 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 (DOE) as part of a package of transportation related programs with the objective of reducing energy consumption. This grant program provided the sum of $5.2 million to local city governments across the state for the optimization of traffic signal timing plans and the replacement of outdated signal controller equipment. 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 166 completed projects, the TLS Program has seen results that will pay for the cost of the program many times over. These results were estimated from the required "Before" and "After" studies that were submitted by the cities. These studies document the major goals of the TLS Program -- reductions in fuel consumption and unnecesary delay and stops. All projects were evaluated using the same unit costs. The TLS Program resulted in 2,243 signals in 44 cities being retimed; the expenditure of $7.9 million of program funds and local matches; and annual reductions in fuel consumptions, delay, and stops of 9.1 percent (30 million gallons), 24.6 percent (43 million hours), and 14.2 percent (1.7 billion stops), respectively. The total savings to the public in the form of reduced fuel, delay, and stops will be approximately $485 million in the next year alone. In regard to fuel savings, Texas motorists are realizing $3.81 in savings for every dollar spent, and if stops and delay are included, Texas motorists are realizing $62 in savings for every dollar spent. These savings will continue to accrue in future years without any additional expenditures; therefore, the benefits to the public will be even greater.

This report is in three volumes. The other volumes are:

Benefits of the Texas Traffic Light Synchronization (TLS) Grant Program I: Volume I. Executive Summary and Appendices A-D

Benefits of the Texas Traffic Light Synchronization (TLS) Grant Program I: Volume II. Appendix E

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

VOLUME III. APPENDICES F - G

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Report No: 0258-3
Contract No. IAC(92-93)0029
Program Title: Traffic Light Synchronization (TLS)
Grant Program I

Sponsored by
The Texas Department of Transportation
and
The Texas Governor's Energy Office

October 1992

Texas Transportation Institute
Texas A&M University
College Station, Texas 77843-3135

APPENDIX F

INDIVIDUAL PROJECT SUMMARIES

MEDIUM CITIES

Individual Project Summaries - Medium Cities

City	System	Reduction In Daily Totals			Total Annual Savings ($)	Total Cost ($)	B/C Ratio	Page
		Stops	Delay (veh-hrs)	Fuel (gals)				
Amarillo	Central Business District	15,443	45,037.00	17,065.00	532,300	187,717	2.8	F- 5
Beaumont	College Street	7,389	449.25	60.30	1,396,874	N/A	N/A	F-11
	Dowlen Road	9,185	26.25	88.35	143,830	N/A	N/A	F-14
	Highland Avenue	2,358	(2.55)	15.90	7,024	N/A	N/A	F-17
	Lucas Street	(294)	33.15	10.80	101,455	N/A	N/A	F-20
	Major Drive	5,097	52.80	77.85	203,162	N/A	N/A	F-23
	Washington Boulevard	1,892	586.35	33.30	1,776,984	N/A	N/A	F-26
Brownsville	Boca Chica Boulevard	23,854	404.80	376.20	1,427,447	41,176	34.67	F-29
	Central Boulevard	7,680	67.60	86.20	260,916	40,016	6.52	F-32
	International Boulevard	9,166	133.40	27.60	446,977	32,171	13.89	F-35
	Palm Boulevard	9,372	31.40	46.40	147,482	59,306	2.49	F-38
Denton	Bell	58,582	616.80	811.60	2,339,924	57,143	40.95	F-41
Galveston	Galveston System	6,924	169.70	155.80	584,921	181,688	3.22	F-44
Garland	Central Area System	36,025	376.51	1,154.31	1,627,131	330,580	4.92	F-47
	North Area System	211,687	785.00	1,849.00	3,798,785	698,000	5.44	F-50
	South Sub-network System	9,356	2,377.50	3,265.00	8,152,043	500,000	16.30	F-53
Grand Prairie	Great Southwest Parkway	8,232	330.00	286.00	1,110,374	119,583	9.29	F-56
	Main/Jefferson Street System							F-59
	SH 303	39,560	7,420.00	1,608.00	22,908,552	118,538	193.26	F-62
Harlingen	Commerce Street	6,554	64.60	9.80	224,267	14,363	15.61	F-65
	First Street	160	4.60	2.64	15,264	4,221	3.62	F-68
	Loop 448	5,804	125.60	0.80	401,417	5,166	77.7	F-71
Longview	High Street	9,740	168.40	293.20	634,068	86,590	7.32	F-74
	Judson Road	3,568	148.60	(108.00)	428,386	31,053	13.8	F-77
	Mobberly Avenue	5,808	43.80	(262.00)	77,194	51,003	1.51	F-80
Lubbock	Central Business District	N/A	N/A	N/A	N/A	106,962	N/A	F-83

Individual Project Summaries - Medium Cities (Cont.)

City	System	Reduction In Daily Totals			Total Annual Savings ($)	Total Cost ($)	B/C Ratio	Page
		Stops	Delay (veh-hrs)	Fuel (gals)				
McAllen	Loop 374	19,792	348.80	516.80	1,284,566	969,546	13.31	F-85
Midland	Big Spring St/ Garfield St	24,261	647.02	809.13	2,285,689	68,615	33.31	F-88
	Midkiff Rd/ Andrews Hwy	127,464	4,053.47	5,883.74	14,460,888	89,231	162.06	F-91
Odessa	Central Business District	106,148	1,856.00	191.00	6,071,120	59,027	102.85	F-94
Port Arthur	Memorial Dr./Gulfway Dr.	36,966	415.80	90.00	1,429,657	109,213	13.09	F-97
San Angelo	Bryant Boulevard	22,381	70.51	259.11	383,263	238,777	1.61	F-100
	CBD System	4,887	175.17	165.19	595,592	179,668	3.31	F-103
Victoria	Navarro Street	(8,304)	315.00	81.40	934,543	62,679	14.91	F-106
	Rio Grande Street	9,462	136.00	57.40	464,960	66,020	7.04	F-109
Waco	S. 17th/S. 18th Streets	9,108	155.00	147.00	547,952	25,211	21.73	F-112
	N. 25th/N. 26th Streets	8,699	36.75	80.00	170,787	40,579	4.21	F-115
	Waco Drive	16,704	318.60	303.00	1,116,857	45,417	24.59	F-118

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Central Business District

The City's Engineering Department was assisted by the Texas Department of Transportation to work on the Central Business District project. The network consists of a 9 into 10 grid of mostly one-way streets. The attached map displays the project network system, cross streets, and link distances.

The network area is predominantly commercial and consists of 86 signalized intersections which are controlled by a central computer located in the city hall. The controllers in the study area consist of 76 electromechanical controllers and 10 solid state controllers. All of the controllers are pretimed. Communications are via city owned hardwire.

Four timing plans are used on a time-of day basis. The AM peak uses an 80 second cycle, the Noon peak an 80 second cycle, the PM peak a 100 second cycle and a 50 second Off-peak cycle. All signals operate on two phases except those along 3rd and 10th at Taylor, Fillmore, Pierce, and Buchanan. These provide a leading left turn onto the north-south one-way. The study also included the feasibility of the removal of some intersections in the west part of the CBD that are not warranted and whose removal could improve progression. In order to improve the reliability, the city has also installed numerous solid state controllers.

In order to evaluate the system performance, traffic conditions were monitored and various data were collected before implementation of any changes. This data was in the form of traffic volumes, saturation flow rates, travel times, and delays. Test car method was used to collect link travel times, average number of stops, and the stop locations.

PASSER II model was considered practical to use in a CBD grid with predominantly one-way streets. The after data was not collected for the PM peak period. Also, the after data for the intersections was not collected/reported in a consistent manner. While AM, Noon, and Off-peak data were reported for some intersections, for other intersections, Noon and Off-peak data were reported, or AM and Noon peak data were reported. Lastly, for one intersection, only the Off peak data was reported. Implementing the new signal timings resulted in a total annual savings of about $532,300 to the motorists using the network. While the number of stops decreased by about 15,443, there were about 45,037 fewer hours of delay, and a fuel savings of about 17,065 gallons in a year. While the average travel times decreased on a few links, there was an increase in the travel times in a few links in the network. The maximum decrease and increase in the travel times were 47 seconds and 65 seconds, respectively. The total cost of the project was $187,717, with a benefit to cost ratio of 3 to 1.

Tyler/Fillmore/Buchanan/3rd/6th/7th/8th/10th

		STOPS		TOTAL SYSTEM DELAY (veh-hrs)		FUEL (gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	AM	49943	46693	309	277.4	479.77	470.1
	NOON	44444	43769	294.2	287.9	443.5	441.02
	PM	N/A	N/A	N/A	N/A	N/A	N/A
	OFF	29969	29099	128.3	123.3	310.05	307.53
DIFFERENCES	AM	3250		31.6		9.67	
	NOON	675		6.3		2.48	
	PM	0		0		0	
	OFF	870		5		2.52	
HRS/DAY	AM	1.5		1.5		1.5	
	NOON	2.25		2.25		2.25	
	PM	N/A		N/A		N/A	
	OFF	5.75		5.75		5.75	
DAILY TOTALS	AM	4875		47.4		14.505	
	NOON	1519		14.175		5.58	
	PM	0		0		0	
	OFF	5003		28.75		14.49	
	TOTAL	11396		90.325		34.575	
UNIT VALUES		$0.014		$10.00		$1.00	
ANNUAL SAVINGS		$47,864		$270,975		$10,373	
PROJECT COST:		See B-1		TOTAL ANNUAL SAVINGS:		$329,212	
BENIFIT/COST RATIO:		See B-1					

Harrison/Polk/Taylor/Pierce/4th/5th

		STOPS		TOTAL SYSTEM DELAY (veh-hrs)		FUEL (gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	AM	N/A	N/A	N/A	N/A	N/A	N/A
	NOON	22503	22031	133.7	132	256.41	255.53
	PM	N/A	N/A	N/A	N/A	N/A	N/A
	OFF	16818	16660	70.9	69.8	187.18	186.75
DIFFERENCES	AM	0		0		0	
	NOON	472		1.7		0.88	
	PM	0		0		0	
	OFF	158		1.1		0.43	
HRS/DAY	AM	N/A		N/A		N/A	
	NOON	2.25		2.25		2.25	
	PM	N/A		N/A		N/A	
	OFF	5.75		5.75		5.75	
DAILY TOTALS	AM	0		0		0	
	NOON	1062		3.825		1.98	
	PM	0		0		0	
	OFF	909		6.325		2.4725	
	TOTAL	1971		10.15		4.4525	
UNIT VALUES		$0.014		$10.00		$1.00	
ANNUAL SAVINGS		$8,276		$30,450		$1,336	

PROJECT COST:	See B-1	TOTAL ANNUAL SAVINGS:	$40,062
BENIFIT/COST RATIO:	See B-1		

9th/11th Avenue

		STOPS		TOTAL SYSTEM DELAY (veh-hrs)		FUEL (gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	AM	13387	12105	120.3	89.3	117.24	105.99
	NOON	12028	11840	90.2	88.8	108.23	107.54
	PM	N/A	N/A	N/A	N/A	N/A	N/A
	OFF	N/A	N/A	N/A	N/A	N/A	N/A
DIFFERENCES	AM	1282		31		11.25	
	NOON	188		1.4		0.69	
	PM	0		0		0	
	OFF	0		0		0	
HRS/DAY	AM	1.5		1.5		1.5	
	NOON	2.25		2.25		2.25	
	PM	N/A		N/A		N/A	
	OFF	N/A		N/A		N/A	
DAILY TOTALS	AM	1923		46.5		16.875	
	NOON	423		3.15		1.5525	
	PM	0		0		0	
	OFF	0		0		0	
	TOTAL	2346		49.65		18.4275	
UNIT VALUES		$0.014		$10.00		$1.00	
ANNUAL SAVINGS		$9,853		$148,950		$5,528	

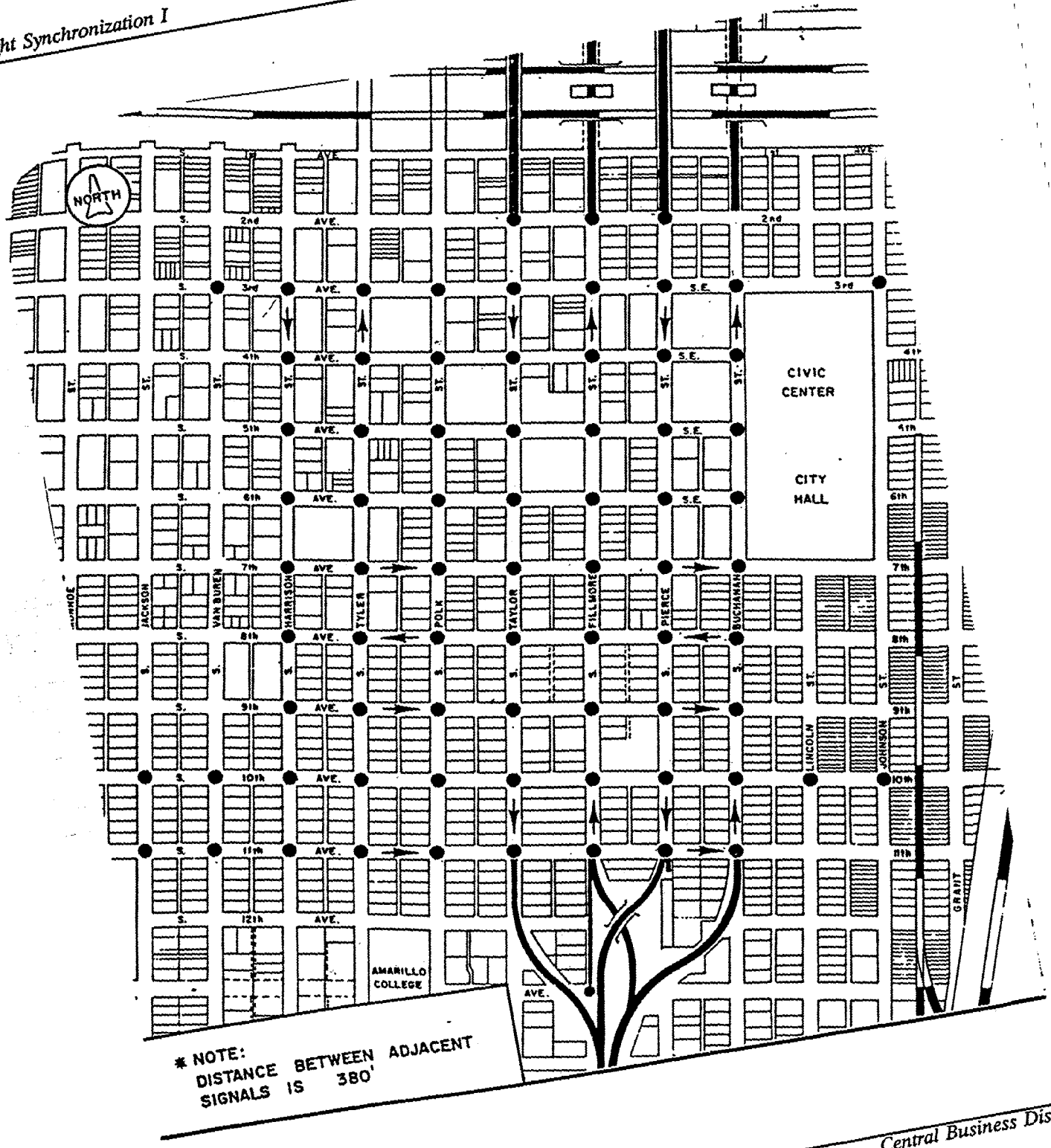
PROJECT COST:	See B-1	TOTAL ANNUAL SAVINGS:	$164,331
BENIFIT/COST RATIO:	See B-1		

2nd Avenue

		STOPS		TOTAL SYSTEM DELAY (veh-hrs)		FUEL (gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	AM	N/A	N/A	N/A	N/A	N/A	N/A
	NOON	N/A	N/A	N/A	N/A	N/A	N/A
	PM	N/A	N/A	N/A	N/A	N/A	N/A
	OFF	885	932	2.4	2.4	10.99	11.09
DIFFERENCES	AM	0		0		0	
	NOON	0		0		0	
	PM	0		0		0	
	OFF	-47		0		-0.1	
HRS/DAY	AM	N/A		N/A		N/A	
	NOON	N/A		N/A		N/A	
	PM	N/A		N/A		N/A	
	OFF	5.75		5.75		5.75	
DAILY TOTALS	AM	0		0		0	
	NOON	0		0		0	
	PM	0		0		0	
	OFF	-270		0		-0.575	
	TOTAL	-270		0		-0.575	
UNIT VALUES		$0.014		$10.00		$1.00	
ANNUAL SAVINGS		($1,135)		$0		($172)	

PROJECT COST:	See B-1	TOTAL ANNUAL SAVINGS:	($1,308)
BENIFIT/COST RATIO:	See B-1		

Traffic Light Synchronization I



Central Business District

Amarillo, Texas

College Street

The City of Beaumont worked on the following project. College Street is an east-west arterial running from the west part of the CBD to the city limits. It has 4 intersections and a diamond interchange over a length of 1.1 miles. The attached map illustrates the project network, cross streets, and link distances.

The interchange and the intersection with 11th Street dominate the performance of the arterial. A hospital and a shopping complex close to the intersection of College Street and 11th Street makes that intersection one of the busiest along the arterial. The land use along College Street is generally commercial and industrial. While the two major intersections are pre-timed, the other two intersections are actuated. These intersections had between two to eight phases. All of these intersections were controlled by 2M-800 controllers. None of the intersections had any pedestrian controls.

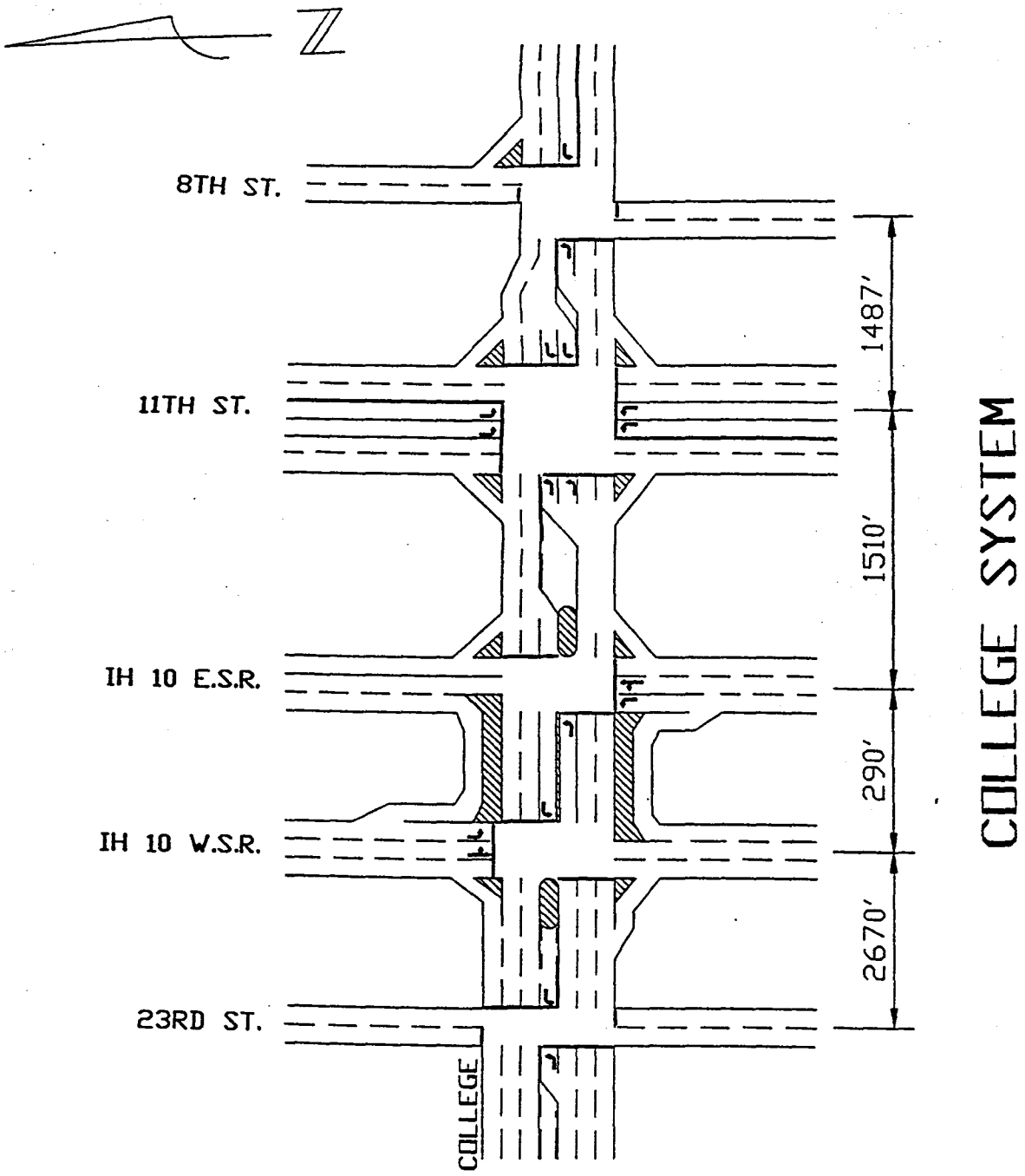
In order to evaluate the system performance, traffic conditions were monitored and various data were collected before the implementation of any changes. This data was in the form of traffic volumes, saturation flow rates, travel times, and delays. Fifteen minute volumes were collected for peak and off-peak periods. Saturation flow rates, lost time, and extension of effective green were estimated using the PASSER II assistant key. Floating test car method was used to collect average link travel times and delays.

Optimization runs were completed utilizing the PASSER II and PASSER III models. The outputs from these two models were combined graphically using methods found in a report titled "Application of Signal Timing Methodology to Suburban Arterials with Diamond Interchanges" by John L. Hibbard and James C. Cline. This method combines the diamond interchange features of PASSER III and the maximum bandwidth solution provided by PASSER II.

Implementing the improved signal timings resulted in a total savings of about 1.3 million dollars. These savings were in the form of 2.2 million fewer stops (a reduction of 10.7 percent), 135,000 fewer hours of delay (a reduction of 32 percent), and 18,090 fewer gallons of fuel (a savings of 3.1 percent) in a year. Travel times decreased in the direction of peak travel as progression was provided only in one direction. In the AM peak, the travel times decreased in the east-bound direction (27 percent), and increased in the west-bound direction (23 percent). In the PM peak, the travel times in the west-bound direction decreased (36 percent) and increased in the east-bound direction (10 percent). The overall cost of the projects in the Beaumont area was about $51,891 with a benefit to cost ratio of 70 to 1.

		STOPS		TOTAL SYSTEM DELAY (veh-hrs)		FUEL (gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	AM	6667	5320	281.6	82.2	205.3	184.5
	OFF	6379	5774	76.3	79.1	169.8	167.2
	PM	7433	6879	254.3	140.2	213.7	207.3
DIFFERENCES	AM	1347		199.4		20.8	
	OFF	605		-2.8		2.6	
	PM	554		114.1		6.4	
HRS/DAY	AM	1.5		1.5		1.5	
	OFF	7.5		7.5		7.5	
	PM	1.5		1.5		1.5	
DAILY	AM	2021		299.1		31.2	
	OFF	4538		-21		19.5	
	PM	831		171.15		9.6	
	TOTAL	7389		449.25		60.3	
UNIT VALUES		$0.014		$10.00		$1.00	
ANNUAL SAVINGS		$31,034		$1,347,750		$18,090	

PROJECT COST:	See B-7	TOTAL ANNUAL SAVINGS:	$1,396,874
BENIFIT/COST RATIO:	See B-7		


N
8TH ST.
11TH ST.
IH 10 E.S.R.
IH 10 W.S.R.
23RD ST.
COLLEGE
1487'
1510'
290'
2670'
COLLEGE SYSTEM

Dowlen Road

The City of Beaumont worked on the following project. Dowlen Street is a north-south arterial running in the west part of the city. The system has four intersections over a length of 1.2 miles. The attached map illustrates the project network, cross streets, and link distances.

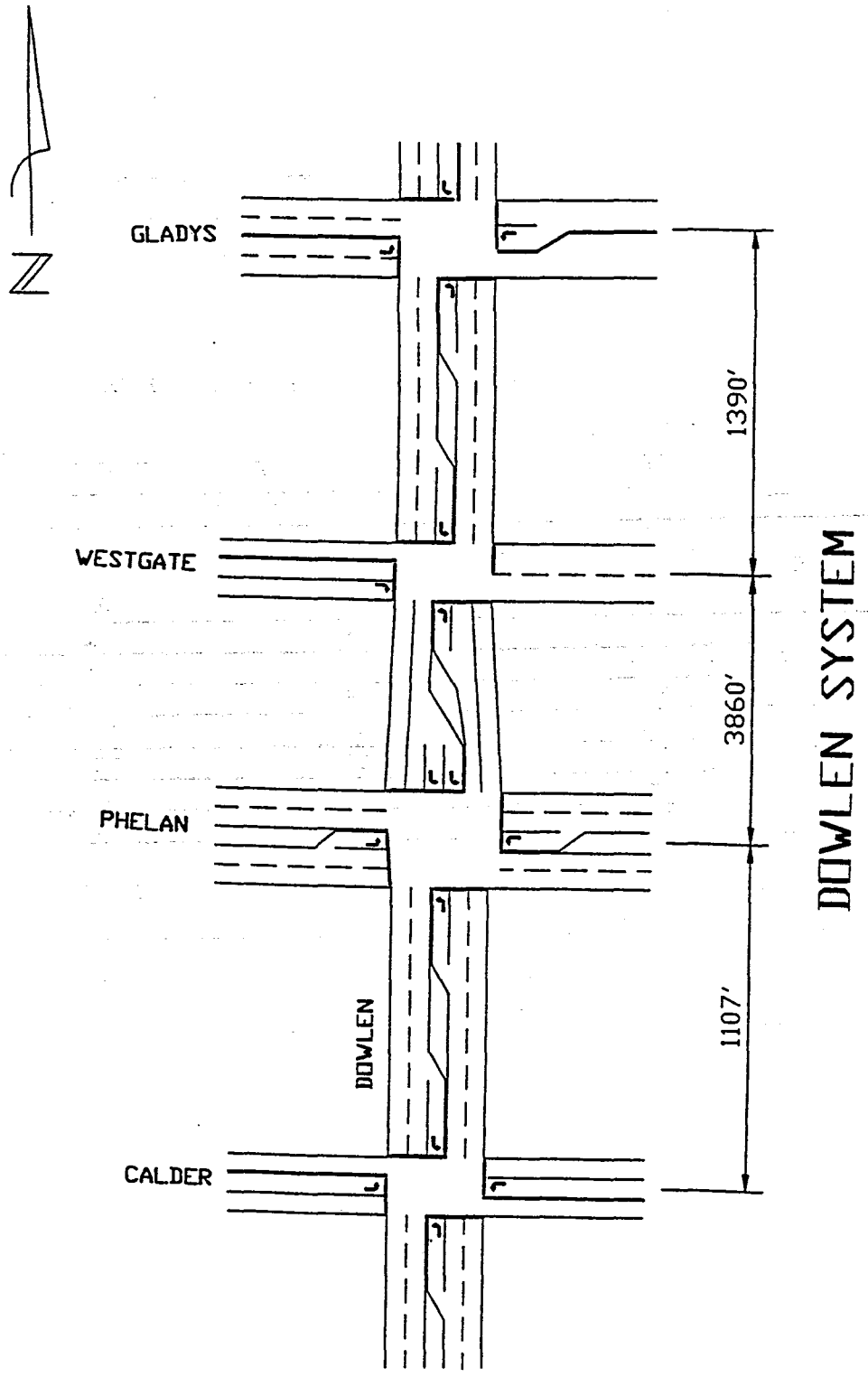
The intersection with Phelan Street is very busy due to the presence of a shopping center nearby. Other factors influencing the performance of the system are a regional mall north of the system and two schools with 20 mph school zones. The land use along Dowlen Street is generally residential and commercial. While two intersections are pre-timed, the other two intersections are actuated. These intersections had between two to eight phases. All of these intersections were controlled by either 2M-800 or 2M-020 controllers. While the intersections with Gladys and Westgate had pedestrian controls, the intersections with Phelan and Calder did not have any pedestrian controls.

In order to evaluate the system performance, traffic conditions were monitored and various data were collected before the implementation of any changes. This data was in the form of traffic volumes, saturation flow rates, travel times, and delays. Fifteen minute volumes were collected for peak and off-peak periods. Saturation flow rates, lost time, and extension of effective green were estimated using the PASSER II assistant key. Floating test car method was used to collect average link travel times and delays.

A maximum cycle length of 90 seconds for the AM peak, and 100 seconds for the Noon/Off Peak and PM peak, respectively, were used in PASSER II program to obtain optimum results. Implementing the improved signal timings resulted in a total savings of about $143,000. These savings were in the form of 2.75 million fewer stops (a reduction of 12 percent), 7,900 fewer hours of delay (a reduction of 3.3 percent), and 26,520 fewer gallons of fuel (a savings of 4.5 percent) in a year. While the timing plans have improved the operational conditions, the travel times were observed to have increased significantly during all times of the day. This increase in travel times has been attributed to some error in the collection of the before data. The overall cost of the projects in the Beaumont area was about $51,891 with a benefit to cost ratio of 70 to 1.

		STOPS		TOTAL SYSTEM DELAY (veh-hrs)		FUEL (gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	AM	9285	8089	100.5	88.6	225.9	208.1
	OFF	6295	5495	58.1	59.6	155.9	151
	PM	10660	9733	134.9	121.8	283.5	266.9
DIFFERENCES	AM	1196		11.9		17.8	
	OFF	800		-1.5		4.9	
	PM	927		13.1		16.6	
HRS/DAY	AM	1.5		1.5		1.5	
	OFF	7.5		7.5		7.5	
	PM	1.5		1.5		1.5	
DAILY	AM	1794		17.85		26.7	
	OFF	6000		-11.25		36.75	
	PM	1391		19.65		24.9	
	TOTAL	9185		26.25		88.35	
UNIT VALUES		$0.014		$10.00		$1.00	
ANNUAL SAVINGS		$38,575		$78,750		$26,505	

PROJECT COST:	See B-10	TOTAL ANNUAL SAVINGS:	$143,830
BENIFIT/COST RATIO:	See B-10		


N
GLADYS
WESTGATE
PHELAN
DOWLEN
CALDER
1390'
3860'
1107'
DOWLEN SYSTEM

Highland Avenue

The City of Beaumont worked on the following project. Highland Street is a north-south arterial running in the southeast section of the city. It has four intersections over a length of 0.78 mile. The attached map illustrates the project network, cross streets, and link distances.

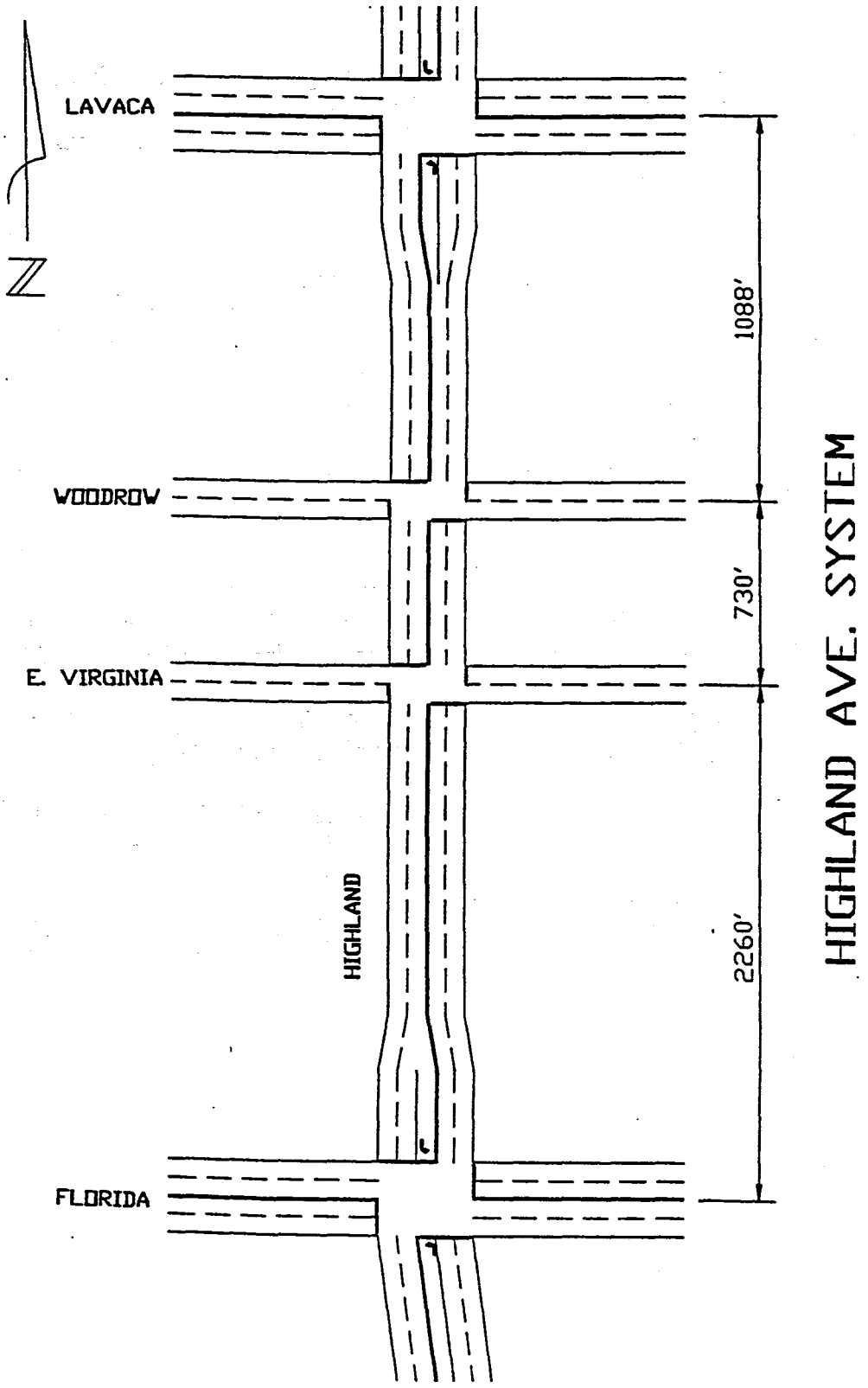
Lavaca and East-Virginia are minor arterials and are the dominant intersections on the arterials. Traffic on Highland does not show the peaking characteristics typical of the Beaumont area. But the close proximity of Lamar University and a 20 mph school zone in the system influence the traffic performance. The intersections in the system were actuated and have 2 phases. All of these intersections were controlled by 2M-800 controllers and were equipped with pedestrian controls.

In order to evaluate the system performance, traffic conditions were monitored and various data were collected before the implementation of any changes. This data was in the form of traffic volumes, saturation flow rates, travel times, and delays. Fifteen minute volumes were collected for peak and off-peak periods. Saturation flow rates, lost time, and extension of effective green were estimated using the PASSER II assistant key. Floating test car method was used to collect average link travel times and delays.

Optimization runs were completed utilizing PASSER II model. While a maximum cycle length of 70 seconds was specified for the AM peak, a cycle length of 60 seconds was specified for the Noon/Off peak and PM peak. Implementing the improved signal timings resulted in a total annual savings of about $7000. While the stops and fuel consumption in a year decreased by 0.7 million (a reduction of 11 percent) and 4,770 gallons (a reduction of 4 percent) respectively, the delay increased by 780 veh-hrs (an increase of 3.7 percent). Before the improvements were made to the signal timings, the intersections were being operated in an isolated mode. Providing progression has resulted in a more efficient flow of traffic on the arterial but has increased the delay to the cross-street traffic. The overall increase in delay has taken place because the moderate traffic flow on Highland has not been able to offset the increase in delay to the cross-street. Travel times have generally decreased due to the improved signal timings. The average decrease in travel times in the AM peak, Noon/Off peak, and the PM peak were 10 percent, 12 percent, and 16 percent, respectively. The overall cost of the projects in the Beaumont area was about $51,891 with a benefit to cost ratio of 70 to 1.

		STOPS		TOTAL SYSTEM DELAY (veh-hrs)		FUEL (gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	AM	3347	2759	10.9	12.2	58.7	58.1
	OFF	1710	1525	5.8	5.9	34.5	32.6
	PM	1813	1754	6.6	6.5	39.3	38.8
DIFFERENCES	AM	588		-1.3		0.6	
	OFF	185		-0.1		1.9	
	PM	59		0.1		0.5	
HRS/DAY	AM	1.5		1.5		1.5	
	OFF	7.5		7.5		7.5	
	PM	1.5		1.5		1.5	
DAILY	AM	882		-1.95		0.9	
	OFF	1388		-0.75		14.25	
	PM	89		0.15		0.75	
	TOTAL	2358		-2.55		15.9	
UNIT VALUES		$0.014		$10.00		$1.00	
ANNUAL SAVINGS		$9,904		($7,650)		$4,770	

PROJECT COST:	See B-13	TOTAL ANNUAL SAVINGS:	$7,024
BENIFIT/COST RATIO:	See B-13		


LAVACA
WOODROW
E. VIRGINIA
HIGHLAND
FLORIDA
1088'
730'
2260'
HIGHLAND AVE. SYSTEM

Lucas Street

The City of Beaumont worked on the following project. Lucas Street is an east-west major arterial running in the north part of the city. It has 5 intersections including a diamond interchange and is over a length of 1.1 miles. The attached map illustrates the project network, cross streets, and link distances.

The most critical intersection dominating the performance of the arterial is the diamond interchange with US 69. Other key intersections on the arterial are with Concord and Folsom. While the land use west of Concord is generally commercial, east of Concord is a mix of residential and commercial. Traffic performance is affected by shopping complexes at US 69 and Concord, vehicles accessing the freeway, and a 9th grade center south of Lucas on Concord. While intersections at Folsom and US 69 are pre-timed, the other intersections are actuated. These intersections had between two to eight phases. Either 2M-020 or 2M-800 controllers were operating the signals at the intersections. While the intersections at Concord and Bigner have pedestrian controls, rest of the intersections did not have any pedestrian controls.

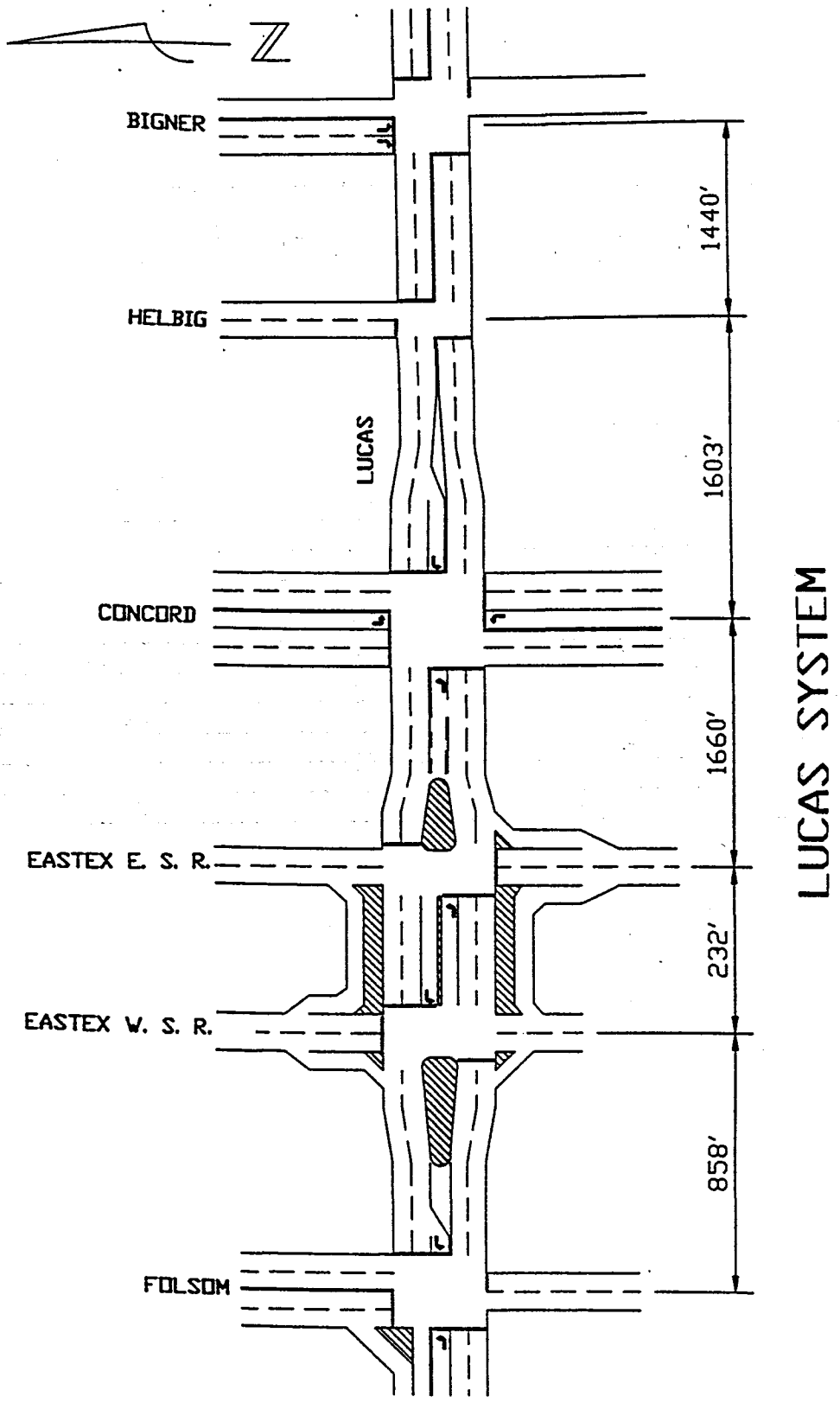
In order to evaluate the system performance, traffic conditions were monitored and various data were collected before the implementation of any changes. This data was in the form of traffic volumes, saturation flow rates, travel times, and delays. Fifteen minute volumes were collected for peak and off-peak periods. Saturation flow rates, lost time, and extension of effective green were estimated using the PASSER II assistant key. Floating test car method was used to collect average link travel times and delays.

Optimization runs were completed utilizing the PASSER II and PASSER III models. The outputs from these two models were combined graphically using methods found in a report titled "Application of Signal Timing Methodology to Suburban Arterials with Diamond Interchanges" by John L. Hibbard and James C. Cline. This method combines the diamond interchange features of PASSER III and the maximum bandwidth solution provided by PASSER II.

Implementing the improved signal timings resulted in a total savings of about $101,000. While the number of stops increased by 88,200 (an marginal increase of under 1 percent), there were about 1000 fewer hours of delay (a reduction of 6 percent), and 3,240 fewer gallons of fuel (a savings of 1.16 percent) in a year. Travel times decreased in the direction of peak travel as progression was provided only in one direction. While in the AM peak, the travel times decreased in the east-bound direction (22 percent), and increased in the west-bound direction (14 percent), in the PM peak, the travel times in both the directions decreased marginally. During the Noon/Off peak the travel times decreased by an average of 15 percent. The overall cost of the projects in the Beaumont area was about $51,891 with a benefit to cost ratio of 70 to 1.

		STOPS		TOTAL SYSTEM DELAY (veh-hrs)		FUEL (gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	AM	3693	3286	71.2	40.3	93.8	85.9
	OFF	2873	2996	39.2	43	78.1	78
	PM	5134	5122	75.4	65.2	131.9	133.1
DIFFERENCES	AM	407		30.9		7.9	
	OFF	-123		-3.8		0.1	
	PM	12		10.2		-1.2	
HRS/DAY	AM	1.5		1.5		1.5	
	OFF	7.5		7.5		7.5	
	PM	1.5		1.5		1.5	
DAILY	AM	611		46.35		11.85	
	OFF	-923		-28.5		0.75	
	PM	18		15.3		-1.8	
	TOTAL	-294		33.15		10.8	
UNIT VALUES		$0.014		$10.00		$1.00	
ANNUAL SAVINGS		($1,235)		$99,450		$3,240	

PROJECT COST:	See B-16	TOTAL ANNUAL SAVINGS:	$101,455
BENIFIT/COST RATIO:	See B-16		


N
BIGNER
HELBIG
LUCAS
CONCORD
EASTEX E. S. R.
EASTEX W. S. R.
FOLSOM
1440'
1603'
1660'
232'
858'
LUCAS SYSTEM

Major Drive

The City of Beaumont worked on the following project. Major Drive is a north-south arterial located approximately one mile from the city limit. It has five intersections over a length of 1.65 miles. The attached map illustrates the project network, cross streets, and link distances.

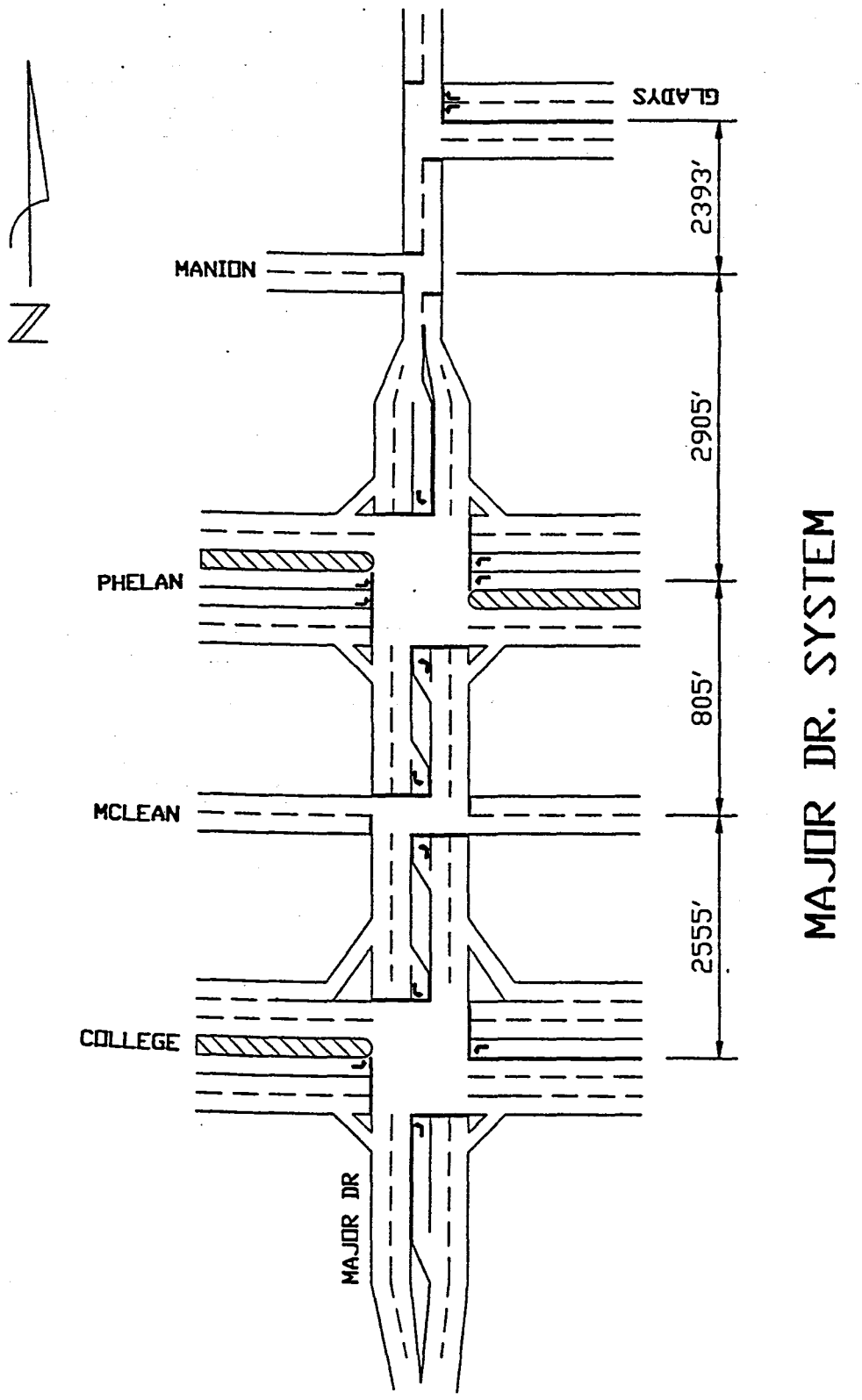
College and Phelan are the major arterials intersecting the Major Drive. Development along this roadway is generally residential with some commercial use near the intersections of College and Phelan. A high school located at Manion has an impact on the intersection performance during the morning and the evening periods. A 20 mph zone is present in front of a school between McLean and College. All of the intersections except Phelan are actuated and have between two to eight phases. The controllers used to operate the signals were either, 2M-020, 2M-800, 2 AUTOMATIC, or CROUSEHINDS DM400 controllers. None of the intersections were equipped with pedestrian controls.

In order to evaluate the system performance, traffic conditions were monitored and various data were collected before the implementation of any changes. This data was in the form of traffic volumes, saturation flow rates, travel times, and delays. Fifteen minute volumes were collected for peak and off-peak periods. Saturation flow rates, lost time, and extension of effective green were estimated using the PASSER II assistant key. Floating test car method was used to collect average link travel times and delays.

Optimization runs were completed utilizing PASSER II model. While a maximum cycle length of 90 seconds was specified for the AM peak, a cycle length of 80 seconds was specified for the Noon/Offpeak and PM peak. Implementing the improved signal timings resulted in a total annual savings of about $203,000. The number of stops, fuel consumption, and total delay in a year decreased by 1.53 million stops (a reduction of 9.8 percent), 23,370 gallons (a reduction of 6.1 percent), and 15,840 veh-hrs (an decrease of 11 percent), respectively. Travel time studies after the implementation were conducted only on segments which were not having any construction activity. The overall cost of the projects in the Beaumont area was about $51,891 with a benefit to cost ratio of 70 to 1.

		STOPS		TOTAL SYSTEM DELAY (veh-hrs)		FUEL (gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	AM	7962	6418	98.5	66.9	202	167.2
	OFF	3879	3569	30.7	30.2	93.8	91
	PM	7017	6713	63.5	62.4	170.7	167.6
DIFFERENCES	AM	1544		31.6		34.8	
	OFF	310		0.5		2.8	
	PM	304		1.1		3.1	
HRS/DAY	AM	1.5		1.5		1.5	
	OFF	7.5		7.5		7.5	
	PM	1.5		1.5		1.5	
DAILY	AM	2316		47.4		52.2	
	OFF	2325		3.75		21	
	PM	456		1.65		4.65	
	TOTAL	5097		52.8		77.85	
UNIT VALUES		$0.014		$10.00		$1.00	
ANNUAL SAVINGS		$21,407		$158,400		$23,355	

PROJECT COST:	See B-19	TOTAL ANNUAL SAVINGS:	$203,162
BENIFIT/COST RATIO:	See B-19		


GLADYS
2393'
MANION
2905'
PHELAN
805'
MCLEAN
2555'
COLLEGE
MAJOR DR
MAJOR DR. SYSTEM

Washington Boulevard

The City of Beaumont worked on the following project. Washington Blvd. is a major east-west arterial located in the southwest part of the city. The system has 4 intersections including a diamond interchange and is over a length of 1.6 miles. The attached map illustrates the project network, cross streets, and link distances.

The most critical intersection dominating the performance of the arterial is the diamond interchange with IH-10. The interchange is skewed and has no U-turn lane. The land use along Washington Blvd. is generally commercial. Traffic performance is affected by trucking companies and the Beaumont Hilton in the area, vehicles accessing the IH-10, and residential areas east and west of the system. All of the intersections except the diamond interchange were pre-timed and had only two phases. The diamond interchange had four phases. While a 2M-020 controller operated the diamond interchange, rest of the intersections were operated by 2M-800 controllers. None of the intersections had any pedestrian controls.

In order to evaluate the system performance, traffic conditions were monitored and various data were collected before the implementation of any changes. This data was in the form of traffic volumes, saturation flow rates, travel times, and delays. Fifteen minute volumes were collected for peak and off-peak periods. Saturation flow rates, lost time, and extension of effective green were estimated using the PASSER II assistant key. Floating test car method was used to collect average link travel times and delays.

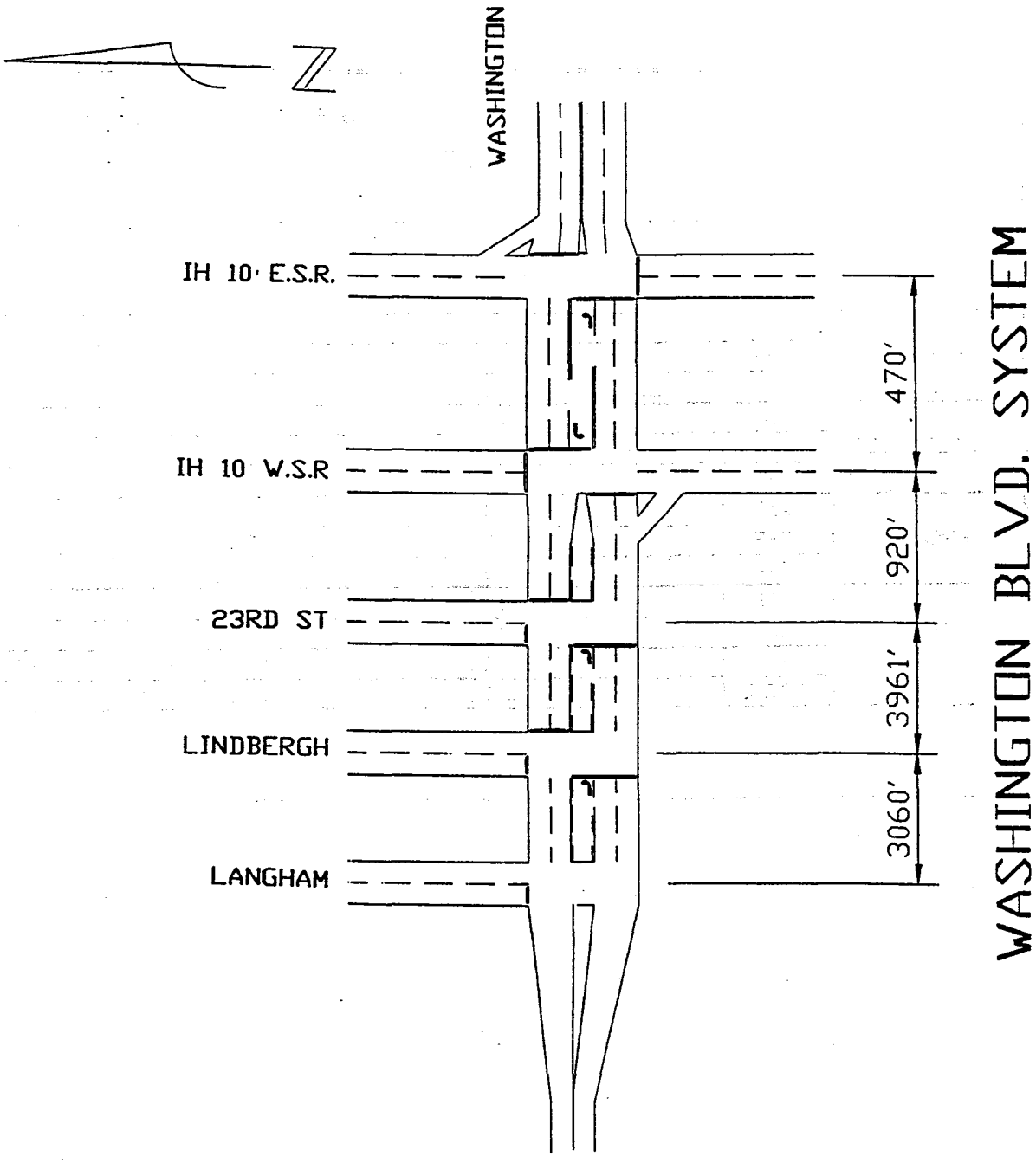
Optimization runs were completed utilizing the PASSER II and PASSER III models. The outputs from these two models were combined graphically using methods found in a report titled "Application of Signal Timing Methodology to Suburban Arterials with Diamond Interchanges" by John L. Hibbard and James C. Cline. This method combines the diamond interchange features of PASSER III and the maximum bandwidth solution provided by PASSER II.

Implementing the improved signal timings resulted in a total savings of about $1,770,000. These savings were in the form of a reduction in the number of stops of 0.57 million (a decrease of about 11 percent), about 176,00 fewer hours of delay (a reduction of 72 percent), and 10,000 fewer gallons of fuel (a savings of 5 percent) in a year. Travel times decreased significantly in both directions for all study periods except in the west-bound direction in the PM peak when it increased by about 7.4 percent. The travel times decreased by 28 percent (east-bound) and 8.6 percent (west-bound) in the AM peak, by 36 percent (east-bound) and 20 percent (west-bound) in the Noon/Off peak, and by 32 percent in the east-bound direction in the PM peak. The overall cost of the projects in the Beaumont area was about $51,891 with a benefit to cost ratio of 70 to 1.

		STOPS		TOTAL SYSTEM DELAY (veh-hrs)		FUEL (gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	AM	2810	2357	48.3	22.9	116	109.1
	OFF	1220	1204	66.4	19.8	51.2	51.4
	PM	2201	1473	162.8	30.3	92.1	75.8
DIFFERENCES	AM	453		25.4		6.9	
	OFF	16		46.6		-0.2	
	PM	728		132.5		16.3	
HRS/DAY	AM	1.5		1.5		1.5	
	OFF	7.5		7.5		7.5	
	PM	1.5		1.5		1.5	
DAILY	AM	680		38.1		10.35	
	OFF	120		349.5		-1.5	
	PM	1092		198.75		24.45	
	TOTAL	1892		586.35		33.3	
UNIT VALUES		$0.014		$10.00		$1.00	
ANNUAL SAVINGS		$7,944		$1,759,050		$9,990	

PROJECT COST: See B-22 TOTAL ANNUAL SAVINGS: $1,776,984

BENIFIT/COST RATIO: See B-22


N
WASHINGTON
IH 10 E.S.R.
IH 10 W.S.R
23RD ST
LINDBERGH
LANGHAM
470'
920'
3961'
3060'
WASHINGTON BLVD. SYSTEM

Boca Chica Boulevard

The City of Brownsville Department of Public Works and Transportation worked on the following project. A total of twelve signalized intersections were included in Boca Chica Blvd. segment at spacing that varied between 250 feet and 3,100 feet. The attached figure displays the project network system, cross streets, and link distances.

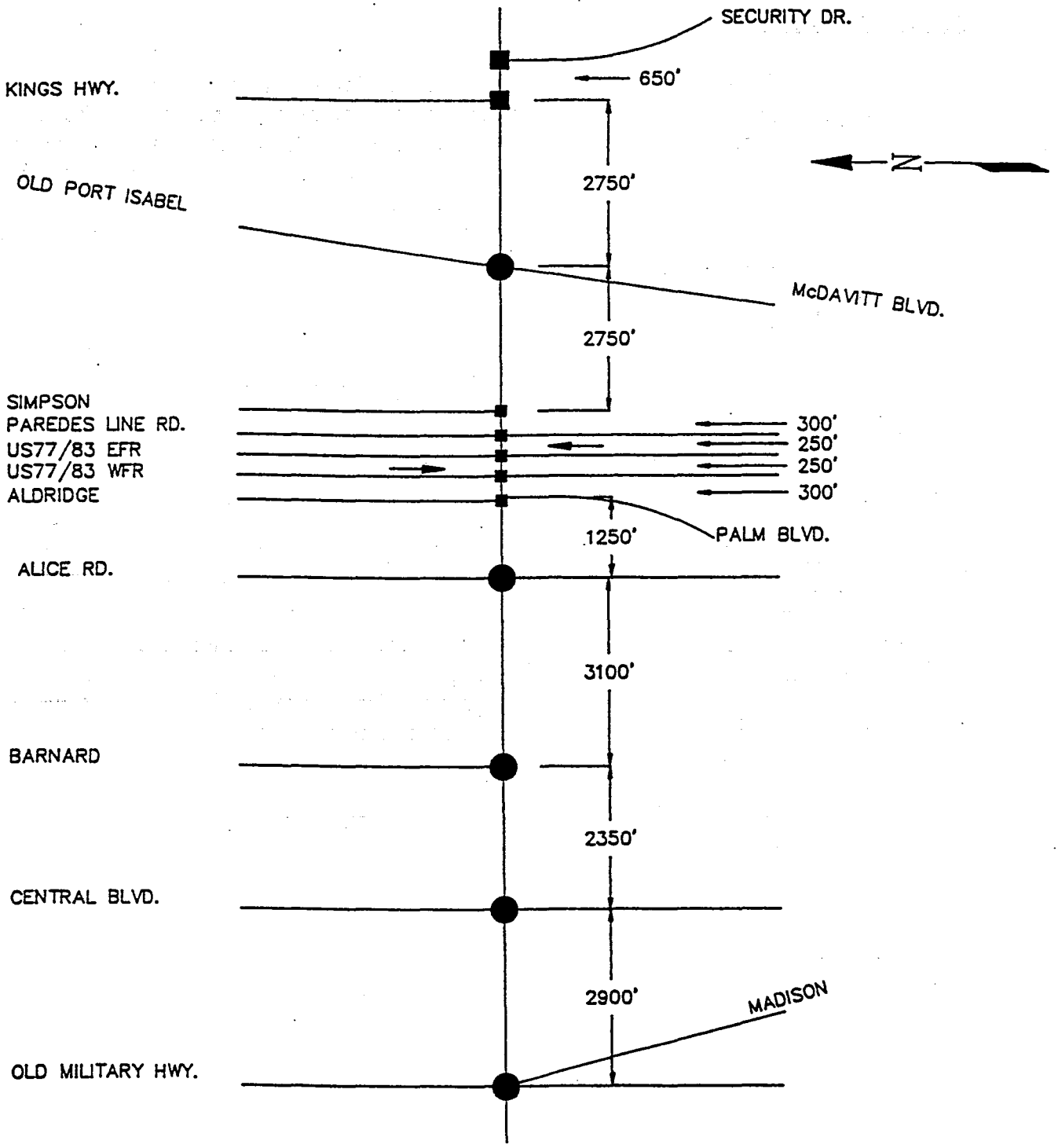
The signals in this system were controlled by five new NEMA type controllers, two three-dial electromechanical controllers, two NEMA TRAFCON controllers, and one NEMA NAZTEC controller. The other intersections in the system had either a TRAFCON or NAZTEC controllers. The master for five interconnected intersections was located at Paredes Line. The controllers at Kings Highway and Security Drive had masters with time-based coordinators, and were also interconnected. Intersections without hardwire interconnect were synchronized into the system by means of the Time Base Coordination of the new controllers installed. The two electromagnetic controllers were pretimed. All other signals are actuated. All intersections had between three and eight signal phases. Five of the twelve signals were equipped with pedestrian controls.

In order to evaluate the system performance, the "before" TLS traffic conditions were monitored and various field data were collected. The data included traffic volumes, travel times, signal timings and phasing, arterial data, intersection geometrics, travel delays, and an operating cost study. The signal system of Boca Chica Blvd. was divided into three subsystems and one isolated intersection based on similar characteristics and/or close proximity of the intersections to optimize the signal timing. The isolated intersection was Old Port Isabel/McDavitt Blvd, which was operating at fully actuated. The intersections at Palm Blvd. and the US 77/83 frontage roads had heavy turning movements onto and from Boca Chica Blvd., which needed manual adjustments to the time-space diagrams. Shorter cycle lengths for off-peak periods from Old Alice to Simpson helped in reducing the building up of queues in segments with limited storage.

Based on Passer II-87 simulation, the project resulted in an estimated 1.4 million dollar savings per year on total operating cost, a direct benefit to motorists using these routes. This operating cost savings included a total savings of 7,156,200 stops (a 10 percent reduction), a total annual fuel savings of 112,860 gallons (a 9.3 percent reduction), and a delay annual savings of 121,440 veh-hrs (a 17.7 percent reduction). Travel times were reduced in the range of 25 to 45 percent. Improvements and benefits were derived from the project in spite of roadway capacity limitations and some electromagnetic controllers that had to be reused. It was assumed that the timings implemented will yield benefits for three to five years. The changes in traffic flow patterns and increases in traffic volumes require another signal retiming after three to five years. The total cost of the project was $42,000, and the resultant benefit to cost ratio was 35 to 1.

		STOPS		TOTAL SYSTEM DELAY (veh-hrs)		FUEL (gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	AM	28008	25125	288.8	244.2	449.5	441.7
	OFF	20423	18847	175.2	150.1	354.3	305
	PM	29931	25615	328.9	246.4	507	474.6
DIFFERENCES	AM		2883		44.6		7.8
	OFF		1576		25.1		49.3
	PM		4316		82.5		32.4
HRS/DAY	AM		2		2		2
	OFF		6		6		6
	PM		2		2		2
DAILY	AM		5766		89.2		15.6
	OFF		9456		150.6		295.8
	PM		8632		165		64.8
	TOTAL		23854		404.8		376.2
UNIT VALUES			$0.014		$10.00		$1.00
ANNUAL SAVINGS			$100,187		$1,214,400		$112,860

PROJECT COST:	$41,176	TOTAL ANNUAL SAVINGS:	$1,427,447
BENIFIT/COST RATIO:	34.67		



LEGEND

Signal with hardwire interconnect

Signal with time base coordinator

one—way street

Central Boulevard

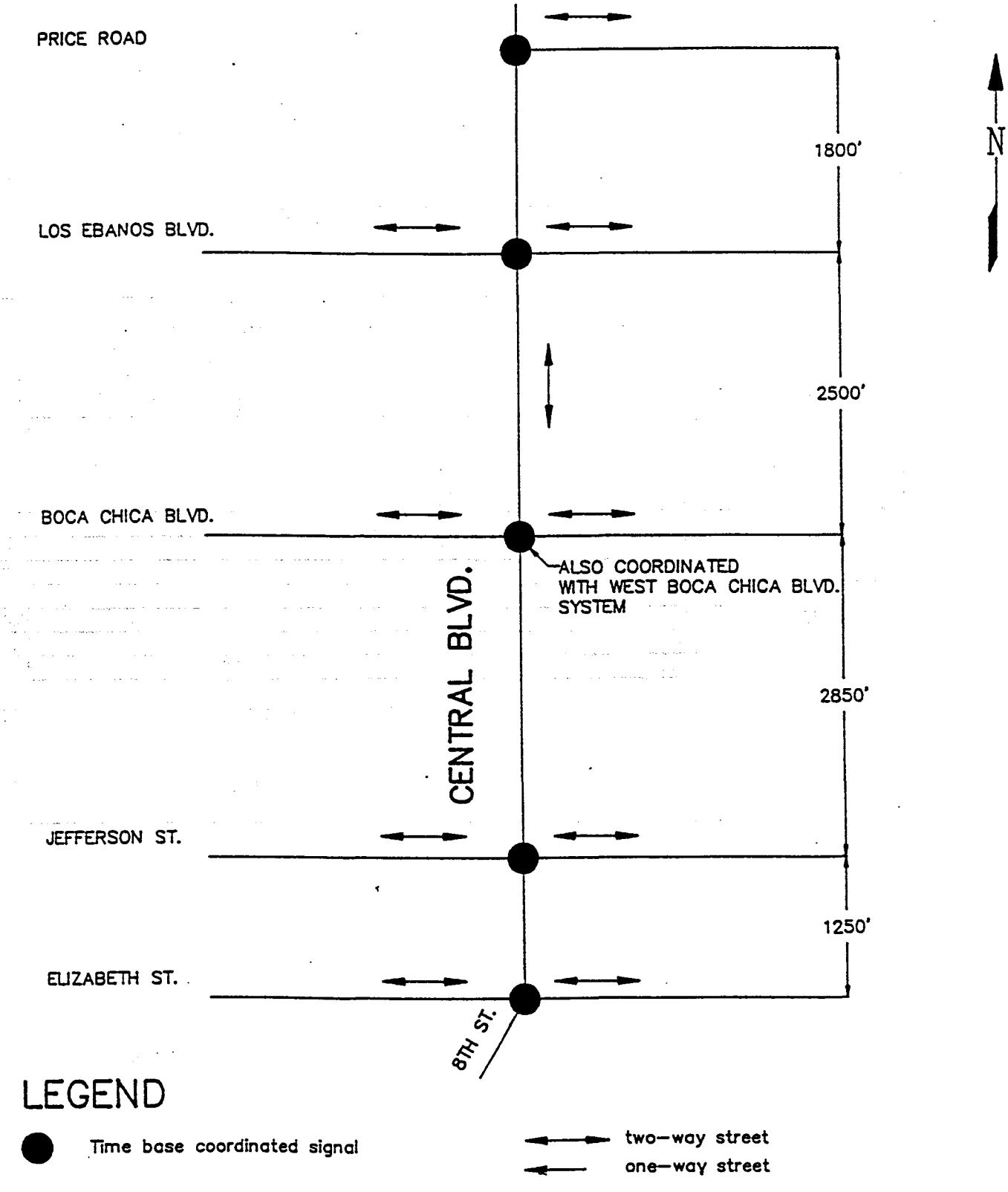
The City of Brownsville Department of Public Works and Transportation worked on the following project. A total of five signalized intersections were included in the Central Blvd. segment at spacing that varied between 1250 feet and 2850 feet. Although the speed limit was 30 miles per hour, the prevailing speeds were found to be 40 to 45 miles per hour. This was due to the excellent roadway facility, with wide travel lanes, shoulders, and a continuous left turn lane. The attached figure displays the project network system, cross streets, and link distances.

The signals in this system were controlled by four new NEMA type controllers with time based coordinators. These new controllers were installed at Elizabeth Street, Jefferson Street, Boca Chica Blvd., and Los Ebanos. Price Road already had a controller with a Time Based Coordinator. All the signals were actuated. The intersections from Elizabeth street to Boca Chica Blvd. did not have vehicle detectors and were operating on recall to max, therefore operating like pretimed controllers. All intersections had between four and eight signal phases. The signals were not equipped with pedestrian controls.

In order to evaluate the system performance, the "before" TLS traffic conditions were monitored and various field data were collected. 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-87 for each of the morning, afternoon, and off-peak periods. Manual adjustments were made to the time-space diagrams to improve the progression for a large number of right turns from Elizabeth street in the northbound direction. To handle an off-peak hour "peak condition" caused by school generated traffic during school discharge in the middle of the afternoon, an additional timing plan was implemented in the field at the intersection of Central and Boca Chica Boulevard. After implementing the new timings, travel time measurements for the optimized conditions produced absolutely no stops in some runs and one stop in other runs.

Based on Passer II-87 simulation, the project resulted in an estimated $260,000 savings per year on total operating cost, a direct benefit to motorists using these routes. This operating cost savings included a total savings of 2,304,000 stops (an 11.6 percent reduction), a total annual fuel savings of 25,860 gallons (a 4.9 percent reduction), and a delay annual savings of 20,280 veh-hrs (an 11.2 percent reduction). Travel times were reduced in the range of 31 to 38 percent, with average travel times of 2.5 minutes at average speeds of 35 MPH. It was assumed that the timings implemented will yield benefits for three to five years. The changes in traffic flow patterns and increases in traffic volumes require another signal retiming after three to five years. The total cost of the project was $40,000, and the resultant benefit to cost ratio was 7 to 1.

		STOPS		TOTAL SYSTEM DELAY (veh-hrs)		FUEL (gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	AM	7745	7019	72.8	69.3	190.3	185.1
	OFF	5938	5184	51.8	43.7	158.6	148.7
	PM	7647	6795	73.6	67.6	207	198.8
DIFFERENCES	AM	726		3.5		5.2	
	OFF	754		8.1		9.9	
	PM	852		6		8.2	
HRS/DAY	AM	2		2		2	
	OFF	6		6		6	
	PM	2		2		2	
DAILY	AM	1452		7		10.4	
	OFF	4524		48.6		59.4	
	PM	1704		12		16.4	
	TOTAL	7680		67.6		86.2	
UNIT VALUES		$0.014		$10.00		$1.00	
ANNUAL SAVINGS		$32,256		$202,800		$25,860	
PROJECT COST:		$40,016		TOTAL ANNUAL SAVINGS:		$260,916	
BENIFIT/COST RATIO:		6.52					


PRICE ROAD
1800'
LOS EBANOS BLVD.
2500'
BOCA CHICA BLVD.
ALSO COORDINATED WITH WEST BOCA CHICA BLVD. SYSTEM
CENTRAL BLVD.
2850'
JEFFERSON ST.
1250'
ELIZABETH ST.
8TH ST.
N
LEGEND
Time base coordinated signal
two-way street
one-way street

International Boulevard

The City of Brownsville Department of Public Works and Transportation worked on the following project. A total of ten signalized intersections were included in the International Blvd. segment at spacing that varied between 315 feet and 1210 feet. International Blvd. is the major route to Matamoros, Mexico. Heavy truck flows were observed through this corridor. Traffic volumes were in the range of 30,000 vehicles per day. The attached figure displays the project network system, cross streets, and link distances.

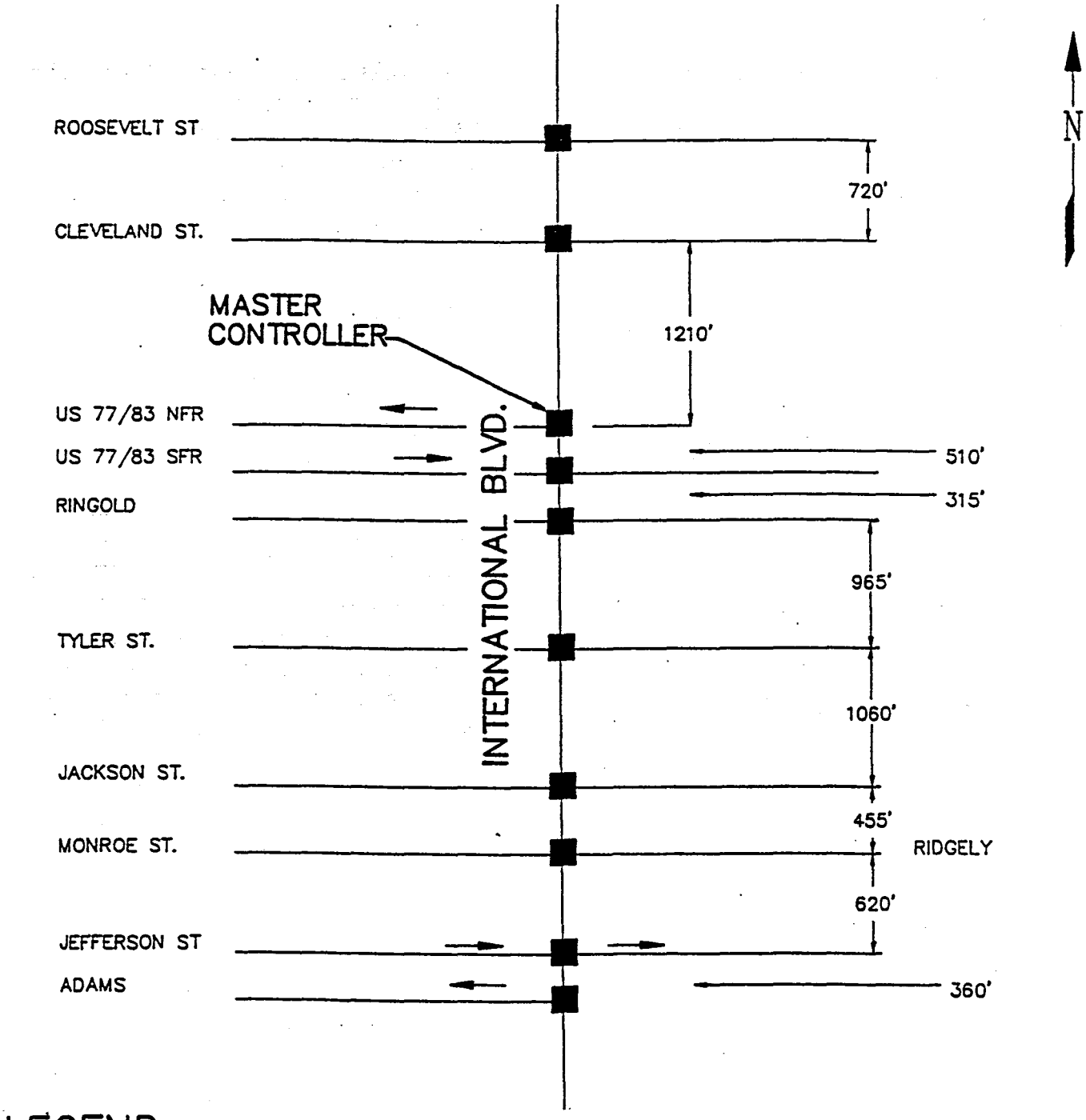
The signals in this system were controlled by three new NEMA type controllers. Two of them, with interconnect and time based coordinators, were installed at Adams and US 77/83 SFR. Another new NEMA controller was a System Master installed at US 77/83 NFR. The controllers at other intersections were solid state pretimed controllers. All the signals were pretimed. All intersections had between two and four signal phases. The signals were not equipped with pedestrian controls.

In order to evaluate the system performance, the "before" TLS traffic conditions were monitored and various field data were collected. 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-87 for each of the morning, afternoon, and off-peak periods. The high accessibility of the corridor provides a need to maintain high levels of movements through the corridor. The cycle lengths used for AM, Noon, and PM peak periods were 85, 90, and 90 seconds respectively. These cycle lengths were found to be most appropriate with regard to the prevailing traffic demand along the system. Manual adjustments were made to splits and offsets to improve the progression of the system. As the southbound traffic was found to be relatively low during the peak periods, the northbound traffic was given priority for progression during the peak periods.

Based on Passer II-87 simulation, the project resulted in an estimated $440,000 savings per year on total operating cost, a direct benefit to motorists using these routes. This operating cost savings included a total savings of 2,749,800 stops (a 5.5 percent reduction), a total annual fuel savings of 8,280 gallons (a 1.4 percent reduction), and a delay annual savings of 40,020 veh-hrs (an 11.4 percent reduction). Travel times were reduced in the range of 18 and 15 percent for the AM and PM peak periods respectively. A 9 percent reduction in travel times was observed for the northbound direction during the noon peak period. It was assumed that the timings implemented will yield benefits for five years. The changes in traffic flow patterns and increases in traffic volumes require another signal retiming after five years. The total cost of the project was $32,000, and the resultant benefit to cost ratio was 14 to 1.

		STOPS		TOTAL SYSTEM DELAY (veh-hrs)		FUEL (gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	AM	15880	15095	101.9	96	197.5	195.2
	OFF	16100	15590	110.7	99.9	199.4	197.6
	PM	19705	17437	151.5	123.1	226.2	220.1
DIFFERENCES	AM	785		5.9		2.3	
	OFF	510		10.8		1.8	
	PM	2268		28.4		6.1	
HRS/DAY	AM	2		2		2	
	OFF	6		6		6	
	PM	2		2		2	
DAILY	AM	1570		11.8		4.6	
	OFF	3060		64.8		10.8	
	PM	4536		56.8		12.2	
	TOTAL	9166		133.4		27.6	
UNIT VALUES		$0.014		$10.00		$1.00	
ANNUAL SAVINGS		$38,497		$400,200		$8,280	

PROJECT COST:	$32,171	TOTAL ANNUAL SAVINGS:	$446,977
BENIFIT/COST RATIO:	13.89		



LEGEND

■ Hard wire interconnected signal

← one-way street

Palm Boulevard

The City of Brownsville Department of Public Works and Transportation worked on the following project. A total of eight signalized intersections were included in the Palm Blvd. segment at spacing that varied between 325 feet and 2100 feet. Vehicles were found to be operating at limited speeds of 25 mph during the peak periods due to the close proximity of traffic signals, high traffic demands, and existing land use. The attached figure displays the project network system, cross streets, and link distances.

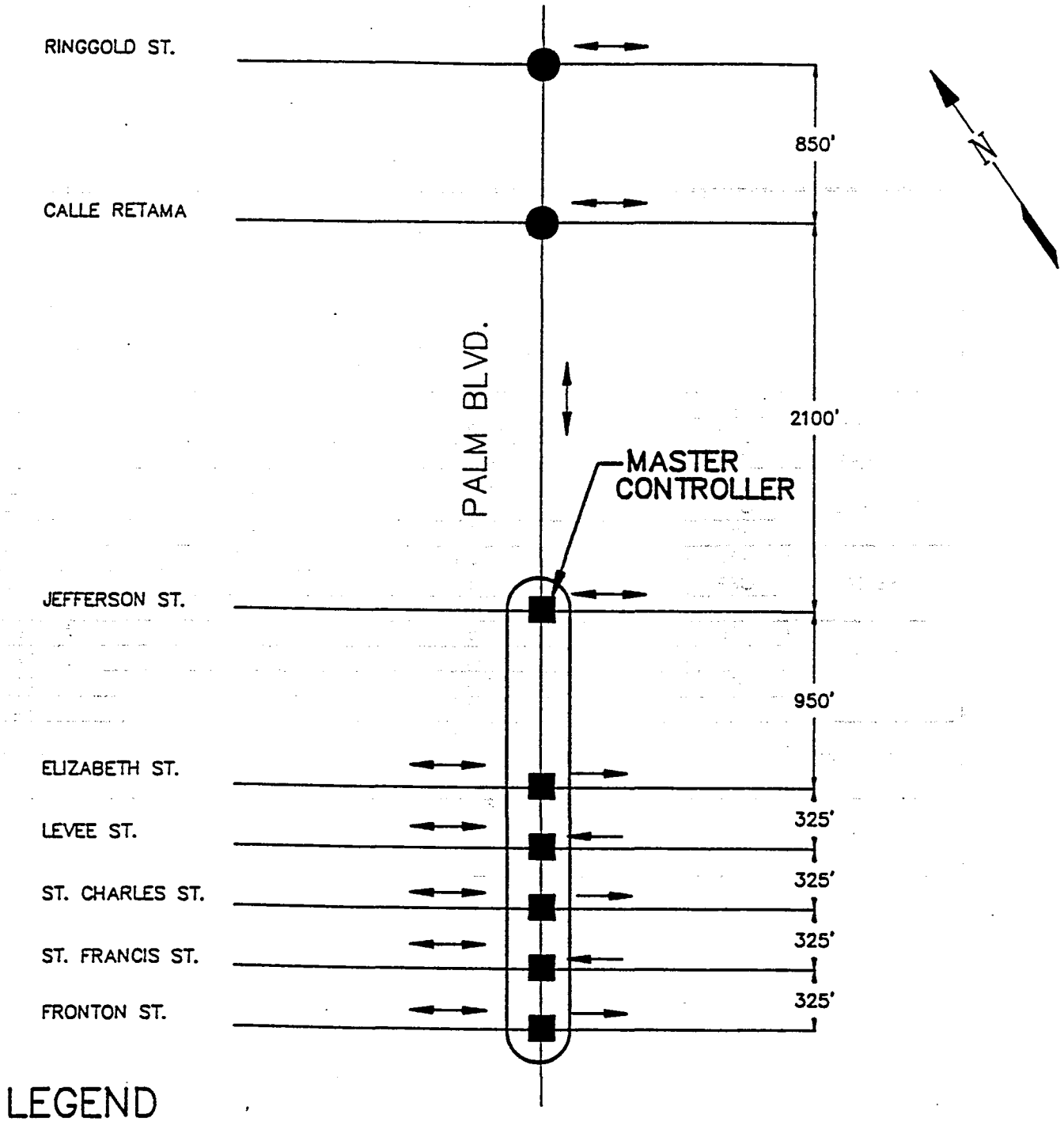
The signals in this system were controlled by two new NEMA type controllers with time based coordinators. Another new NEMA type controller was installed at Jefferson which served as the System Master. The project utilized four existing electromechanical controllers and one existing solid state controller. All the existing controllers were pretimed. The signals at the three new NEMA type controllers were actuated. All intersections had between two and six signal phases. The signal at Ringgold was equipped with pedestrian control. Other signals did not have pedestrian controls.

In order to evaluate the system performance, the "before" TLS traffic conditions were monitored and various field data were collected. 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-87 for each of the morning, afternoon, and off-peak periods. Detectors were installed in the left turning lanes at Calle Retama, Ringgold, and Jefferson Street intersections in order to maximize the efficiency of the signals. A design speed of 25 mph was utilized for all peak periods of the day. The cycle lengths used for the AM, Noon, and PM peak periods were 70, 80, and 80 seconds long, respectively. These cycle lengths were found to be most appropriate with regard to the prevailing traffic demand along the system. Manual adjustments were made to splits and offsets to improve the progression of the system.

Based on Passer II-87 simulation, the project resulted in an estimated $148,000 savings per year on total operating cost, a direct benefit to motorists using these routes. This operating cost savings included a total savings of 2,811,600 stops (a 14 percent reduction), a total annual fuel savings of 13,920 gallons (a 4.7 percent reduction), and a delay annual savings of 9,420 veh-hrs (a 6.9 percent reduction). In spite of the limitations presented by closely spaced signals and high pedestrian and vehicular demand, improvements and benefits were derived from the project. Travel times were reduced between 16 and 39 percent depending on the peak period in question. These travel time savings resulted in system travel speeds ranging between 18 and 25 mph. It was assumed that the timings implemented will yield benefits for five years. The changes in traffic flow patterns and increase in traffic volumes require another signal retiming in five years. The total cost of the project was $59,000, and the resultant benefit to cost ratio was 3 to 1.

		STOPS		TOTAL SYSTEM DELAY (veh-hrs)		FUEL (gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	AM	6050	5462	47.5	40.9	95.4	91
	OFF	6304	5372	40.5	39.2	94.8	91.5
	PM	8600	7298	59.9	54.7	119.2	110.3
DIFFERENCES	AM	588		6.6		4.4	
	OFF	932		1.3		3.3	
	PM	1302		5.2		8.9	
HRS/DAY	AM	2		2		2	
	OFF	6		6		6	
	PM	2		2		2	
DAILY	AM	1176		13.2		8.8	
	OFF	5592		7.8		19.8	
	PM	2604		10.4		17.8	
	TOTAL	9372		31.4		46.4	
UNIT VALUES		$0.014		$10.00		$1.00	
ANNUAL SAVINGS		$39,362		$94,200		$13,920	

PROJECT COST:	$59,306	TOTAL ANNUAL SAVINGS:	$147,482
BENIFIT/COST RATIO:	2.49		



LEGEND

- Hard wire interconnected signal
- Time base coordinated signal
- two-way street
- one-way street

Bell

The City of Denton Department of Public Works and Transportation worked on the following project. A total of seven signalized intersections and two mid-block pedestrian signals were included in this traffic signal network at spacing that varied between 460 feet and 1,660 feet. Prior to this study, the signals were not coordinated and congestion was most pronounced during the morning, evening, and noon peak periods. Apart from the morning and evening peak periods, the project area exhibits a traffic characteristic indicative of a noon peak period. The attached figure shows the project network system, cross streets, and link distances.

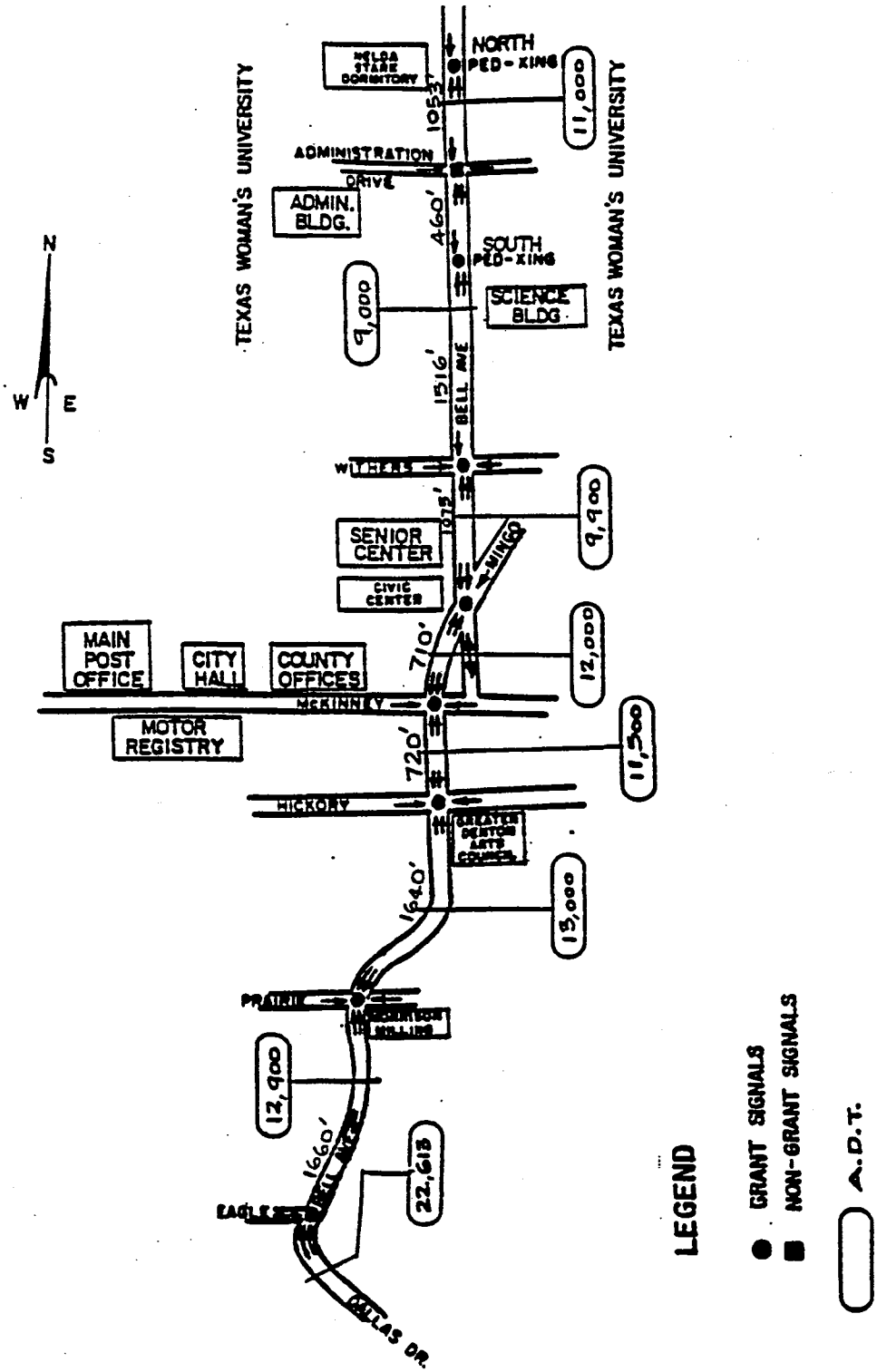
The signals in this system were controlled by eight new signal controllers. Each controller was installed with internal time base coordination (TBC) capabilities. The intersections were controlled by a mixture of pretimed, semi-actuated, and fully actuated controllers. The intersections at South Pedestrian crossing and North pedestrian crossing were equipped with pedestrian controls. Other intersections did not have pedestrian controls. The intersections had between two and three signal phases. The signal phasing at McKinney and at Mingo was revised.

In order to evaluate the system performance, the "before" TLS traffic conditions were monitored and various field data were collected. The data included traffic volumes, travel times, signal timings and phasing, arterial data, intersection geometrics, travel delays, and an operating cost study. The average daily traffic on this network was between 9,000 and 22,613 vehicles. Optimum cycle lengths were determined using PASSER II-87 for the "after" conditions for each of the morning, afternoon, evening, and off-peak periods. The new cycle lengths used for the AM, Noon, PM, and Off peak periods were 80, 80, 90 and 70 seconds long, respectively.

Based on PASSER II-87 simulation, the project resulted in an estimated $2,340,000 savings per year on total operating cost, a direct benefit to motorists using these routes. This operating cost savings included a total savings of 17,574,600 stops (a 37.2 percent reduction), a total annual fuel savings of 243,480 gallons (a 26.9 percent reduction), and a delay annual savings of 185,040 veh-hrs (a 50.2 percent reduction). Travel times were significantly reduced for northbound and southbound traffic on the arterial system. Progression was increased for both the northbound and southbound traffic. Minimal difficulties were experienced with the operation of the PASSER II-87. The city's liability risk exposure was minimized for the southbound through traffic at Mingo by the installation of signals at this intersection. The total cost of the project was $57,143 and the resultant benefit to cost ratio was 41 to 1.

		STOPS		TOTAL SYSTEM DELAY (veh-hrs)		FUEL (gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	AM	13494	9207	108.2	63	256	196.5
	OFF	8548	5586	46.3	30	158.9	130.9
	NOON	10777	7608	70.7	49.7	200.6	166.8
	PM	20381	10394	249.9	72.9	416.2	215.7
DIFFERENCES	AM		4287		45.2		59.5
	OFF		2962		16.3		28
	NOON		3169		21		33.8
	PM		9987		177		200.5
HRS/DAY	AM		2		2		2
	OFF		8		8		8
	NOON		2		2		2
	PM		2		2		2
DAILY TOTALS	AM		8574		90.4		119
	OFF		23696		130.4		224
	NOON		6338		42		67.6
	PM		19974		354		401
	TOTAL		58582		616.8		811.6
UNIT VALUES			$0.014		$10.00		$1.00
ANNUAL SAVINGS			$246,044		$1,850,400		$243,480

PROJECT COST:	$57,143	TOTAL ANNUAL SAVINGS:	$2,339,924
BENIFIT/COST RATIO:	40.95		


NELDA STARK DORMITORY
NORTH PED-XING
11,000
1053'
ADMINISTRATION DRIVE
ADMIN. BLDG.
460'
SOUTH PED-XING
9,000
SCIENCE BLDG.
TEXAS WOMAN'S UNIVERSITY
TEXAS WOMAN'S UNIVERSITY
1316'
BELL AVE
N
W
E
S
1075'
9,900
SENIOR CENTER
CIVIC CENTER
710'
12,000
MAIN POST OFFICE
CITY HALL
COUNTY OFFICES
MCKINNEY
MOTOR REGISTRY
720'
11,500
HICKORY
1640'
13,000
PRAIRIE
12,900
1660'
22,615
LEGEND
GRANT SIGNALS
NON-GRANT SIGNALS
A.D.T.

Galveston System

Galveston's Engineering Department in conjunction with Traffic Engineers, Inc. worked on the following project. The system consisted of three sub-systems with 30 intersections. While, the Post Industrial sub-system is a relatively high speed system exhibiting a large directional split, the East Market Street sub-system is influenced by the activities of the University of Texas. Travel patterns in the Downtown Grid sub-system are typical of the low speed CBD areas. The attached map displays the project network system, sub-systems, cross streets, and link distances.

Prior to the implementation of the improvements, controllers at only four of the intersections were capable of time based coordination. The remaining controllers were a mixture of electromechanical and solid state controllers. Three of the intersections had loop detectors and the remaining were operating in a pretimed mode. As part of improvements, existing controllers not capable of time-based coordination were replaced with controllers having this feature. Most of the controllers were operating using two to three phases. Except for five, the rest of the intersections were equipped with pedestrian controls.

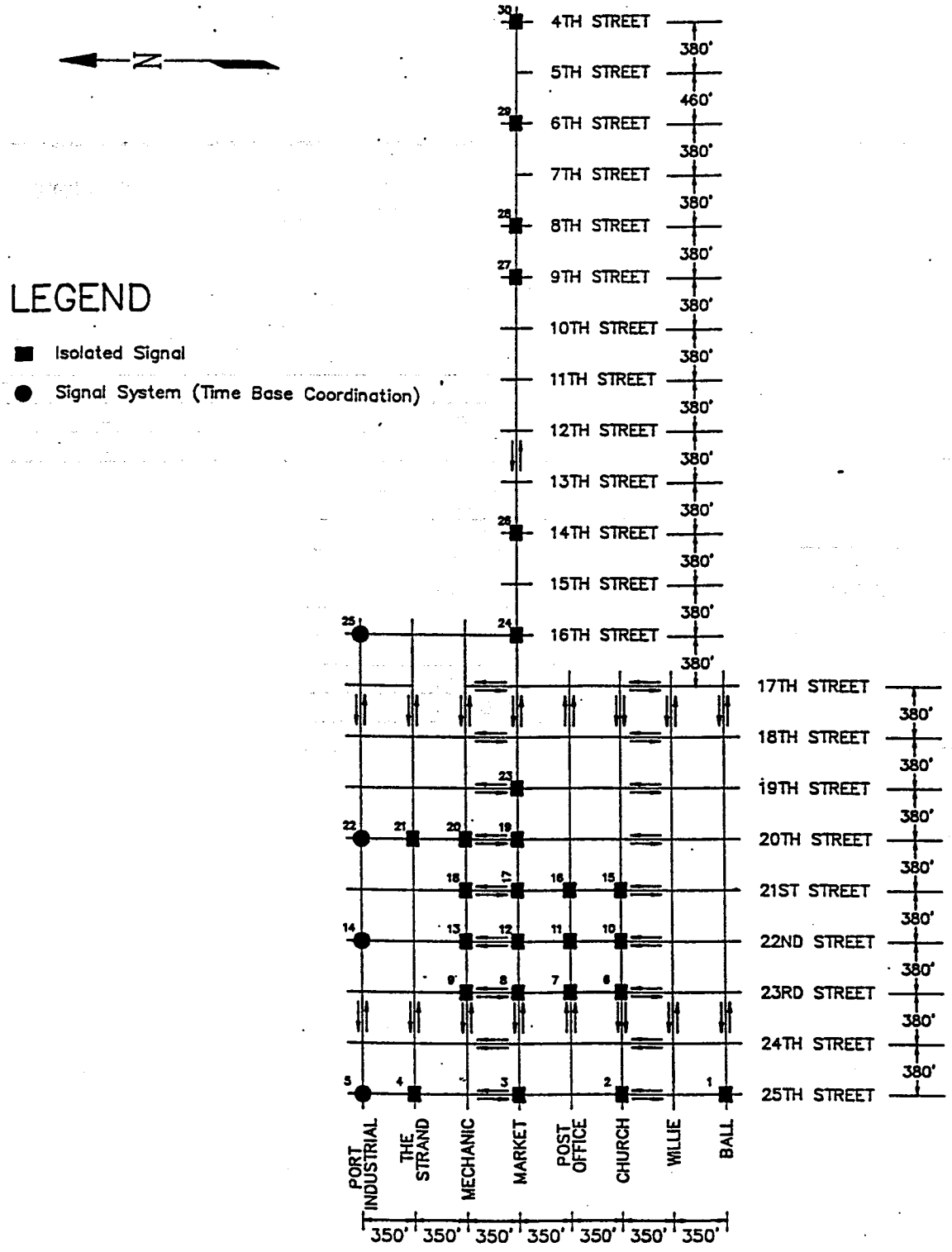
In order to evaluate the system performance, traffic conditions were monitored and various data were collected before implementation of any changes. This data was in the form of traffic volumes, travel times, and delays collected on a the study periods. The test car method was used to collect link travel times, stopped delay, and running speeds.

While PASSER II was used to model the Port Industrial sub-system, TRANSYT-7F was employed to model the other two sub-systems. The objective was to obtain appropriate offsets to provide progression to the traffic in these sub-systems. While a progression band of about 40 seconds could be obtained for the peak periods in the peak directions in the Port Industrial sub-system, a band of about 20 seconds was obtained for the off-peak periods. For the East Market Street sub-system, a progression band of about 15 to 25 seconds was obtained for the peak periods. In the Downtown Grid sub-system, a variety of the vehicle mix was obtained. This results in very low vehicle speeds. Three streets were identified as major routes, and progression was provided along those routes.

Implementing the new signal timings resulted in a total annual savings of about $584,924 to the motorists traversing the system. The number of stops decreased by about 2 million (a decrease of 3.8 percent), the delay decreased by about 50,910 veh-hrs (a decrease of 15 percent), and the fuel consumption decreased by about 46,740 gallons (a decrease of about 5.5 percent) in a year. There was a significant decrease in the travel times in the three sub-systems. While the decrease in travel times ranged 20 to 30 percent for the two arterial sub-systems the decrease in travel for the CBD was between 10 to 50 percent. The system had a cost of $181,688 with a benefit to cost ratio of about 3 to 1.

		STOPS		TOTAL SYSTEM DELAY (veh-hrs)		FUEL (gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	AM	17399	17664	149	96.8	288	252.5
	OFF	16183	15550	86	89.1	248	249.3
	PM	19541	18086	108	102.4	307	293.7
DIFFERENCES	AM	-265		52.2		35.5	
	OFF	633		-3.1		-1.3	
	PM	1455		5.6		13.3	
HRS/DAY	AM	3		3		3	
	OFF	3		3		3	
	PM	4		4		4	
DAILY	AM	-795		156.6		106.5	
	OFF	1899		-9.3		-3.9	
	PM	5820		22.4		53.2	
	TOTAL	6924		169.7		155.8	
UNIT VALUES		$0.014		$10.00		$1.00	
ANNUAL SAVINGS		$29,081		$509,100		$46,740	

PROJECT COST:	$181,688	TOTAL ANNUAL SAVINGS:	$584,921
BENIFIT/COST RATIO:	3.22		


N
LEGEND
Isolated Signal
Signal System (Time Base Coordination)
4TH STREET
5TH STREET
6TH STREET
7TH STREET
8TH STREET
9TH STREET
10TH STREET
11TH STREET
12TH STREET
13TH STREET
14TH STREET
15TH STREET
16TH STREET
17TH STREET
18TH STREET
19TH STREET
20TH STREET
21ST STREET
22ND STREET
23RD STREET
24TH STREET
25TH STREET
380'
460'
PORT INDUSTRIAL
THE STRAND
MECHANIC
MARKET
POST OFFICE
CHURCH
WILLIE
BALL
350'

Central Area System

The Garland Transportation Department, along with Barton-Aschman, Inc., worked on the following project. The study network consisted of ten arterials and constituted 45 intersections. Two of these intersections are currently unsignalized with plans to be signalized in the near future. Ten of the intersections are isolated from the other intersections in the before study. A total of six systems operate within the Garland Central Area. The attached map displays the project network system and the link distances.

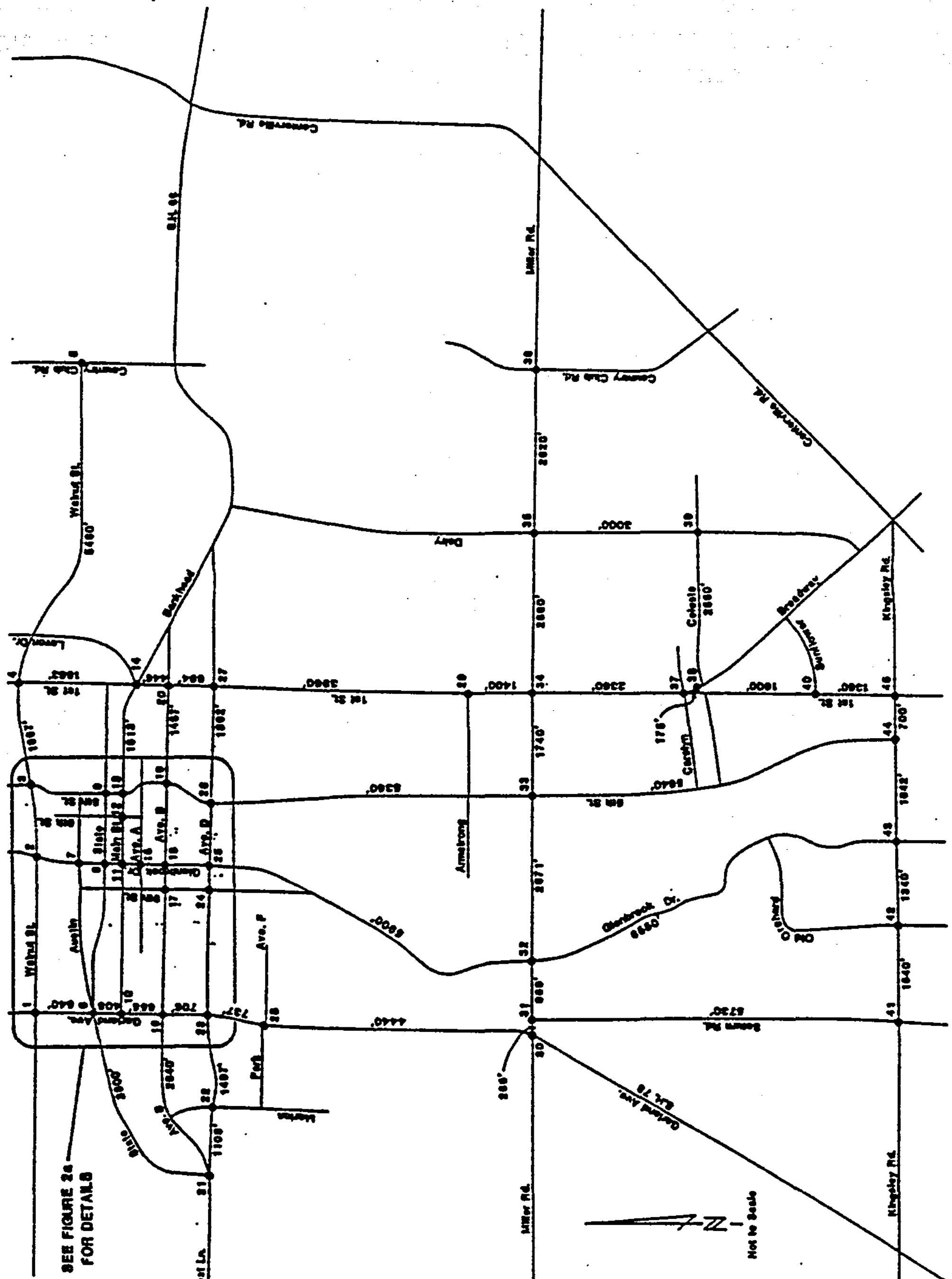
Twelve of the 45 intersections are completely actuated. The remaining intersections are pretimed. While two of the intersections have eight phases, the remaining have between two and four phases. All except ten intersections have pedestrian controls. Thirty one new ASC-8000 traffic signal controllers were purchased under this program and replaced the existing controllers.

In order to evaluate the system performance, traffic conditions were monitored and various data were collected before implementation of any changes. This data was in the form of traffic volumes, saturation flow rates, travel times, and delays. Test car method was used to collect link travel times, average number of stops, and the stop locations.

TRANSYT-7F and PASSER II simulation models were employed to optimize the signal timings. The fine tuned timings were then simulated by TRANSYT-7F for the "After" condition analysis. Implementing the new signal timings resulted in a total annual savings of about 1.6 million dollars to the motorists using this network. While the number of stops decreased by about 10.7 million (a decrease of about 9.6 percent), there were about 112,954 fewer hours of delay (a reduction of 11.8 percent), and fuel savings of about 346,292 gallons (a reduction of about 10.4 percent) in a year. It was observed that progression improved the traffic flow on all arterials. There was a significant improvement in the travel times in the system. The total cost of the project was $330,000 and the benefit to cost ratio was 5 to 1.

		STOPS		TOTAL SYSTEM DELAY (veh-hrs)		FUEL (gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	AM	45851	41715	501.19	391.26	1410.07	1247.75
	OFF	25801	23673	188.47	176.23	759.21	684.41
	PM	54539	46757	584.97	484.769	1603.62	1416.03
DIFFERENCES	AM		4136		109.93		162.32
	OFF		2128		12.24		74.8
	PM		7782		100.201		187.59
HRS/DAY	AM		1		1		1
	OFF		9.5		9.5		9.5
	PM		1.5		1.5		1.5
DAILY	AM		4136		109.93		162.32
	OFF		20216		116.28		710.6
	PM		11673		150.30		281.38
	TOTAL		36025		376.51		1154.31
UNIT VALUES			$0.014		$10.00		$1.00
ANNUAL SAVINGS			$151,305		$1,129,535		$346,292

PROJECT COST:	$330,580	TOTAL ANNUAL SAVINGS:	$1,627,131
BENIFIT/COST RATIO:	4.92		


Centerville Rd.
Country Club Rd.
Miller Rd.
Kingsley Rd.
1st St.
Walnut St.
Garland Ave.
SEE FIGURE 2a FOR DETAILS
Not to Scale

North Area System

The Garland Transportation Department along with Kimley-Horn worked on the following project. A total of three groups of intersections were operating within the North Garland Area. The attached map displays the project network system.

Four intersections on Buckingham Road had 3-dial electromechanical pretimed controllers. Two groups of three intersections had systems that used time-based coordination. Except one, all of them had solid-state pretimed controllers. Fifteen intersections which had earlier been a part of a close loop system, were operating in isolated mode. They were being operated by a mixture of controllers. Seven intersections signalized either shortly before or during the TLS project were a part of a new close loop systems. All other intersections in the project had either solid state pretimed controllers or non-NEMA actuated controllers, and operated in isolated mode.

In order to evaluate the system performance, traffic conditions were monitored and various data were collected before implementation of any changes. This data was in the form of traffic volumes, saturation flow rates, travel times, and delays. Test car method was used to collect link travel times, average number of stops, and the stop locations. Providing two-way progression to the three main arterials in the system was considered to be feasible.

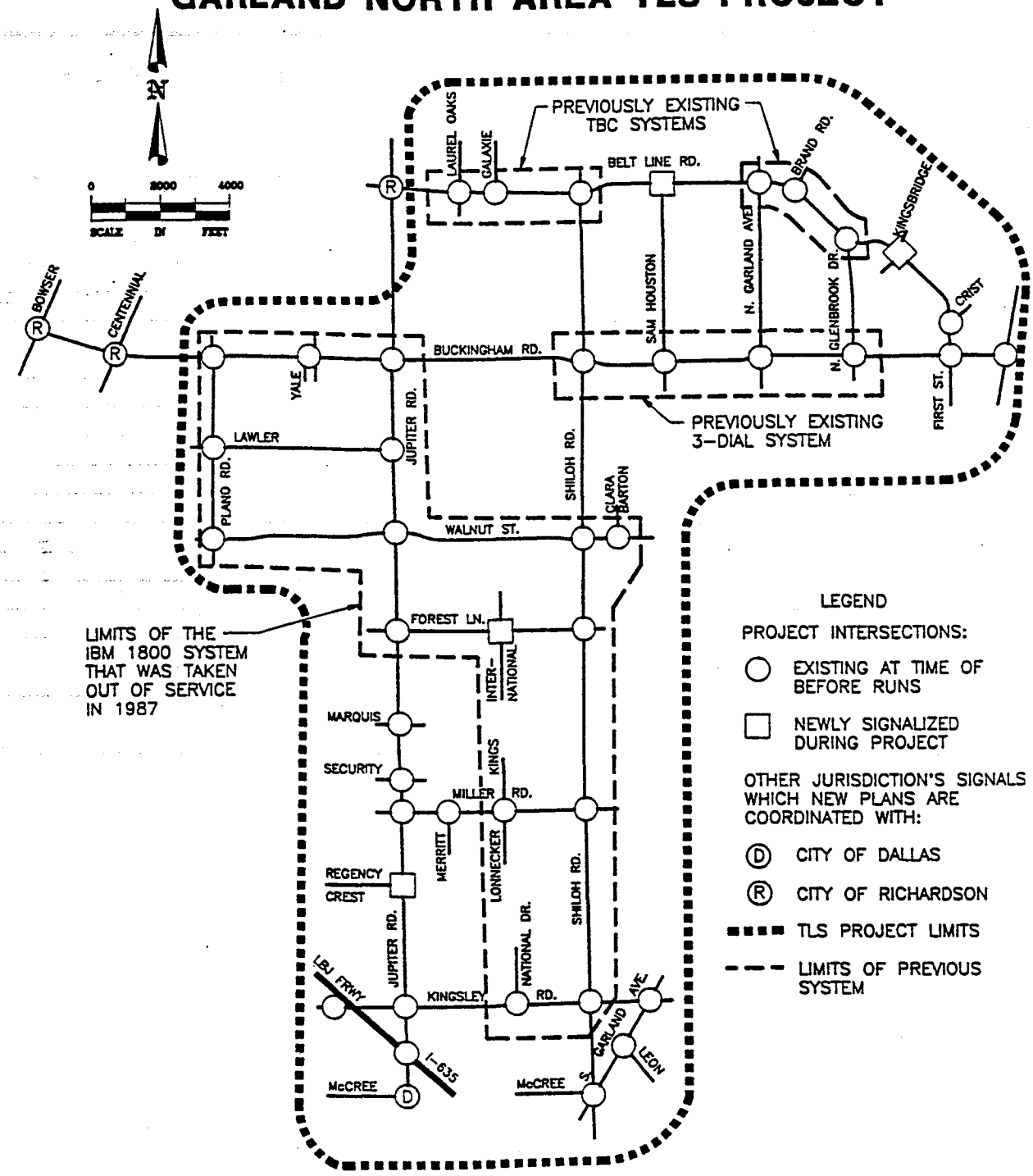
PASSER II model was employed to optimize the signal timings. A cycle length of about 120 and 128 seconds for the AM and PM peaks, respectively, and about 90 seconds for the Noon and the Off peaks were selected. Such cycle lengths allowed the coordination of the signals in that system with the signals in the city of Richardson. A number of priorities had to be considered to provide progression in the north-south direction as well as in the east-west direction.

Implementing the new signal timings resulted in a total annual savings of about 3.8 million dollars to the motorists using this network. While the number of stops decreased by about 6.35 million (a decrease of about 18.7 percent), there were about 235,000 fewer hours of delay (a reduction of 7.6 percent), and fuel savings of about 555,700 gallons (a reduction of about 7.7 percent) in a year. There was a significant improvement in the travel times in the system. The travel times reduced in a range of about 15 to 25 percent. The new close loop system provides the traffic information that can be very useful to update the signal timings in the future. The total cost of the project was $698,000 and the benefit to cost ratio was 5 to 1.

		STOPS		TOTAL SYSTEM DELAY (veh-hrs)		FUEL (gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	AM	144854	118219	1439	1249	3608	3291
	OFF	69994	53777	433	410	1655	1524
	NOON	87492	67221	542	513	2069	1905
	PM	157548	139153	2095	1979	2095	1979
DIFFERENCES	AM	26635		190		317	
	OFF	16217		23		131	
	NOON	20271		29		164	
	PM	18395		116		116	
HRS/DAY	AM	2		2		2	
	OFF	5		5		5	
	NOON	2		2		2	
	PM	2		2		2	
DAILY	AM	53270		380		634	
	OFF	81085		115		655	
	NOON	40542		58		328	
	PM	36790		232		232	
	TOTAL	211687		785		1849	
UNIT VALUES		$0.014		$10.00		$1.00	
ANNUAL SAVINGS		$889,085		$2,355,000		$554,700	

PROJECT COST:	$698,000	TOTAL ANNUAL SAVINGS:	$3,798,785
BENIFIT/COST RATIO:	5.44		

PROJECT LIMITS
GARLAND NORTH AREA TLS PROJECT



South Sub-network System

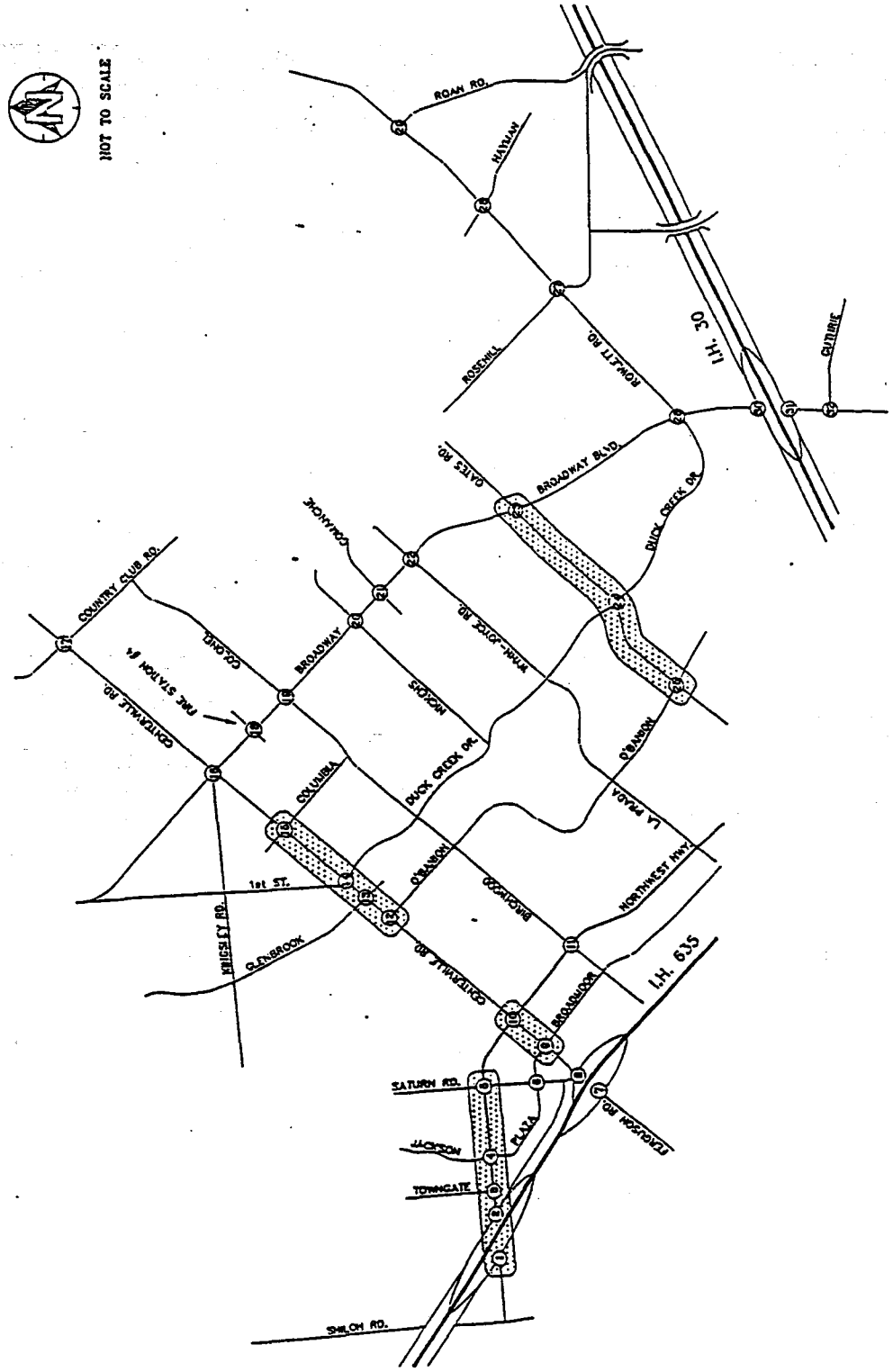
The Garland Transportation Department along with DeShazo, Starek & Tang, Inc. worked on the following project. The study network constituted 24 intersections and three highway interchanges on six arterial streets. A total of four systems operated within the project area. The attached map displays the project network system and the link distances.

The modifications to the system were done in three phases. The first step evaluated potential coordination between traffic signals. The platoon dispersion model in TRANSYT 7-F was used to determine the intersections that would benefit from interconnections and coordination. The second phase confirmed the coordination choices. A number of combinations of coordination signal systems were evaluated on a number of arterials by using PASSER II. The results from PASSER II were coordinated with the diamond interchanges by using PASSER III to back check the feasibility of using PASSER II at each diamond. Based on results of the two phases, five signal systems were identified. The final step consisted of developing the actual implemented signal timings. TRANSYT-7F, PASSER II, and PASSER III were used to develop the timings.

No field studies were conducted for this evaluation. The City of Garland is awaiting installation of the necessary signal equipment to implement the recommended traffic signal timings. The estimated benefits were computed by simulating the modifications in TRANSYT-7F, PASSER II, and PASSER III. Implementing the new signal timings would result in a total annual savings of about 8.15 million dollars to the motorists using this network. While the number of stops would decrease by about 2.8 million (a decrease of about 2.7 percent), there would be about 0.7 million fewer hours of delay (a reduction of 40 percent), and a fuel savings of about 0.98 million gallons (a reduction of about 19.6 percent) in a year. The total cost of the project would be $500,000 with a benefit to cost ratio of 16 to 1.

		STOPS		TOTAL SYSTEM DELAY (veh-hrs)		FUEL (gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	AM	40793	38931	716.4	382.9	1910	1460
	OFF	16177	15853	202.3	93.8	842	762
	PM	51702	50729	1075.3	761.5	2376	1744
DIFFERENCES	AM	1862		333.5		450	
	OFF	324		108.5		80	
	PM	973		313.8		632	
HRS/DAY	AM	2.5		2.5		2.5	
	OFF	7		7		7	
	PM	2.5		2.5		2.5	
DAILY	AM	4655		833.75		1125	
	OFF	2268		759.5		560	
	PM	2433		784.5		1580	
	TOTAL	9356		2377.75		3265	
UNIT VALUES		$0.014		$10.00		$1.00	
ANNUAL SAVINGS		$39,293		$7,133,250		$979,500	

PROJECT COST:	$500,000	TOTAL ANNUAL SAVINGS:	$8,152,043
BENIFIT/COST RATIO:	16.30		


NOT TO SCALE
ROAN RD.
HAYMAN
ROSEHILL
ROWLETT RD.
I.H. 30
GUNTER
DALTS RD.
BROADWAY BLVD.
DUCK CREEK DR.
COUNTRY CLUB RD.
BROADWAY
NICHOLS
MAIN-OFFICE RD.
CENTERVALE RD.
COLUMBIA
DUCK CREEK DR.
O'BANION
LA PRADA
1st ST.
O'BANION
NORTHWEST HWY.
BROADMOOR
CENTERVALE RD.
I.H. 635
SATURN RD.
PLANO
JACKSON
TOWNGATE
SHILOH RD.

Great Southwest Parkway (GSP)

The Grand Prairie Transportation Services along with TxDOT and TTI worked on the following project. This project analyzes Grand Southwest Parkway (GSP) which is the only arterial in the TLS study running in the north-south direction. The attached map displays the project network system, cross streets, and link distances.

The GSP serves the southern portion of the city's large light-industrial area, commercial area close to the intersection with SH-303, the city's Municipal Airport, and the residential areas along the southern extension. The diverse land use along the arterial results in a wide mix of traffic. This wide mix of traffic affects the fuel consumption calculations.

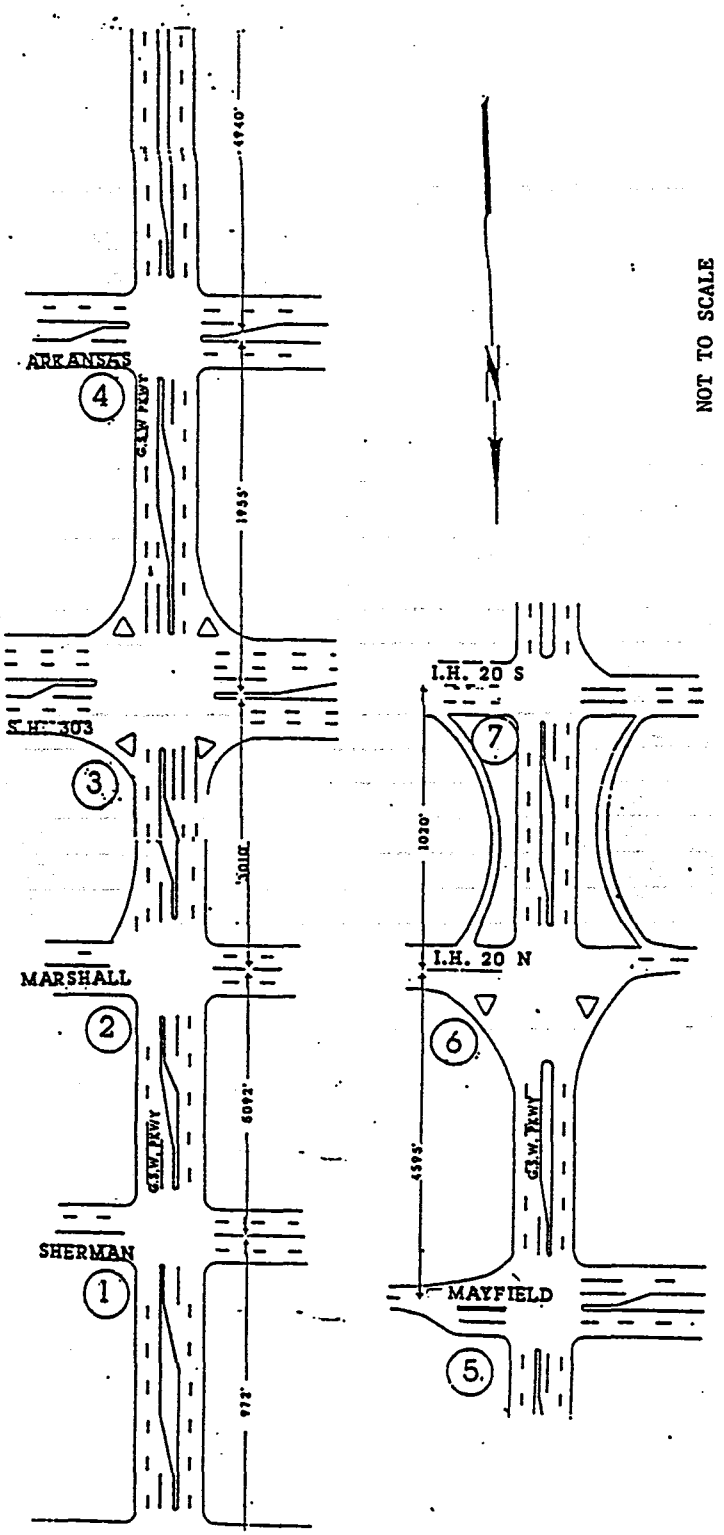
Due to the diverse land use no definite "noon-peak" could be ascertained from the 24-hour tube counts. Hence, it was decided to analyze an "off-peak" period and compare the fuel consumption of fixed time pattern with fully actuated conditions. A 1200 feet school crossing zone was influencing the speeds along the arterial for a few hours each day. Hence, the system timing patterns had to be modified. All the signals on Great Southwest Parkway are fully actuated and are controlled by eight phase NEMA signal controllers.

In order to evaluate the system performance, traffic conditions were monitored and various data were collected before implementation of any changes. This data was in the form of traffic volumes, travel times, and delays. Twenty four counts were made at the intersections. Hourly volumes were later collected for the study periods. Test car method was used to collect link travel times, stopped delay, and running speeds.

PASSER II simulation model was employed to optimize the phase splits and estimate delays. Implementing the new signal timings resulted in a total annual savings of about 1.1 million dollars to the motorists using this route. The number of stops decreased by about 2.23 million (a decrease of 8.4 percent), the delay decreased by about 99,000 veh-hrs (a decrease of 15.4 percent), and the fuel consumption decreased by about 85,800 gallons (a decrease of about 6 percent) in a year. The average travel times decreased by about 26 percent. The total cost of the project was about $119,000 with a benefit to cost ratio of about 9 to 1.

		STOPS		TOTAL SYSTEM DELAY (veh-hrs)		FUEL (gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	AM	15237	12275	247	118	667	453
	OFF	4656	4143	135	31	252	239
	PM	15077	15975	285	665	693	816
DIFFERENCES	AM		2962		129		214
	OFF		513		104		13
	PM		-898		-380		-123
HRS/DAY	AM		2		2		2
	OFF		8		8		8
	PM		2		2		2
DAILY	AM		5924		258		428
	OFF		4104		832		104
	PM		-1796		-760		-246
	TOTAL		8232		330		286
UNIT VALUES			$0.014		$10.00		$1.00
ANNUAL SAVINGS			$34,574		$990,000		$85,800

PROJECT COST:	$119,583	TOTAL ANNUAL SAVINGS:	$1,110,374
BENIFIT/COST RATIO:	9.29		


ARKANSAS
4
G.S.W. PKWY.
1935'
S.H. 303
3
1010'
MARSHALL
2
G.S.W. PKWY.
6092'
SHERMAN
1
973'
I.H. 20 S
7
1010'
I.H. 20 N
6
G.S.W. PKWY.
4595'
MAYFIELD
5
NOT TO SCALE

Main/Jefferson Street System

The Grand Prairie Transportation Services along with TxDOT and TTI worked on the following project. This project analyzes Main Street and Jefferson Street which run parallel to one another in the east-west direction. The attached map displays the project network system, cross streets, and link distances.

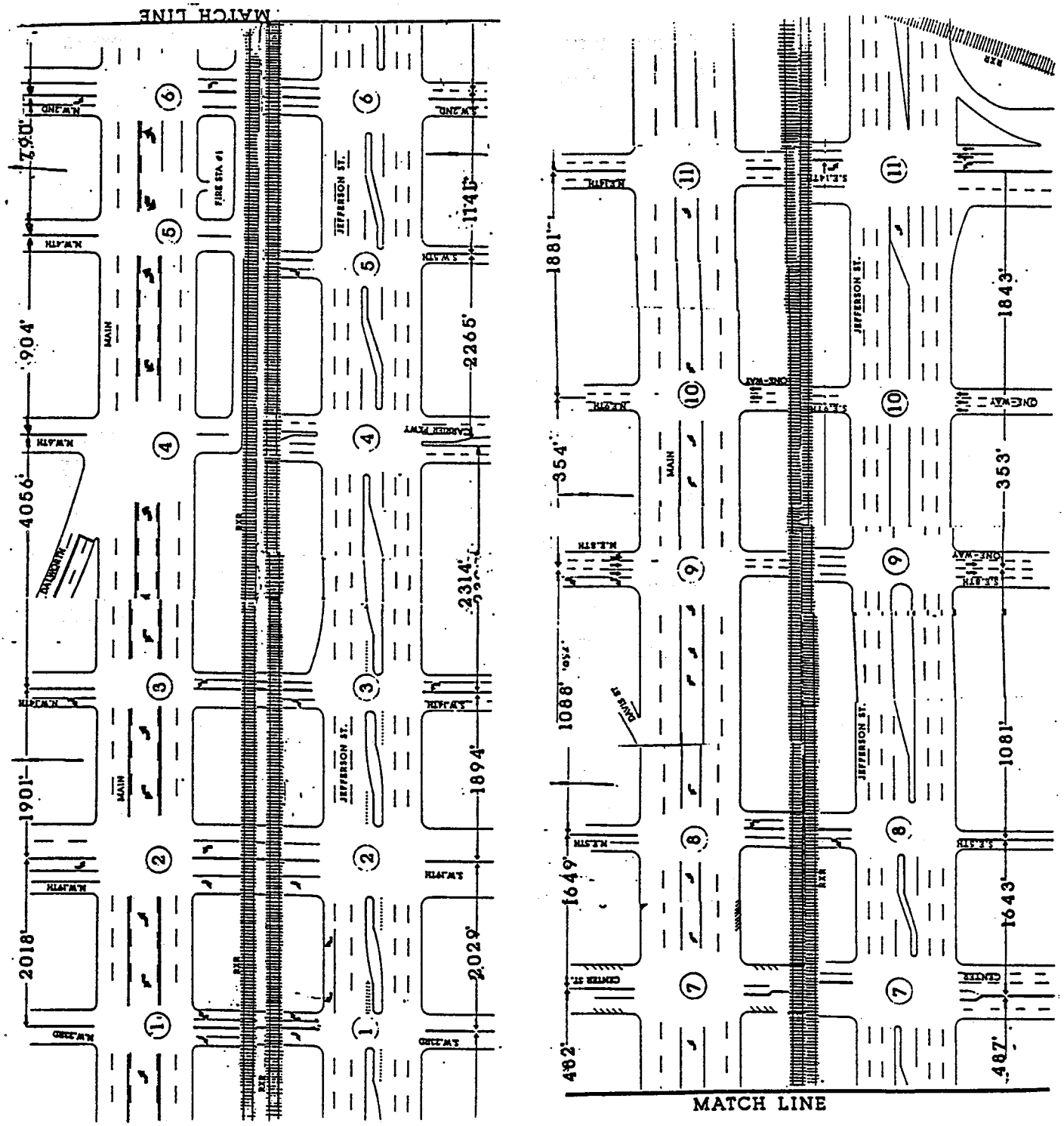
The two roadways serve commercial businesses including shopping centers, restaurants, banks, and auto dealerships. The Jefferson Street serves the LTV Corporation and the Naval Air Base. Hence, a 70/30 directional split is observed during the peak periods. While the speed limit on Jefferson is 40 mph throughout, the speed limit changes from 35 mph to 45 mph on Main Street. Lack of storage facilities between the two arterials on the railway tracks in the western third portion of the project resulted in the selection of a different cycle length for that portion. The different speeds on the two parallel arterials in a few sections created some problems to provide progression. Thus the Main Street is acting as a slave to the needs of Jefferson Street in the eastern two-thirds of the arterial, while the splits and the offsets of the Main Street control the operation in the remaining portion of the arterial.

The diverse land use along the arterial results in a wide mix of traffic. This wide mix of traffic influences the fuel consumption calculations. Due to the diverse land use, no definite "noon-peak" could be ascertained from the 24-hour tube counts. Hence, it was decided to analyze an "off-peak" period and compare the fuel consumption of fixed time pattern with fully actuated conditions.

In order to evaluate the system performance, traffic conditions were monitored and various data were collected before implementation of any changes. This data was in the form of traffic volumes, travel times, and delays. Twenty four counts were made at the intersections. Hourly volumes were later collected for the study periods. Test car method was used to collect link travel times, stopped delay, and running speeds. PASSER II simulation model was employed to optimize the phase splits and estimate delays.

		STOPS		TOTAL SYSTEM DELAY (veh-hrs)		FUEL (gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	AM	55085	40403	777	624	969	1107
	OFF	18125	18465	93	117	180	393
	PM	61842	53388	725	561	988	1215
DIFFERENCES	AM	14682		153		-138	
	OFF	-340		-24		-213	
	PM	8454		164		-227	
HRS/DAY	AM	2		2		2	
	OFF	7		7		7	
	PM	3		3		3	
DAILY	AM	29364		306		-276	
	OFF	-2380		-168		-1491	
	PM	25362		492		-681	
	TOTAL	52346		630		-2448	
UNIT VALUES		$0.014		$10.00		$1.00	
ANNUAL SAVINGS		$219,853		$1,890,000		($734,400)	

PROJECT COST:	$119,583	TOTAL ANNUAL SAVINGS:	$1,375,453
BENIFIT/COST RATIO:	11.50		


MATCH LINE
MAIN
JEFFERSON ST.
DAVIS ST
CENTER ST.
ONE-WAY
2018'
1901'
4056'
904'
1894'
2029'
2314'
2265'
1141'
1881'
354'
1088'
1649'
482'
1843'
353'
1081'
1643'
487'
MATCH LINE

SH 303

The Grand Prairie Transportation Services along with TxDOT and TTI worked on the following project. This project analyzes SH 303 which is the one of the arterials in the TLS study running in the east-west direction. The attached map displays the project network system, cross streets, and link distances.

SH 303 originates from the east end of the city, traverses the city, and enters the city of Arlington on the west. The land development along SH 303 is generally commercial. The arterial is influenced by LTV Corporation which is located at the intersection of SH 303 and West Freeway. LTV Corporation is the single largest traffic generator along the SH 303 corridor. The diverse land use along the arterial results in a wide mix of traffic. This wide mix of traffic affects the fuel consumption calculations.

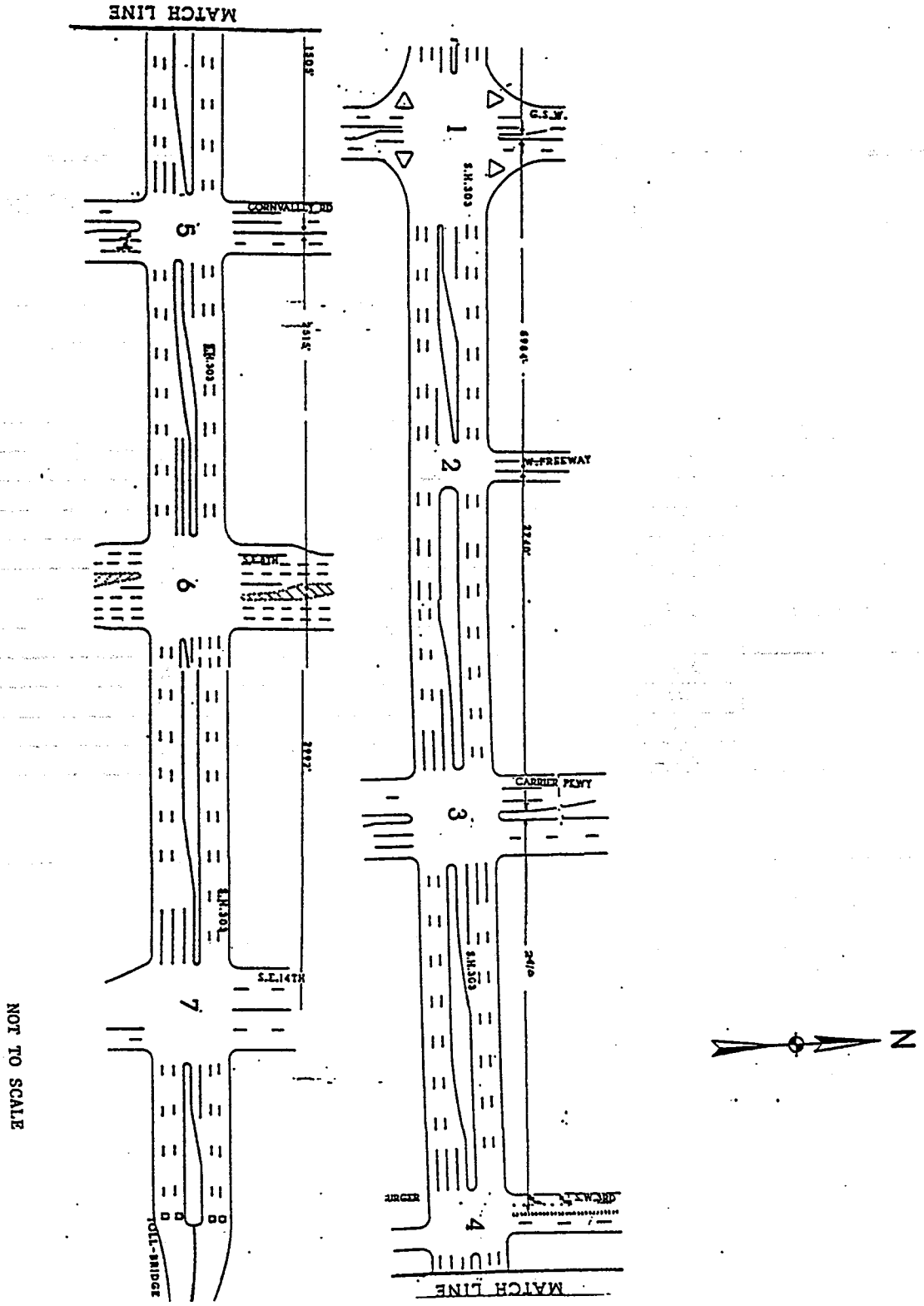
Due to the diverse land use no definite "noon-peak" could be ascertained from the 24-hour tube counts. Hence, it was decided to analyze an "off-peak" period and compare the fuel consumption of fixed time pattern with fully actuated conditions. The intersection with Great Southwest Parkway (GSP) was evaluated as an isolated system with green splits developed in the GSP project.

In order to evaluate the system performance, traffic conditions were monitored and various data were collected before implementation of any changes. This data was in the form of traffic volumes, travel times, and delays. Twenty four counts were made at the intersections. Hourly volumes were later collected for the study periods. Test car method was used to collect link travel times, stopped delay, and running speeds.

PASSER II simulation model was employed to optimize the phase splits and estimate delays. Implementing the new signal timings resulted in a total annual savings of about 22.9 million dollars to the motorists using this route. The number of stops decreased by about 11.8 million (a decrease of 29 percent), the delay decreased by about 2.2 million veh-hrs (a decrease of 75 percent), and the fuel consumption decreased by about 482,400 gallons (a decrease of 31 percent) in a year. The average travel times decreased by about 21 percent. The total cost of the project was about $118,000 with a benefit to cost ratio of about 193 to 1.

		STOPS		TOTAL SYSTEM DELAY (veh-hrs)		FUEL (gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	AM	17989	12718	1474	270	643	461
	OFF	6528	4962	258	49	275	194
	PM	23433	15188	2405	735	827	529
DIFFERENCES	AM	5271		1204		182	
	OFF	1566		209		81	
	PM	8245		1670		298	
HRS/DAY	AM	2		2		2	
	OFF	8		8		8	
	PM	2		2		2	
DAILY	AM	10542		2408		364	
	OFF	12528		1672		648	
	PM	16490		3340		596	
	TOTAL	39560		7420		1608	
UNIT VALUES		$0.014		$10.00		$1.00	
ANNUAL SAVINGS		$166,152		$22,260,000		$482,400	

PROJECT COST:	$118,538	TOTAL ANNUAL SAVINGS:	$22,908,552
BENIFIT/COST RATIO:	193.26		


MATCH LINE
CORNVALLEY RD
W. FREEWAY
CARRIER PKWY
S.H.303
S.E.14TH
TOLL-BRIDGE
MATCH LINE
1
2
3
4
5
6
7
N
NOT TO SCALE

Commerce Street

The City's Planning Department and Traffic Signals Unit were assisted by Traffic Engineers, Inc, to work on the following project. Seven intersections covering a distance of 0.9 miles were included in the project of Commerce Street. The attached map displays the project network system, cross streets, and link distances.

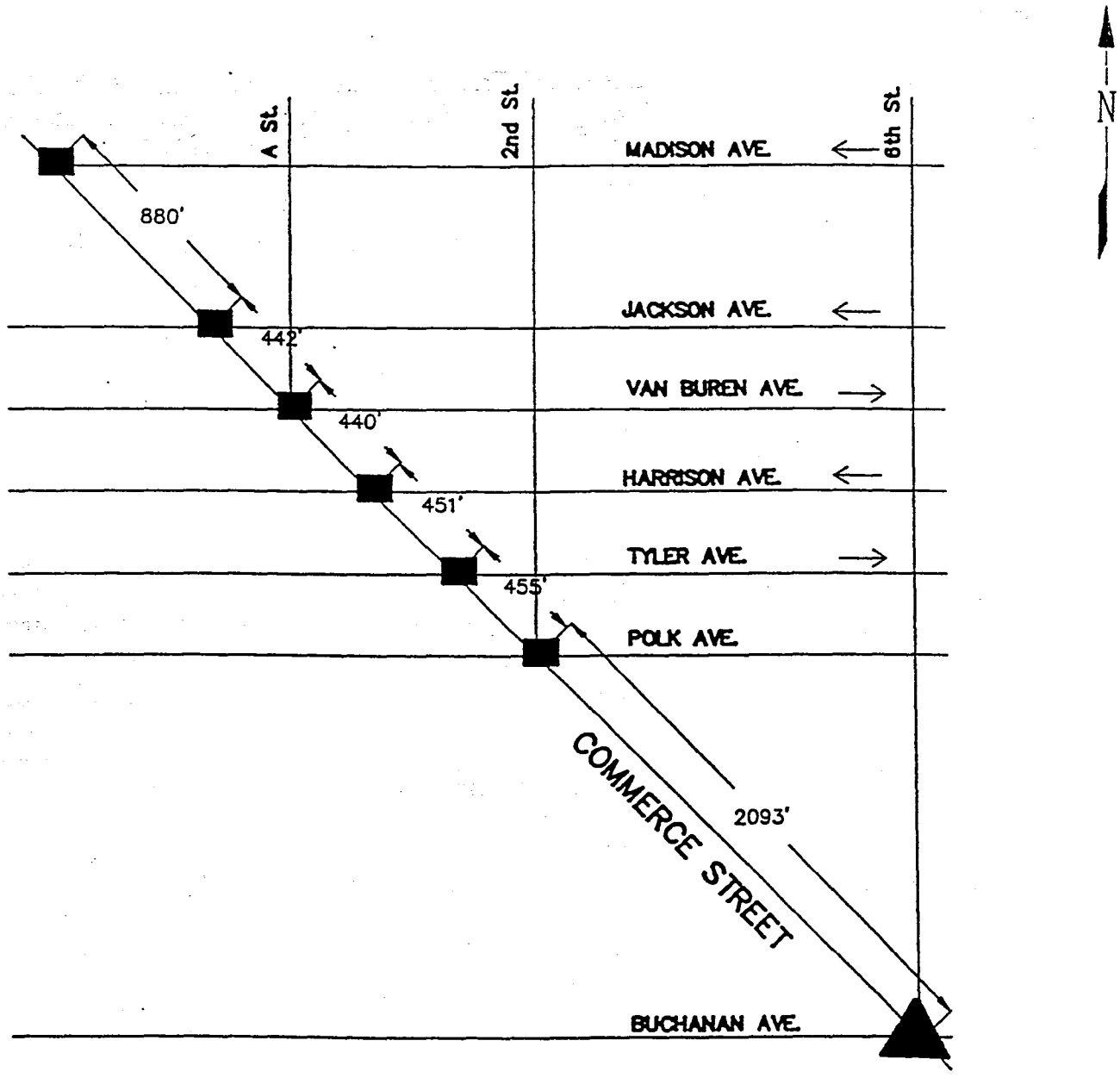
Six hardwire interconnected intersections and one traffic actuated intersection constitute the Commerce Street project. The system had better coordination going south than going north. Hence, timings needed to be developed to maximize efficiency in both directions. Two east-west arterials having perfect progression were the limiting factors to obtain good progression along Commerce Street. One of the controllers in the system needed to be replaced. The remaining six intersections were using two-dial Kentron electromechanical units. A new solid state time base coordinator replaced the old time clock. This facilitated in providing three different timing plans. The intersections were using two to three phases. None of the intersections had pedestrian controls.

In order to evaluate the system performance, traffic conditions were monitored and various data were collected before implementation of any changes. This data was in the form of traffic volumes, saturation flow rates, travel times, and delays. The highest fifteen minute volumes were multiplied by four to provide the input volumes for PASSER II. The test car method was used to collect link travel times, average number of stops, and the stop locations.

PASSER II-87 simulation model was employed to optimize the phase splits and estimate delays. Minor fine tuning of the splits and offsets was done to improve the progression along Commerce Street. Implementing the new signal timings resulted in a total annual savings of about $225,000 to the motorists using this route. The number of stops decreased by about 1.99 million (a decrease of about 7.4 percent), there were about 19,380 fewer hours of delay (a reduction of 10.6 percent), and there was a marginal fuel savings of about 2,960 gallons (a reduction of under 1 percent) in a year. The average travel times decreased by as much as 25 percent on some routes in certain periods. The total cost of the project was $14,363 with a benefit to cost ratio of 16 to 1.

		STOPS		TOTAL SYSTEM DELAY (veh-hrs)		FUEL (gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	AM	7764	7476	52.7	51.8	91.6	91
	OFF	8238	7924	50.4	49.9	97	97
	PM	12671	10572	100.4	70.5	136.7	132.4
DIFFERENCES	AM		288		0.9		0.6
	OFF		314		0.5		0
	PM		2099		29.9		4.3
HRS/DAY	AM		6		2		2
	OFF		2		6		6
	PM		2		2		2
DAILY	AM		1728		1.8		1.2
	OFF		628		3		0
	PM		4198		59.8		8.6
	TOTAL		6554		64.6		9.8
UNIT VALUES			$0.014		$10.00		$1.00
ANNUAL SAVINGS			$27,527		$193,800		$2,940

PROJECT COST:	$14,363	TOTAL ANNUAL SAVINGS:	$224,267
BENIFIT/COST RATIO:	15.61		



LEGEND

Signal System (hard wire interconect)

Signal System (Time base Coordination)

First Street

The City's Planning Department and Traffic Signals Unit were assisted by Traffic Engineers, Inc, to work on the following project. Four intersections covering a distance of 0.2 miles were included in the project of First Street. The attached map displays the project network system, cross streets, and link distances.

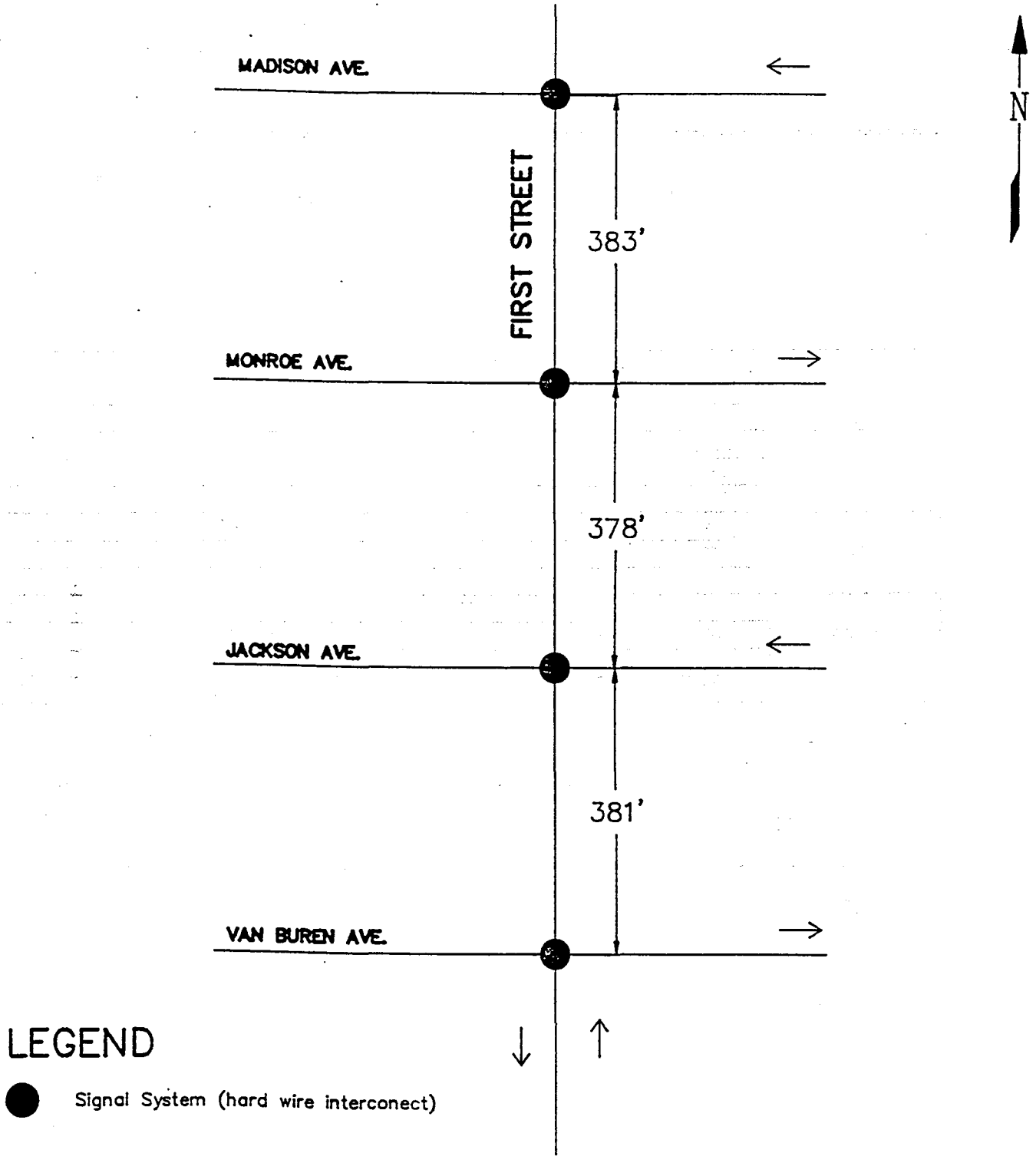
Four hardwire interconnected intersections constitute the First Street project. The close spacing between the intersections made the achievement of progression in both directions very difficult. Hence, progression was provided in the direction of heavy traffic. First Street is a part of a large synchronized system which has a few major arterials having perfect progression. Hence, some limitations exist to provide progression along First Street. The four intersections were using two-dial Kentron electromechanical units. A new solid state time base coordinator replaced the old time clock. This facilitated in providing three different timing plans. All of the intersections were using two phases and had pedestrian controls.

In order to evaluate the system performance, traffic conditions were monitored and various data were collected before implementation of any changes. This data was in the form of traffic volumes, saturation flow rates, travel times, and delays. The highest fifteen minute volumes were multiplied by four to provide the input volumes for PASSER II. The test car method was used to collect link travel times, average number of stops, and the stop locations.

PASSER II-87 simulation model was employed to optimize the phase splits and estimate delays. Minor fine tuning of the splits and offsets was done to improve the progression. Implementing the new signal timings resulted in a total annual savings of about $15,264 to the motorists using this route. The number of stops marginally decreased by about 48,000 (a decrease of about 0.5 percent), there were about 1,380 fewer hours of delay (a reduction of 2.8 percent), and there was a marginal fuel savings of about 792 gallons (a reduction of under 1 percent) in a year. The average travel times decreased by as much as 25 percent on some routes in certain periods. The total cost of the project was $4,221 with a benefit to cost ratio of 4 to 1.

		STOPS		TOTAL SYSTEM DELAY (veh-hrs)		FUEL (gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	AM	2055	2040	9	9	23.5	23.5
	OFF	3640	3635	20.9	20.3	34.1	33.8
	PM	2132	2082	10.1	9.6	24.62	24.2
DIFFERENCES	AM	15		0		0	
	OFF	5		0.6		0.3	
	PM	50		0.5		0.42	
HRS/DAY	AM	2		2		2	
	OFF	6		6		6	
	PM	2		2		2	
DAILY	AM	30		0		0	
	OFF	30		3.6		1.8	
	PM	100		1		0.84	
	TOTAL	160		4.6		2.64	
UNIT VALUES		$0.014		$10.00		$1.00	
ANNUAL SAVINGS		$672		$13,800		$792	

PROJECT COST:	$4,221	TOTAL ANNUAL SAVINGS:	$15,264
BENIFIT/COST RATIO:	3.62		


MADISON AVE.
FIRST STREET
383'
MONROE AVE.
378'
JACKSON AVE.
381'
VAN BUREN AVE.
N
LEGEND
Signal System (hard wire interconect)

Loop 448

The City's Planning Department and Traffic Signals Unit were assisted by Traffic Engineers, Inc, to work on the following project. Five intersections covering a distance of 1.44 miles were included in the project of Loop 448. The attached map displays the project network system, cross streets, and link distances.

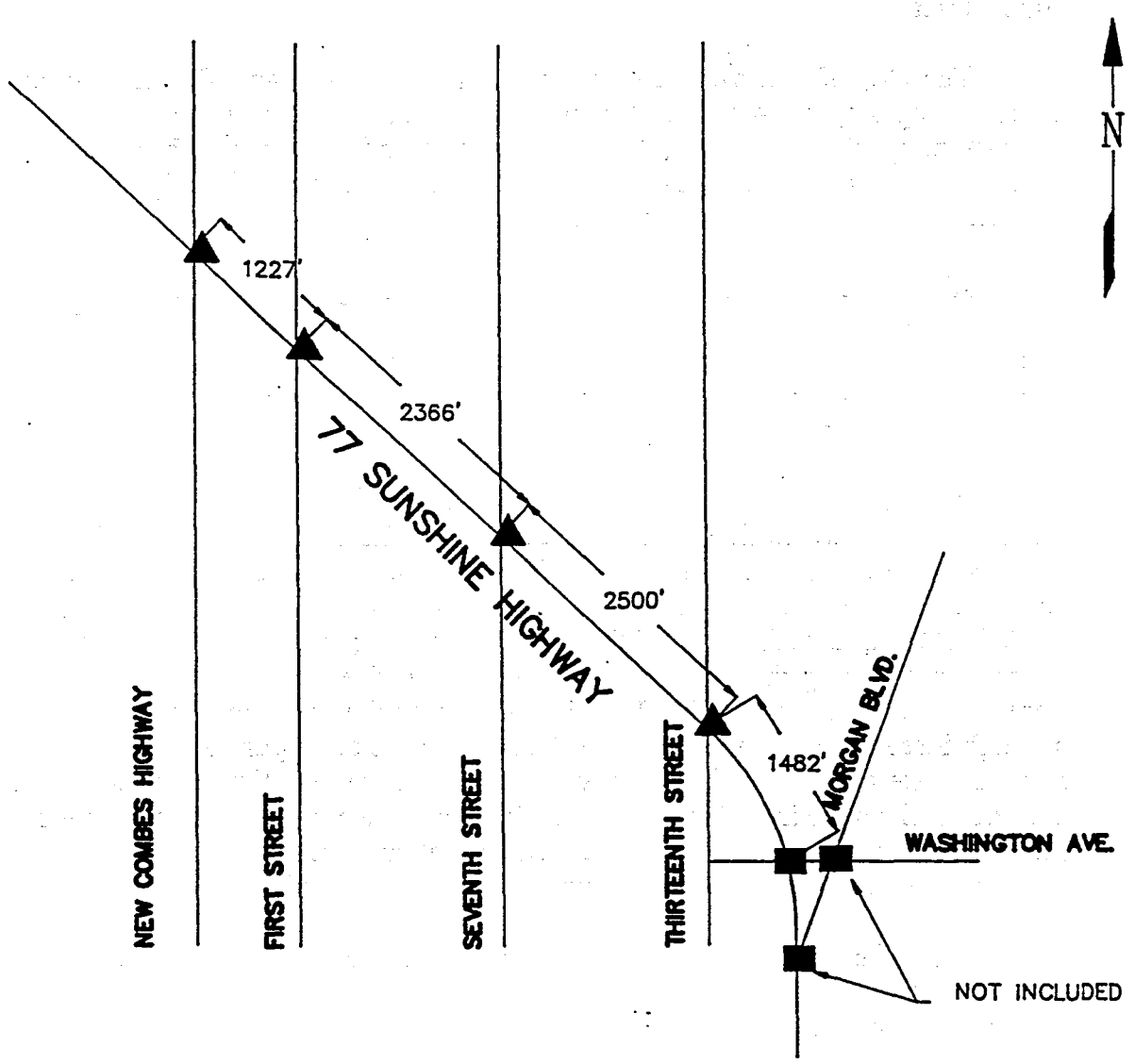
Four pre-timed isolated intersections with time based coordinators and an intersection with hard wire interconnect constitute the Loop 448 project. Although distances between intersections were fairly long, prevailing speeds of over 40 mph make travel times suitable for coordination. Protected-permissive phasing was being used at four of the five intersections. The intersections were using between four to six phases. All the intersections except First Street had pedestrian controls.

In order to evaluate the system performance, traffic conditions were monitored and various data were collected before implementation of any changes. This data was in the form of traffic volumes, saturation flow rates, travel times, and delays. The highest fifteen minute volumes were multiplied by four to provide the input volumes for PASSER II. The test car method was used to collect link travel times, average number of stops, and the stop locations.

PASSER II-87 simulation model was employed to optimize the phase splits and estimate delays. The optimum cycle length to operate was between 60 and 80 seconds. Cycle lengths of 70 and 80 seconds were developed for implementation. Minor fine tuning of the splits and offsets was done to improve the progression along Loop 448. Implementing the new signal timings resulted in a total annual savings of about $401,000 to the motorists using this route. The number of stops decreased by about 1.7 million (a decrease of about 9.9 percent), there were about 37,600 fewer hours of delay (a reduction of 27 percent), and there was a marginal fuel savings of about 240 gallons (a reduction of under 1 percent) in a year. The average travel times decreased by as much as 27 percent on some routes in certain periods. The total cost of the project was $5,166 with a benefit to cost ratio of 78 to 1.

		STOPS		TOTAL SYSTEM DELAY (veh-hrs)		FUEL (gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	AM	7334	6727	59.2	47.6	182.1	182
	OFF	4987	4265	38.8	25	129	129
	PM	6927	6798	56.3	46.5	176.3	176
DIFFERENCES	AM	607		11.6		0.1	
	OFF	722		13.8		0	
	PM	129		9.8		0.3	
HRS/DAY	AM	2		2		2	
	OFF	6		6		6	
	PM	2		2		2	
DAILY	AM	1214		23.2		0.2	
	OFF	4332		82.8		0	
	PM	258		19.6		0.6	
	TOTAL	5804		125.6		0.8	
UNIT VALUES		$0.014		$10.00		$1.00	
ANNUAL SAVINGS		$24,377		$376,800		$240	

PROJECT COST:	$5,166	TOTAL ANNUAL SAVINGS:	$401,417
BENIFIT/COST RATIO:	77.70		



LEGEND

- Signal System (hard wire interconect)
- Isolated Signal
- Signal System (Time base Coordination)

High Street

The City of Longview Department of Public Works and Transportation worked on the following project. A total of eleven (11) intersections were included in this traffic signal network at spacing that varied between 420 feet and 3,120 feet. Prior to this study, nine intersections were operating as isolated intersections. The attached figure shows the project network system, cross streets, and link distances.

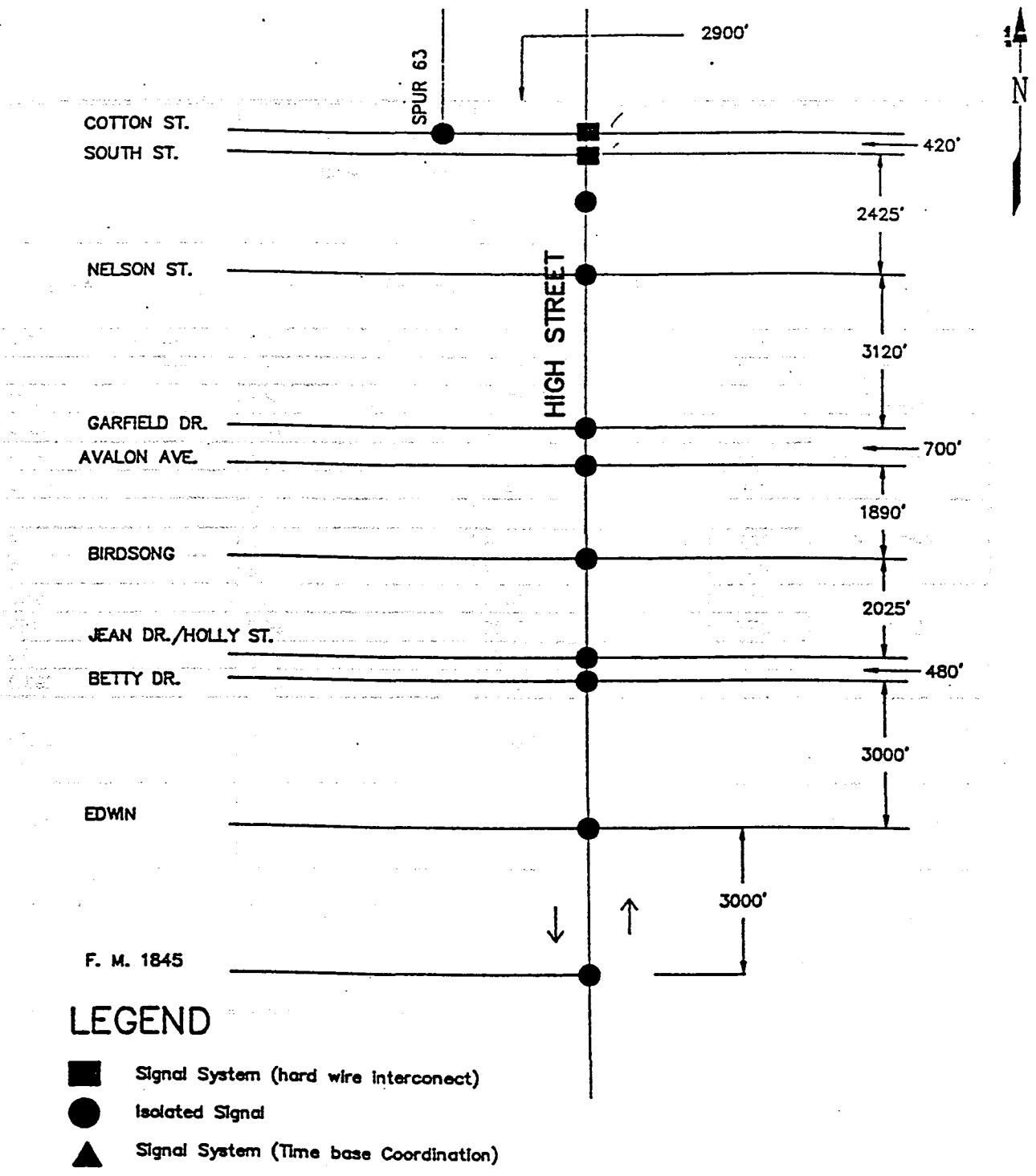
All the existing controllers were replaced by solid state eight phase NEMA controllers with time based coordination capabilities. The intersections at Edwin/High and Spur 63/Cotton were operated with actuated controllers. All other intersections were operated by pretimed controllers. The intersections had between four and eight signal phases and were not equipped with pedestrian controls.

In order to evaluate the system performance, the "before" TLS traffic conditions were monitored and various field data were collected. 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-87 for the "after" conditions for each of the morning, evening, and off-peak periods. The primary concern in selecting the optimum cycle length was fuel consumption. Minor adjustments were made to offsets and splits. In order to increase the bandwidth to a reasonable duration on High Street, the intersections of FM 1845 at Estes and Spur 63 at Cotton were removed from the system. Timings for these two intersections were optimized as isolated operations, and the results were included in the benefit analysis. Removal of the two intersections from the system resulted in an overall decrease in fuel consumption for the arterial. Very little fine-tuning was required after optimized timings were implemented in the field.

Based on PASSER II-87 simulation, the project resulted in an estimated $634,000 savings per year on total operating cost, a direct benefit to motorists using these routes. This operating cost savings included a total savings of 2,922,000 stops (a 9.9 percent reduction), a total annual fuel savings of 87,960 gallons (an 11.6 percent reduction), and a delay annual savings of 50,520 veh-hrs (a 24.9 percent reduction). Travel times were reduced by an average of 56 percent along this Street. Future improvements can be achieved by the installation of pedestrian push buttons, vehicle loop detectors, and traffic signal communication cable at all locations. It was estimated that these improvements would provide an additional 15 percent reduction in vehicular delay and fuel consumption. The total cost of the project was $86,590 and the resultant benefit to cost ratio was 7 to 1.

		STOPS		TOTAL SYSTEM DELAY (veh-hrs)		FUEL (gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	AM	9724	9215	67.4	51.3	236.5	208.9
	OFF	8997	7981	60.6	44.9	238.2	211.7
	PM	12627	11314	89.5	68.5	311.5	272
DIFFERENCES	AM	509		16.1		27.6	
	OFF	1016		15.7		26.5	
	PM	1313		21		39.5	
HRS/DAY	AM	2		2		2	
	OFF	6		6		6	
	PM	2		2		2	
DAILY	AM	1018		32.2		55.2	
	OFF	6096		94.2		159	
	PM	2626		42		79	
	TOTAL	9740		168.4		293.2	
UNIT VALUES		$0.014		$10.00		$1.00	
ANNUAL SAVINGS		$40,908		$505,200		$87,960	

PROJECT COST:	$86,590	TOTAL ANNUAL SAVINGS:	$634,068
BENIFIT/COST RATIO:	7.32		


SPUR 63
2900'
N
COTTON ST.
SOUTH ST.
420'
2425'
NELSON ST.
HIGH STREET
3120'
GARFIELD DR.
AVALON AVE.
700'
1890'
BIRDSONG
2025'
JEAN DR./HOLLY ST.
BETTY DR.
480'
3000'
EDWIN
3000'
F. M. 1845
LEGEND
Signal System (hard wire interconect)
Isolated Signal
Signal System (Time base Coordination)

Judson Road

The City of Longview Department of Public Works and Transportation worked on the following project. A total of four (4) intersections were included in this traffic signal network at spacing that varied between 1,500 feet and 2,900 feet. Prior to this study, all intersections were operating as isolated intersections. The attached figure shows the project network system, cross streets, and link distances.

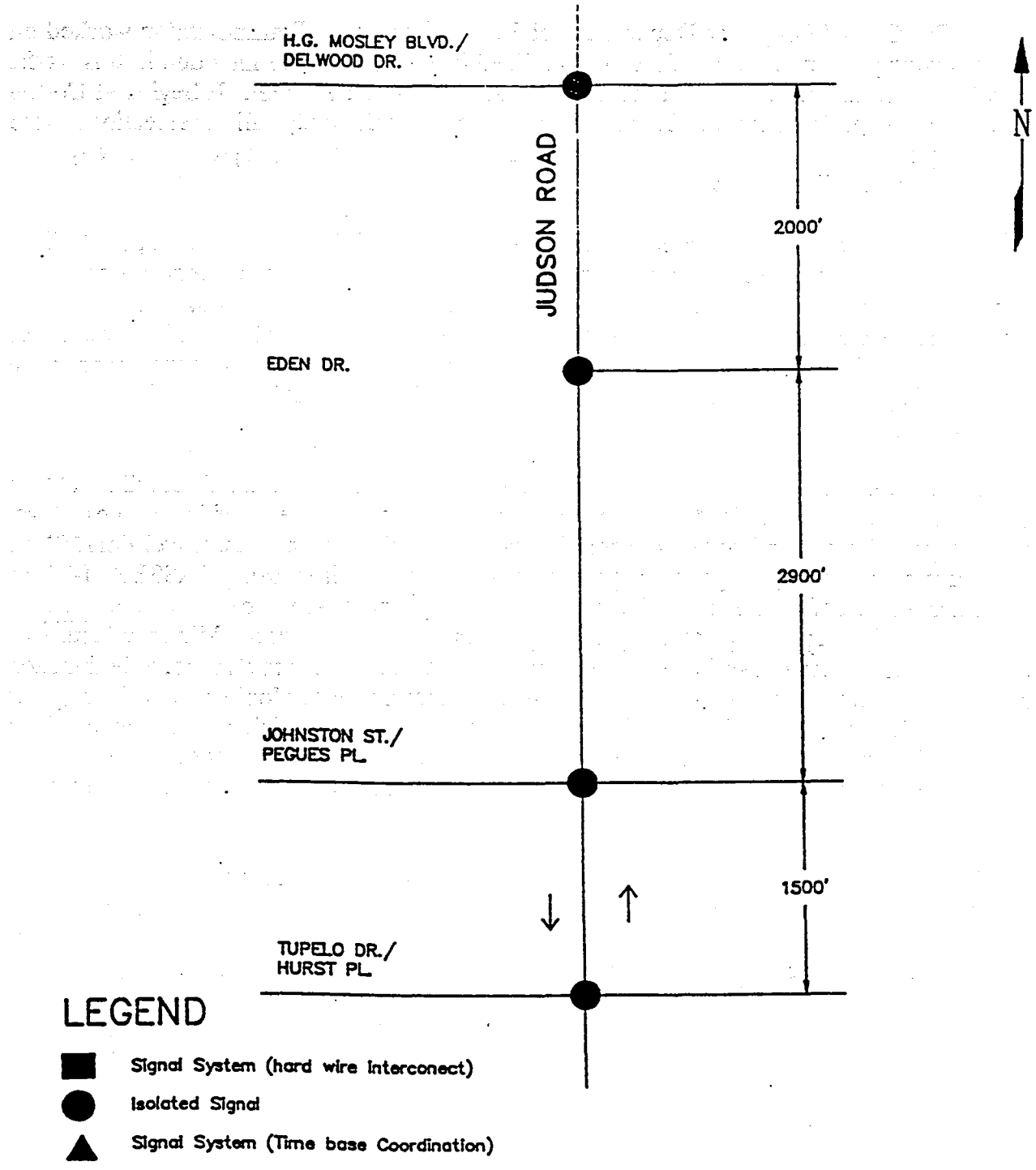
All the existing controllers were replaced by solid state eight phase NEMA controllers with time based coordination (TBC) capabilities. The intersection at Tupelo/Hurst was operated with a pretimed controller. The other three intersections were operated by actuated controllers. The intersections had between four and eight signal phases and were not equipped with pedestrian controls.

In order to evaluate the system performance, the "before" TLS traffic conditions were monitored and various field data were collected. 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-87 for the "after" conditions for each of the morning, evening, and off-peak periods. Timing optimization was accomplished by selecting minimum phase splits for pedestrian accommodation using the same traffic volumes that were used in the "before" conditions, and varying the cycle length to come up with the best progression for the respective peak periods. The primary concern in selecting the optimum cycle length was fuel consumption. The computer model was run for each daily peak period utilizing cycle lengths ranging from 50 to 90 seconds, incremented in 5 second intervals. Minor adjustments were made to offsets and splits. Very little fine-tuning was required after optimized timings were implemented in the field.

Based on PASSER II-87 simulation, the project resulted in an estimated $428,400 savings per year on total operating cost, a direct benefit to motorists using these routes. This operating cost savings included a total savings of 1,070,400 stops (a 4.7 percent reduction) and a delay annual savings of 44,580 veh-hrs (a 26.2 percent reduction). However, fuel consumption was increased along Judson Road by 32,400 gallons (a 5.6 percent increase). This was due to the increase in green time for the cross streets to provide for pedestrians; and, subsequently, the main street green was decreased. Travel times were reduced by an average of 23 percent along Judson Road. Future improvements can be achieved by the installation of pedestrian push buttons, vehicle loop detectors, and traffic signal communication cable at all locations. It was estimated that these improvements would provide an additional 15 percent reduction in vehicular delay and fuel consumption. The total cost of the project was $31,053 and the resultant benefit to cost ratio was 14 to 1.

		STOPS		TOTAL SYSTEM DELAY (veh-hrs)		FUEL (gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	AM	7136	6513	51.1	33.9	179.9	189.4
	OFF	7406	5795	55.6	32	188.4	191.7
	PM	8969	10665	74.2	75.1	234.6	256.8
DIFFERENCES	AM		623		17.2		-9.5
	OFF		1611		23.6		-3.3
	PM		-1696		-0.9		-22.2
HRS/DAY	AM		6		6		6
	OFF		2		2		2
	PM		2		2		2
DAILY	AM		3738		103.2		-57
	OFF		3222		47.2		-6.6
	PM		-3392		-1.8		-44.4
	TOTAL		3568		148.6		-108
UNIT VALUES			$0.014		$10.00		$1.00
ANNUAL SAVINGS			$14,986		$445,800		($32,400)

PROJECT COST:	$31,053	TOTAL ANNUAL SAVINGS:	$428,386
BENIFIT/COST RATIO:	13.80		


H.G. MOSLEY BLVD./
DELWOOD DR.
JUDSON ROAD
N
2000'
EDEN DR.
2900'
JOHNSTON ST./
PEGUES PL.
1500'
TUPELO DR./
HURST PL.
LEGEND
Signal System (hard wire interconect)
Isolated Signal
Signal System (Time base Coordination)

Mobberly Avenue

The City of Longview Department of Public Works and Transportation worked on the following project. A total of six (6) signalized intersections were included in this traffic signal network at spacing that varied between 950 feet and 2,850 feet. It begins at Cotton Street and extends south to Green street. Prior to this study, all intersections were operating as isolated intersections. The attached figure shows the project network system, cross streets, and link distances.

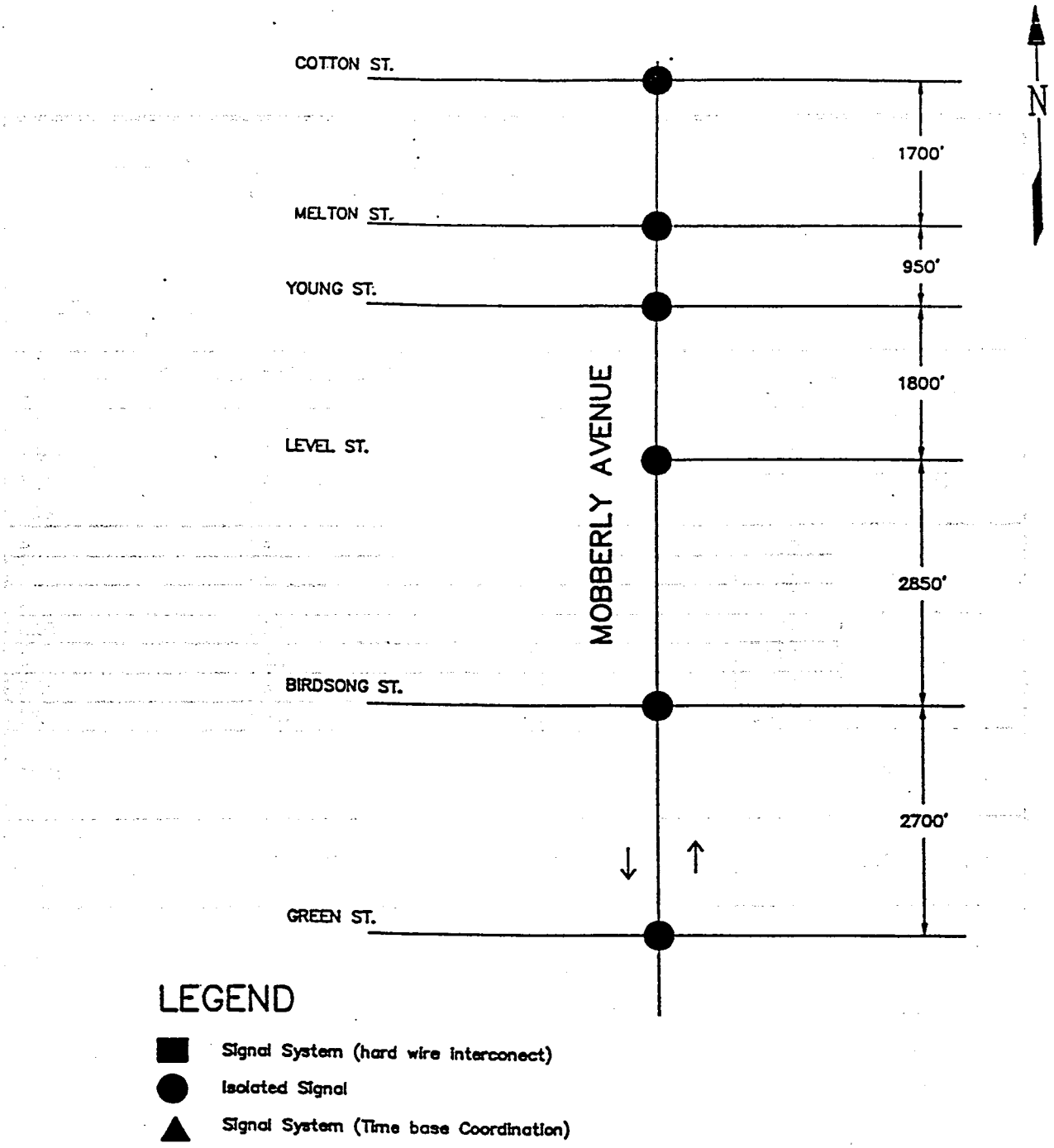
All the existing controllers were replaced by solid state eight phase NEMA controllers with time based coordination (TBC) capabilities. All of the intersections except one were controlled by pretimed controllers. The intersection at Birdsong was controlled with an Eagle DP 900 full actuated NEMA controller. The intersections had between four and eight signal phases and were not equipped with pedestrian controls. One school zone exists at Level and Mobberly to accommodate pedestrian traffic generated from the Southward School.

In order to evaluate the system performance, the "before" TLS traffic conditions were monitored and various field data were collected. 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-87 for the "after" conditions for each of the morning, evening, and off-peak periods. The primary concern in selecting the optimum cycle length was fuel consumption. Minor adjustments were made to offsets and splits. In order to increase the bandwidth to a reasonable duration on Mobberly Avenue, the southbound exclusive left turn phase at Mobberly and Young was removed. This resulted in improved safety and traffic operation efficiency. Removal of the exclusive left turn phase also resulted in an overall decrease in fuel consumption for the arterial. Very little fine-tuning was required after optimized timings were implemented in the field.

Based on PASSER II-87 simulation, the project resulted in an estimated $77,194 savings per year on total operating cost, a direct benefit to motorists using these routes. This operating cost savings included a total savings of 1,742,400 stops (a 16.0 percent reduction) and a delay annual savings of 13,140 veh-hrs (a 17.1 percent reduction). However, fuel consumption was increased along Mobberly Avenue by 78,600 gallons (a 29.6 percent increase). This increase was attributed to the fact that the signals did not include adequate green time on the cross streets to accommodate pedestrian traffic. When the optimized timings were developed, the green time for the cross streets was increased to provide for pedestrians and subsequently the main street green was decreased. Travel times were reduced by an average of 39 percent along this Avenue. The total cost of the project was $51,003 and the resultant benefit to cost ratio was 2 to 1.

		STOPS		TOTAL SYSTEM DELAY (veh-hrs)		FUEL (gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	AM	3611	2933	25.6	23.3	85.4	113.8
	OFF	3389	2838	24.1	19.9	81.9	107.4
	PM	4394	3821	30.4	23.4	111.3	137.4
DIFFERENCES	AM	678		2.3		-28.4	
	OFF	551		4.2		-25.5	
	PM	573		7		-26.1	
HRS/DAY	AM	2		2		2	
	OFF	6		6		6	
	PM	2		2		2	
DAILY	AM	1356		4.6		-56.8	
	OFF	3306		25.2		-153	
	PM	1146		14		-52.2	
	TOTAL	5808		43.8		-262	
UNIT VALUES		$0.014		$10.00		$1.00	
ANNUAL SAVINGS		$24,394		$131,400		($78,600)	

PROJECT COST:	$51,003	TOTAL ANNUAL SAVINGS:	$77,194
BENIFIT/COST RATIO:	1.51		


COTTON ST.
MELTON ST.
YOUNG ST.
LEVEL ST.
BIRDSONG ST.
GREEN ST.
MOBBERLY AVENUE
1700'
950'
1800'
2850'
2700'
N
LEGEND
Signal System (hard wire interconect)
Isolated Signal
Signal System (Time base Coordination)

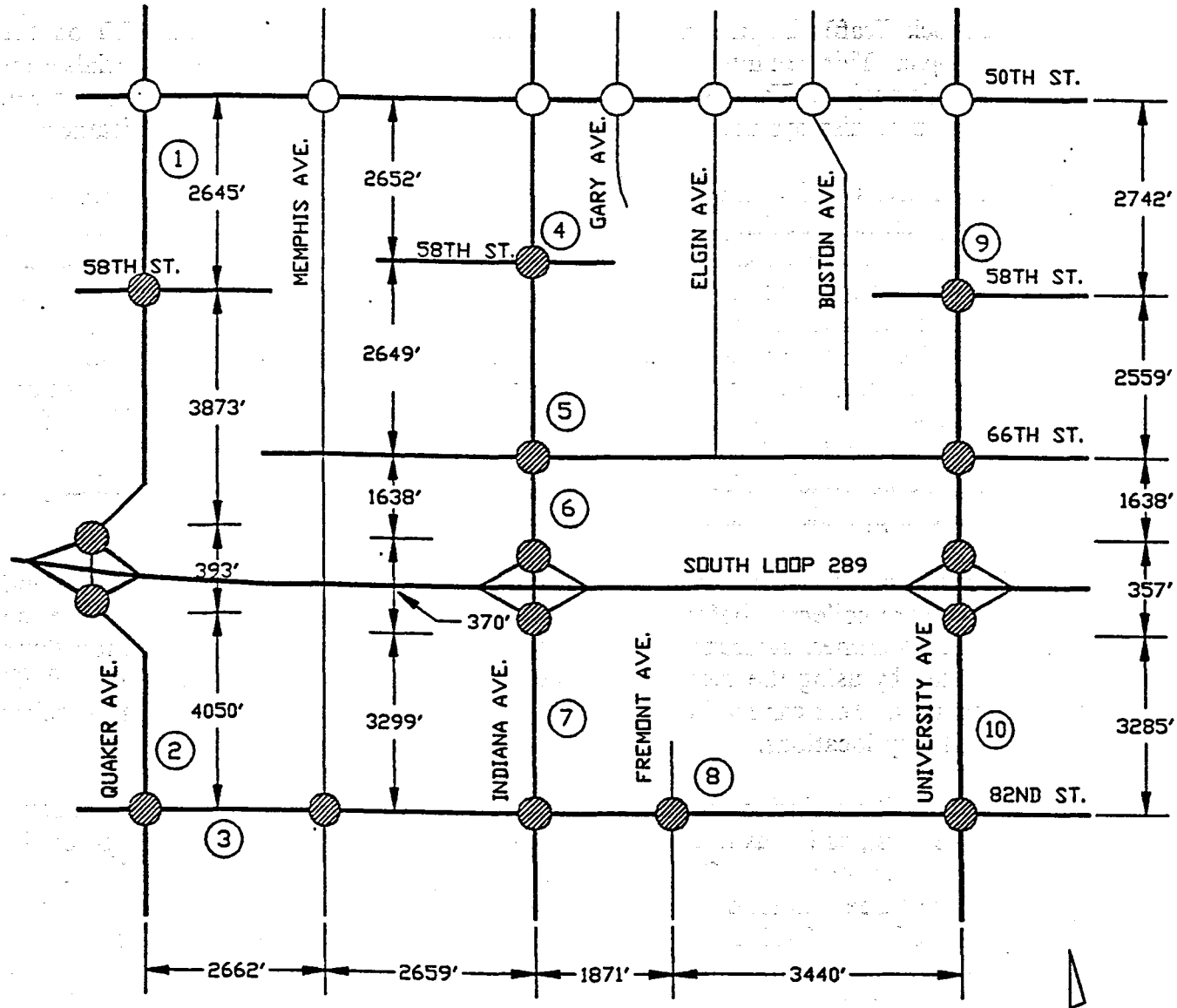
Central Business District

Lubbock Traffic Engineering Department worked with TxDOT and TTI on the following project. Thirteen intersections, including three interchanges on four arterials were included in this project. The system has three north-south streets and one east-west street. The attached map displays the project network system, cross streets, and link distances.

The arterials under study are in the vicinity of Texas Tech University, which is the main traffic generator. Parking is not permitted on the four arterials. The major streets are mostly six-lane undivided roadways with continuous two-way left-turn lanes. Most of the cross streets have a left turn bay. Congestion was most pronounced during the concentrated morning, noon and evening peak periods. During these periods, the traffic entering or leaving the university and the downtown area was subjected to excessive delays. While three of the thirteen intersections in the network were pretimed, the remaining intersections are actuated. Between three and eight phases were being used at the intersections. While four of the intersections did not have any pedestrian controls, seven intersections had pedestrian controls on one approach. New CALTRANS Type 170 controllers were installed as part of the project to provide "time-of-day" time based coordination operation.

In order to evaluate the system performance, traffic conditions were monitored and various data were collected before implementation of any changes. This data was in the form of traffic volumes, saturation flow rates, travel times, and delays. Saturation flows were estimated by using the method suggested in the TLS PASSER II and PASSER III training manuals. Test car method was used to collect link travel times, average number of stops, and stop locations.

PASSER II simulation model was employed to optimize the offsets and phase splits of 82nd Street first, as it was intersecting all the other arterials. Then the timings for the other arterials were obtained. Finally, these timings were input into PASSER III to obtain timings for the three diamond interchanges on Loop 289. Some fine tuning of the signal timings obtained from PASSER II and PASSER III had to be done in the field. Due to construction work on three arterials, the after data for these arterials was obtained by extrapolating the results of the fourth arterial (82nd Street). The improvements on 82nd Street were reduced to savings per vehicle-mile driven and applied to the remaining arterials. The total savings obtained in this manner were $5,668,100. The total cost of the project was $106,962 with a benefit to cost ratio of 53 to 1.



ALL STREET: 2-WAY TRAFFIC

◯ DONATES TRAFFIC SIGNALS

▨ TRAFFIC SIGNALS UNDER STUDY

ADT

(1)	17,200	(6)	26,800
(2)	16,300	(7)	12,500
(3)	18,700	(8)	10,000
(4)	30,400	(9)	30,500
(5)	28,200	(10)	15,100

Loop 374

The City's Safety Department and Traffic Signals unit worked with Texas Department of Transportation on the following project. This project analyzes the improvements made to the signal timings along Loop 374 in the city of McAllen. The attached map displays the project system, cross streets, and link distances.

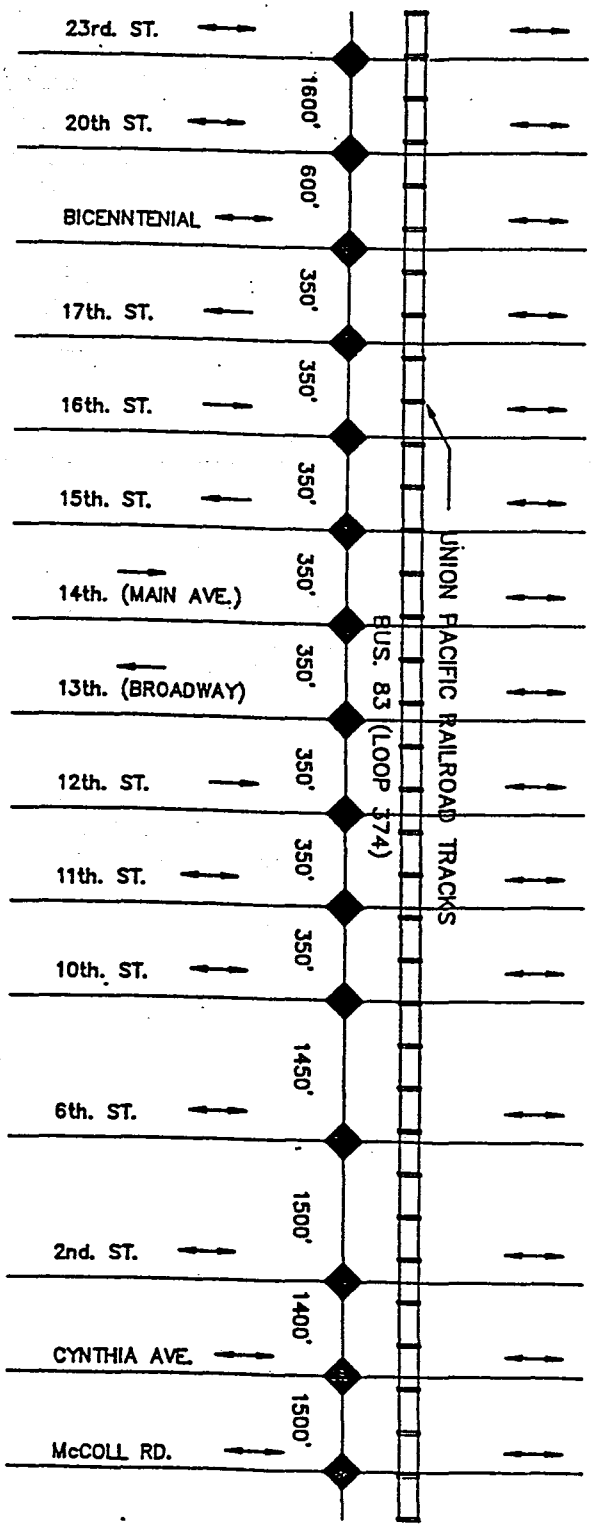
Loop 374 consists of 15 hardwired interconnected signalized intersections. The close spacing between the intersections made the task of providing progression in both directions difficult. Hence, progression was favored in the western direction, which has the heaviest traffic flow. All 15 existing controllers were replaced with new controllers to facilitate time base coordination. Separate timing plans for daytime and nighttime were being used. Two of the 15 intersections were pretimed. The rest were semi-actuated. The intersections used between four to eight phases. Four of the 15 intersections did not have pedestrian controls. A rail track is present parallel to the arterial. All except four of the intersections did not have railroad preemption.

In order to evaluate the system performance, traffic conditions were monitored and various data were collected before implementation of any changes. This data was in the form of traffic volumes, travel times, and delays. Twenty four hour counts were made at the intersections. These counts indicated the existence of a single peak period of eight hours. The peak 15 minute volumes were selected and multiplied by 4 to obtain peak hour volumes. The test car method was used to collect link travel times, stopped delay, and running speeds.

PASSER II simulation model was employed to optimize the phase splits, obtain offsets, and estimate delays. Minor fine tuning was done to the timing plans to improve progression. Implementing the new signal timings resulted in a total annual savings of about 1.3 million dollars to the motorists using this route. The number of stops decreased by about 5.9 million (a decrease of 8.2 percent), the delay decreased by about 104,640 veh-hrs (a decrease of 17.8 percent), and the fuel consumption decreased by about 155,040 gallons (a decrease of about 12.7 percent) in an year. It was observed that the modified signal timings significantly improved the progression along the arterial. The average travel times decreased by about 25 percent. The total cost of the project was about $96,500 with a benefit to cost ratio of about 13 to 1.

		STOPS		TOTAL SYSTEM DELAY (veh-hrs)		FUEL (gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	AM						
	OFF	30042	27568	244.2	200.6	507.1	442.5
	PM						
DIFFERENCES	AM						
	OFF	2474		43.6		64.6	
	PM						
HRS/DAY	AM						
	OFF	8		8		8	
	PM						
DAILY	AM						
	OFF	19792		348.8		516.8	
	PM						
	TOTAL	19792		348.8		516.8	
UNIT VALUES		$0.014		$10.00		$1.00	
ANNUAL SAVINGS		$83,126		$1,046,400		$155,040	

PROJECT COST:	$96,546	TOTAL ANNUAL SAVINGS:	$1,284,566
BENIFIT/COST RATIO:	13.31		



LOOP 374
(U.S. BUSINESS 83)
T.L.S. PROGRAM
McALLEN, TEXAS

LEGEND

- SIGNAL SYSTEM HARDWIRE INTERCONNECT
- ONE WAY
- TWO WAY

Big Spring Street/Garfield Street

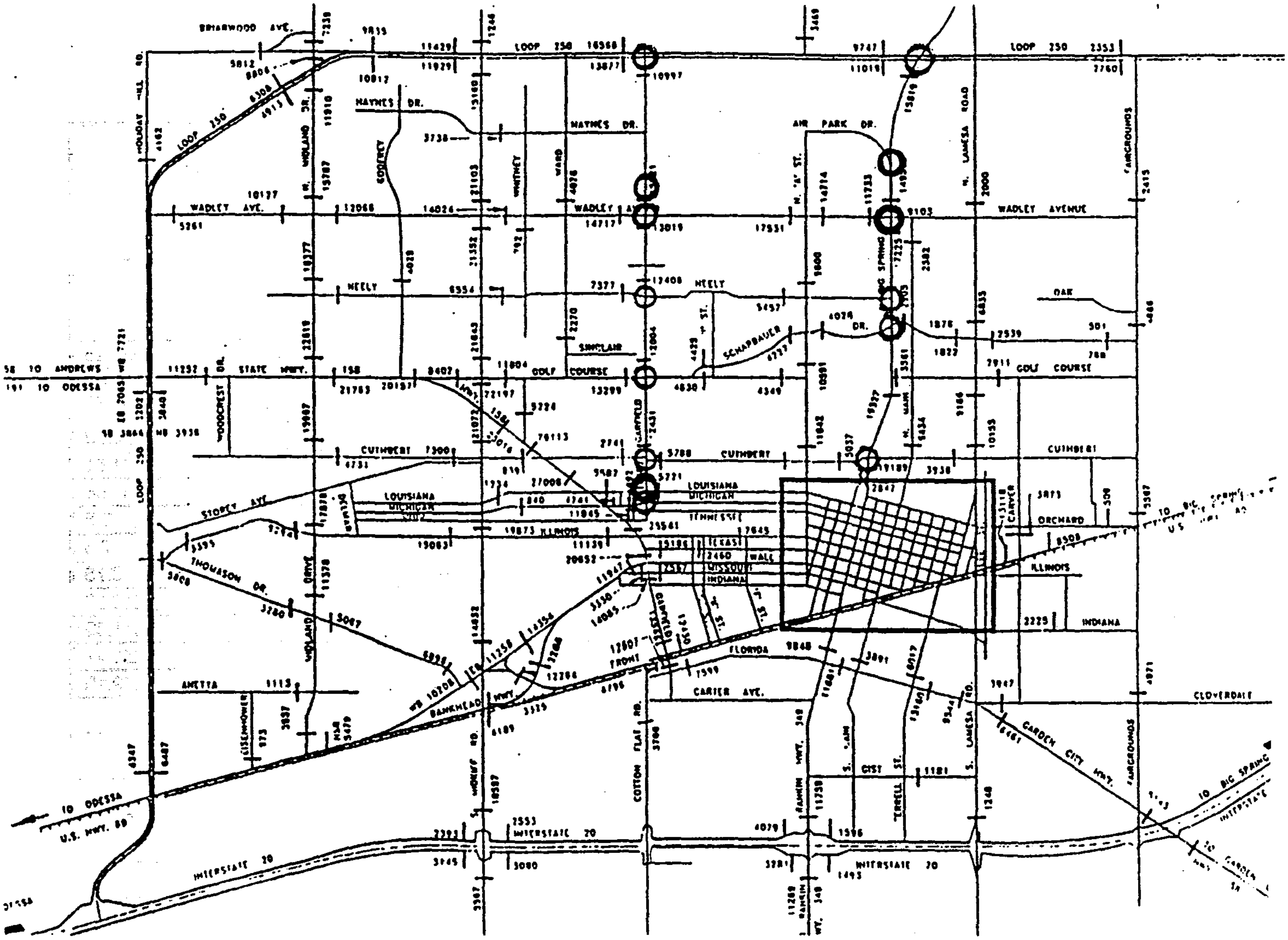
The City's Traffic Signals unit worked with the Texas Department of Transportation on the following project. This project analyzed the modifications made to the signal timings along Big Spring St. and Garfield St. in the city of Midland. The attached map displays the project system, cross streets, and link distances. Six intersections along Big Spring and eight intersections along Garfield St. were analyzed in this project. The implementation of timing plans required the replacement of cabinets with 12 channel NEMA type load facilities. Re-cabling was required on several intersections. All of the intersections along Big Spring St are actuated. The controllers were using between four and eight phases. None of the intersections had any pedestrian controls. All of the intersections along Garfield St. were actuated. The controllers were using between three and eight phases. Only two of the intersections had pedestrian controls. Based on the PASSER II simulation runs, phasing modifications were made at a number of intersections.

In order to evaluate the system performance, traffic conditions were monitored and various data were collected before implementation of any changes. This data was in the form of traffic volumes, travel times, and delays. Saturation flow rates and lost times were computed using the assistant key in PASSER II. Twenty four hour counts were made at the intersections. The test car method was used to collect link travel times, stopped delay, and running speeds.

PASSER II simulation model was employed to optimize the phase splits, obtain offsets, and estimate delays. Minor fine tuning was done to the timing plans to improve progression. Implementing the new signal timings resulted in a total annual savings of about 2.28 million dollars to the motorists using this route. The number of stops decreased by about 101,897 (a decrease of 10.3 percent), the delay decreased by about 0.9 million veh-hrs (a decrease of 25.5 percent), and the fuel consumption decreased by about 242,742 gallons (a decrease of about 11.1 percent) in an year. It was observed that the modified signal timings significantly improved the traffic operation along the two arterials. The total cost of the project was about $68,615 with a benefit to cost ratio of about 33 to 1.

		STOPS		TOTAL SYSTEM DELAY (veh-hrs)		FUEL (gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	AM	20313	18193	229.47	172.74	601.63	531.25
	OFF	11877	10158	110.88	80.1	366.31	324.8
	PM	20055	19002	240.39	182.36	644.3	577.24
DIFFERENCES	AM		2120		56.73		70.38
	OFF		1719		30.78		41.51
	PM		1053		58.03		67.06
HRS/DAY	AM		3.5		3.5		3.5
	OFF		7.5		7.5		7.5
	PM		3.75		3.75		3.75
DAILY	AM		7420		198.55		246.33
	OFF		12893		230.85		311.32
	PM		3949		217.61		251.47
	TOTAL		24261		647.02		809.13
UNIT VALUES			$0.014		$10.00		$1.00
ANNUAL SAVINGS			$101,897		$1,941,052		$242,739

PROJECT COST:	$68,615	TOTAL ANNUAL SAVINGS:	$2,285,689
BENIFIT/COST RATIO:	33.31		



ALL PROJECT STREETS ARE TWO-WAY

O EXISTING CONTROLLERS WITH TIME BASED COORDINATION

O PROPOSED CONTROLLERS FOR PROJECT

Midkiff Road/Andrews Highway

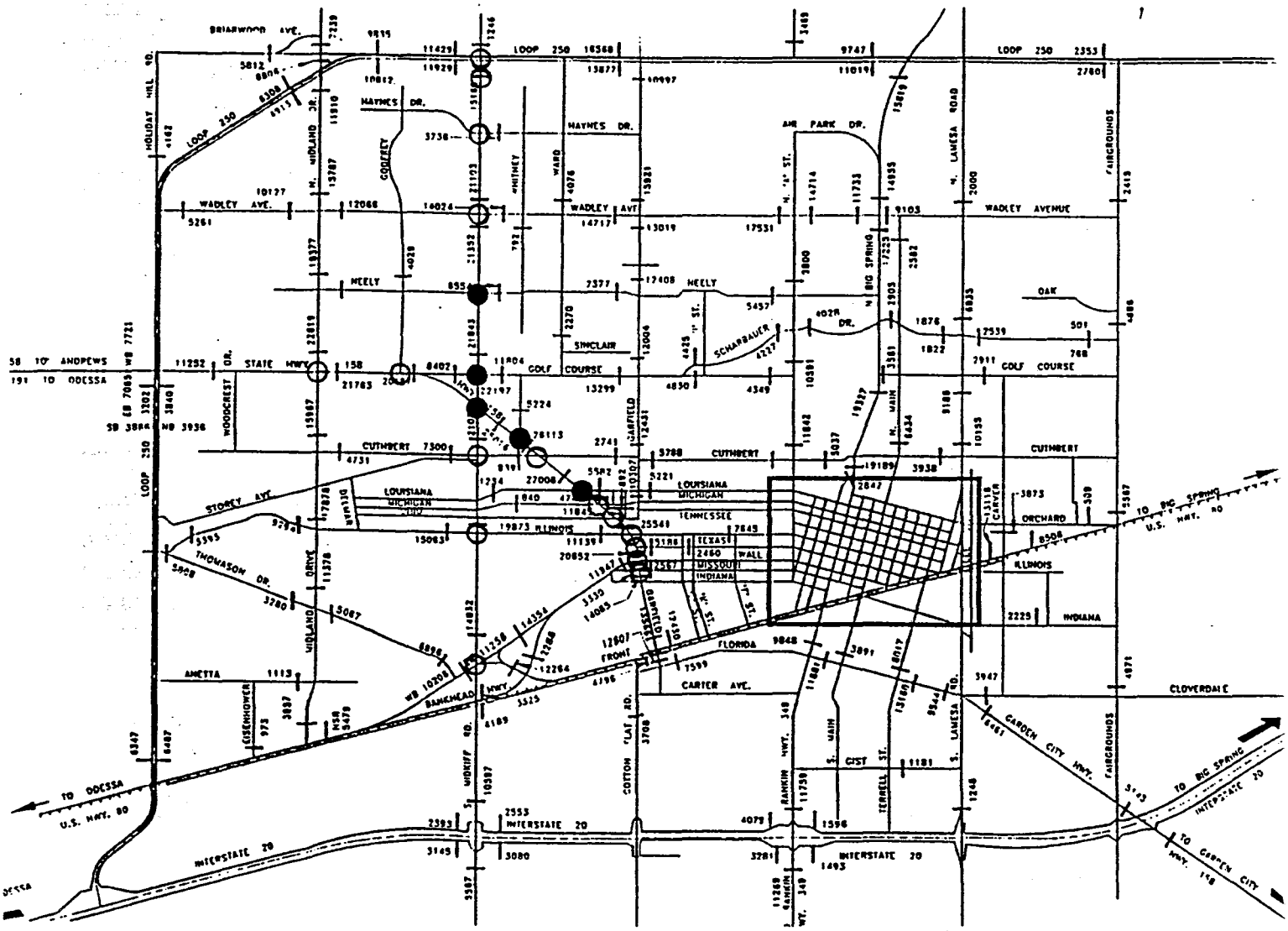
The City's Traffic Signals unit worked with the Texas Department of Transportation on the following project. This project analyzed the modifications made to the signal timings along Midkiff Rd. and Andrews Hwy. in the city of Midland. The attached map displays the project system, cross streets, and link distances.

Ten intersections along Midkiff Rd. and 12 intersections along Andrews Hwy. were analyzed in this project. The implementation of timing plans required the replacement of cabinets with 12 channel NEMA type load facilities. Re-cabling was required on several intersections. All of the intersections along Midkiff Rd. were actuated. The controllers were using between six and eight phases. None of the intersections had any pedestrian controls. All of the intersections along Andrews Hwy. were actuated. The controllers were using between three and eight phases. Only one of the intersections had pedestrian controls. Based on the PASSER II simulation runs, phasing modifications were made at a number of intersections.

In order to evaluate the system performance, traffic conditions were monitored and various data were collected before implementation of any changes. This data was in the form of traffic volumes, travel times, and delays. Saturation flow rates and lost times were computed using the assistant key in PASSER II. Twenty four hour counts were made at the intersections. The test car method was used to collect link travel times, stopped delay, and running speeds.

PASSER II simulation model was employed to optimize the phase splits, obtain offsets, and estimate delays. Minor fine tuning was done to the timing plans to improve progression. Implementing the new signal timings resulted in a total annual savings of about 14.46 million dollars to the motorists using this route. The number of stops decreased by about 38.2 million (a decrease of 17.3 percent), the delay decreased by about 1.2 million veh-hrs (a decrease of 40 percent), and the fuel consumption decreased by about 1.7 million gallons (a decrease of about 29 percent) in a year. It was observed that the modified signal timings significantly improved the traffic operation along the two arterials. The total cost of the project was about $89,230 with a benefit to cost ratio of about 162 to 1.

		STOPS		TOTAL SYSTEM DELAY (veh-hrs)		FUEL (gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	AM	57448	42965	1069.78	441.37	1735.31	994.85
	OFF	36637	31126	326.06	250.79	916.16	788.9
	PM	68695	59244	1017.28	673.41	1941.44	1318.06
DIFFERENCES	AM		14483		628.41		740.46
	OFF		5511		75.27		127.26
	PM		9451		343.87		623.38
HRS/DAY	AM		3.5		3.5		3.5
	OFF		7.5		7.5		7.5
	PM		3.75		3.75		3.75
DAILY	AM		50691		2199.44		2591.61
	OFF		41333		564.53		954.45
	PM		35441		1289.51		2337.68
	TOTAL		127464		4053.47		5883.74
UNIT VALUES			$0.014		$10.00		$1.00
ANNUAL SAVINGS			$535,350		$12,160,418		$1,765,121
PROJECT COST:			$89,231	TOTAL ANNUAL SAVINGS:			$14,460,888
BENIFIT/COST RATIO:			162.06				



ALL PROJECT STREETS ARE TWO-WAY

● EXISTING CONTROLLERS WITH TIME BASED COORDINATION

○ PROPOSED CONTROLLERS FOR PROJECT

Central Business District

The City of Odessa staff worked on the following Odessa Project. The city has a total of 173 signalized intersections, of which 89 are in the CBD. These signals were installed 40 years ago and were coordinated with a "hard wire" interconnect cable. The controllers are coordinated by time-base.

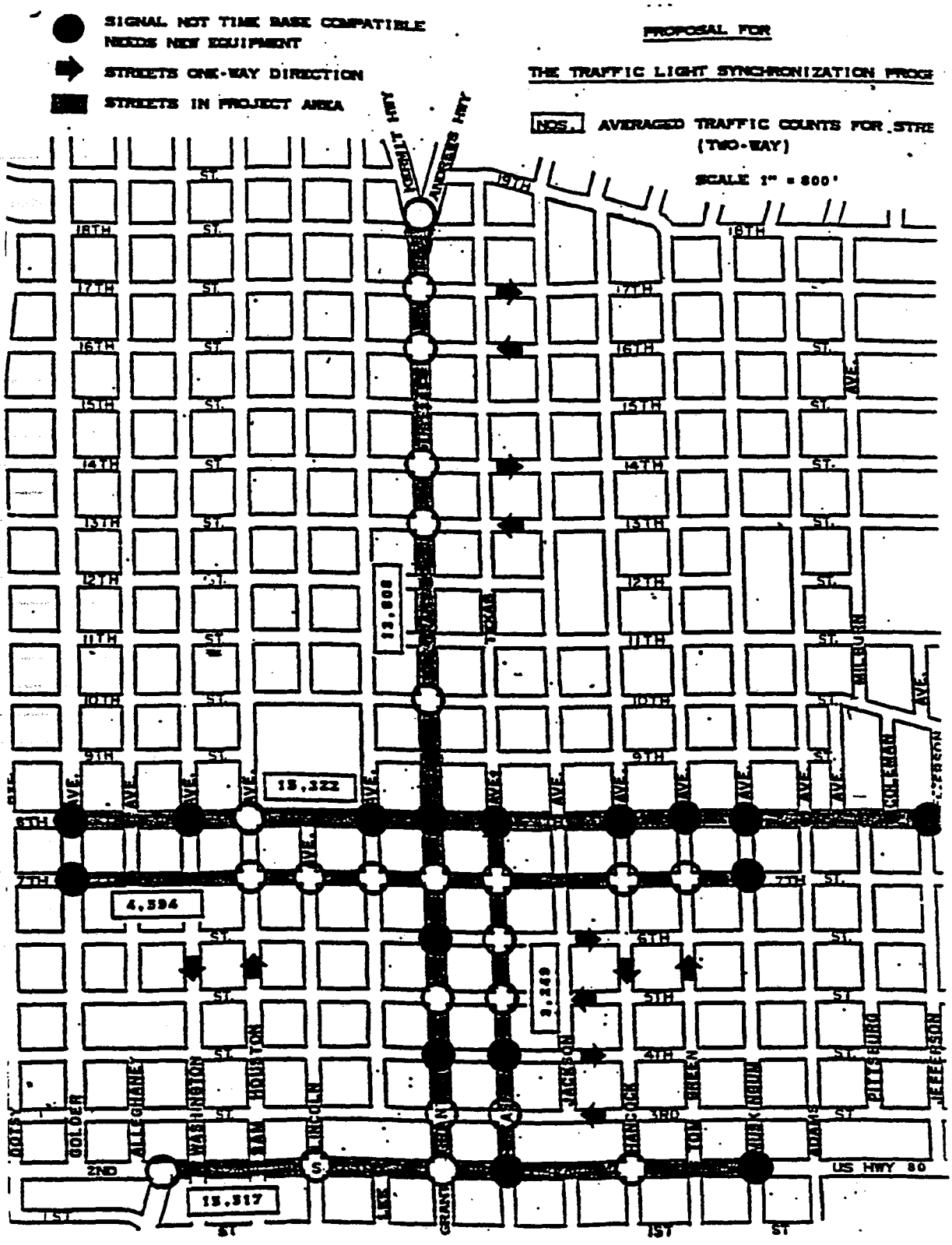
A total of five intersecting arterials consisting of 39 signals were included in the 8th Street Network System. 23 of these intersections already have time-base coordination but were coordinated via the old hardware interconnect system. The attached map displays the project network system and cross streets. As a result of the computer simulation runs, the City of Odessa recommended and installed new, state-of-the-art, time-base controller\coordination equipment. 17 of the 39 signals received this hardware, and five of these 17 received new controller cabinets.

In order to evaluate the system's performance, the "before" TLS traffic conditions were monitored and various field data were collected. The data included traffic volumes, saturation flow rates, travel times, travel delays, and an operating cost study. Upon selection of optimum timing plans, proposed green time for each intersection was evaluated with respect to delay time. Overall, the city benefitted because it reduced the number of stops, number of delays, and the fuel consumed. The TLS program has helped the City of Odessa unify its signal system and save fuel for its citizens through an overall reduction in delay. Odessa's changes were apparent since there overall system had not been improved in 40 years.

Based on the TRANSYT-7F simulation, the project had an estimated total annual cost savings of $6,071,120. This operating cost savings included a total annual savings of 31,844,286 stops (a 24.6 percent reduction), a total annual fuel savings of 57,300 gallons (a 2.4 percent reduction), and a total annual delay savings of 556,800 veh-hrs (a 31.6 percent reduction). The city continues to fine tune and recommend new hardware for the system as the need arises. Before this time, the city of Odessa never had a base to improve their signals. Now that they do, their improvements have extended to other signal system inside and outside the CBD. The total cost of the project was $59,027 and the resultant benefit to cost ratio was 103 to 1.

		STOPS		TOTAL SYSTEM DELAY (veh-hrs)		FUEL (gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	AM	26658	19795	358	182	493	435
	OFF	37564	30373	605	1065	762	1207
	PM	34827	28521	443	503	621	768
DIFFERENCES	AM	6863		176		58	
	OFF	7191		-460		-445	
	PM	6306		-60		-147	
HRS/DAY	AM	13.5		13.5		13.5	
	OFF	1		1		1	
	PM	1		1		1	
DAILY	AM	92651		2376		783	
	OFF	7191		-460		-445	
	PM	6306		-60		-147	
	TOTAL	106148		1856		191	
UNIT VALUES		$0.014		$10.00		$1.00	
ANNUAL SAVINGS		$445,820		$5,568,000		$57,300	

PROJECT COST:	$59,027	TOTAL ANNUAL SAVINGS:	$6,071,120
BENIFIT/COST RATIO:	102.85		


SIGNAL NOT TIME BASE COMPATIBLE
NEEDS NEW EQUIPMENT
STREETS ONE-WAY DIRECTION
STREETS IN PROJECT AREA
PROPOSAL FOR
THE TRAFFIC LIGHT SYNCHRONIZATION PROG
NOS. AVERAGED TRAFFIC COUNTS FOR STRE
(TWO-WAY)
SCALE 1" = 800'
18,808
15,322
4,394
2,269
15,317
US HWY 80

Memorial Dr./Gulfway Dr.

The Traffic and Engineering Staff of the City of Port Arthur worked with Traffic Engineers, Inc. on the following project. The project analyzes Memorial Dr. and Gulfway Dr., running in the north-south and east-west direction, respectively, in the Port Arthur area. Gulfway Dr. connects the refineries in the area and carries very heavy traffic in the peak periods. The attached map displays the project network system and cross streets.

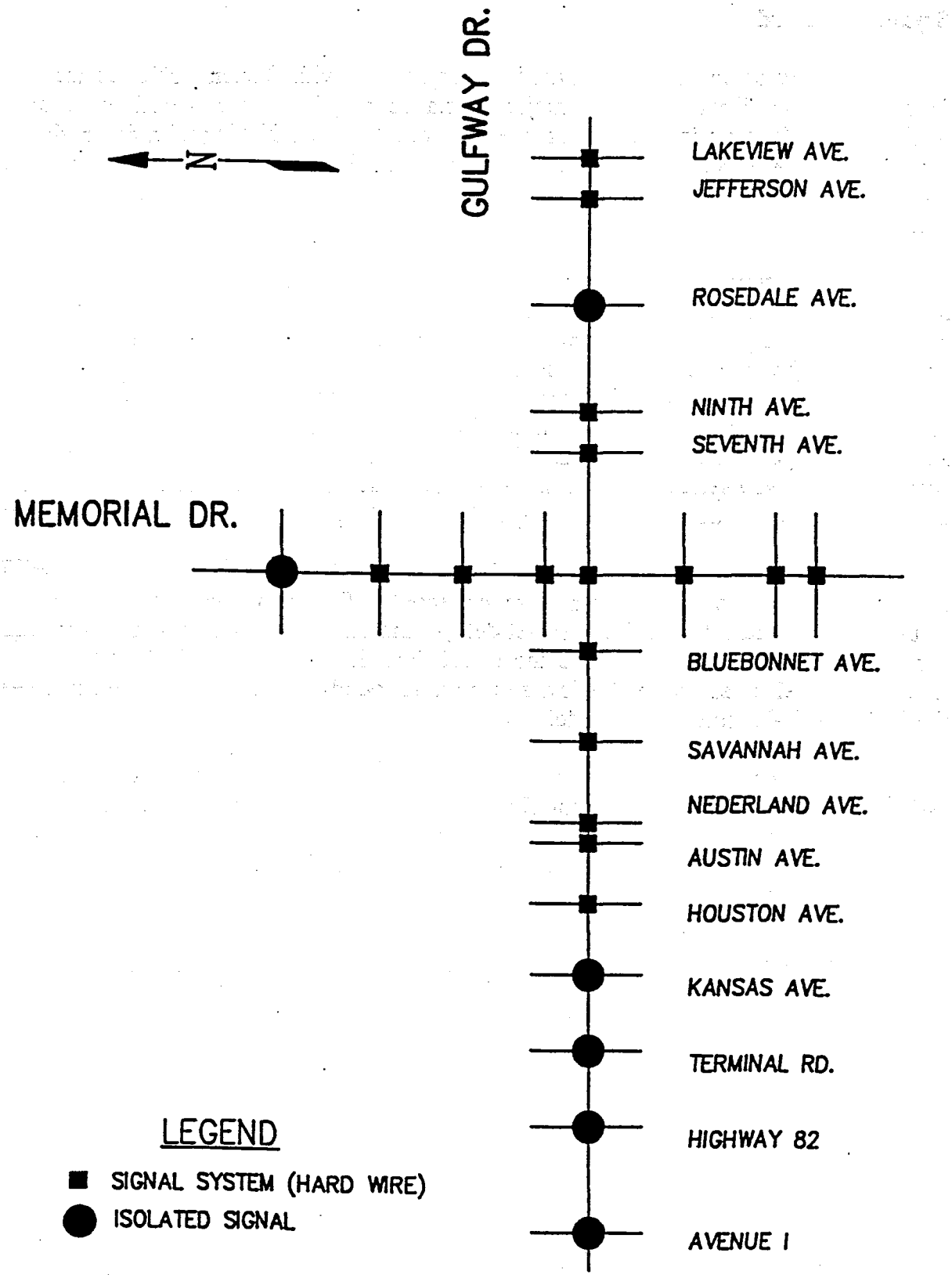
The project evaluated eight intersections along Memorial Dr. and 15 intersections along Gulfway Drive. With one exception, all intersections along Memorial Dr. were pretimed and interconnected. The intersection with 39th St. was operating in an actuated isolated mode. The controllers were using between two and seven phases. None of the intersections were equipped with pedestrian controls. While four intersections along the Gulfway Dr. are being operated in isolated mode, the rest are interconnected to a number of systems. Of the 15 intersections in the Gulfway Dr. project, one intersection is semi-actuated, one is fully actuated, and the remaining are pretimed. The controllers were using between two and eight phases. Only one intersection was equipped with pedestrian controls.

In order to evaluate the system performance, traffic conditions were monitored and various data were collected before implementation of any changes. This data was in the form of traffic volumes, saturation flow rates, travel times, and delays. While 15 minute volumes were collected for peak periods, hourly volumes were collected for the off-peak periods. Saturation flows were estimated in the field by using the method suggested in the TLS PASSER II training manuals. The volumes indicated that the PM peak volumes were far higher than the volumes during the rest of the day. The test car method was used to collect link travel times, average number of stops, and the stop locations.

PASSER II-87 simulation model was employed to optimize the phase splits and estimate delays. It was decided to operate Memorial Dr. independently from Gulfway Drive. Gulfway Dr., in turn, was broken into three sub-systems. NEMA controllers with time base coordinators were installed to facilitate coordination. In all, nine new controllers were installed. Implementing the new signal timings resulted in a total annual savings of about 1.4 million dollars to the motorists using this route. While the number of stops decreased by about 11 million (a decrease of about 16.1 percent), there were about 124,740 fewer hours of delay (a reduction of 21.9 percent), and fuel savings of about 27,000 gallons (a reduction of about 1.4 percent) in an year. There was a significant reduction (21 percent) in the travel times. The cost of the project was $109,000 with a benefit to cost ratio of 13 to 1.

		STOPS		TOTAL SYSTEM DELAY (veh-hrs)		FUEL (gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	AM	23812	19552	199.3	150	645	639.2
	OFF	20959	18015	161	135.5	597.4	602.4
	PM	29384	23335	288.3	194.3	772.9	713.3
DIFFERENCES	AM		4260		49.3		5.8
	OFF		2944		25.5		-5
	PM		6049		94		59.6
HRS/DAY	AM		1		1		1
	OFF		7		7		7
	PM		2		2		2
DAILY	AM		4260		49.3		5.8
	OFF		20608		178.5		-35
	PM		12098		188		119.2
	TOTAL		36966		415.8		90
UNIT VALUES			$0.014		$10.00		$1.00
ANNUAL SAVINGS			$155,257		$1,247,400		$27,000

PROJECT COST:	$109,213	TOTAL ANNUAL SAVINGS:	$1,429,657
BENIFIT/COST RATIO:	13.09		


N
GULFWAY DR.
LAKEVIEW AVE.
JEFFERSON AVE.
ROSEDALE AVE.
NINTH AVE.
SEVENTH AVE.
MEMORIAL DR.
BLUEBONNET AVE.
SAVANNAH AVE.
NEDERLAND AVE.
AUSTIN AVE.
HOUSTON AVE.
KANSAS AVE.
TERMINAL RD.
HIGHWAY 82
AVENUE I
LEGEND
SIGNAL SYSTEM (HARD WIRE)
ISOLATED SIGNAL

Bryant Boulevard

The City of San Angelo worked in conjunction with Barton Aschman Inc. on the following project. Bryant Blvd. is a major arterial running in the north-south direction, west of the CBD. It splits into a pair of one way streets called Koeingheim St. in the north direction and Abe St. in the south direction. The Bryant Blvd. system consists of 17 intersections. The attached figure illustrates the project network details, cross streets, and link distances.

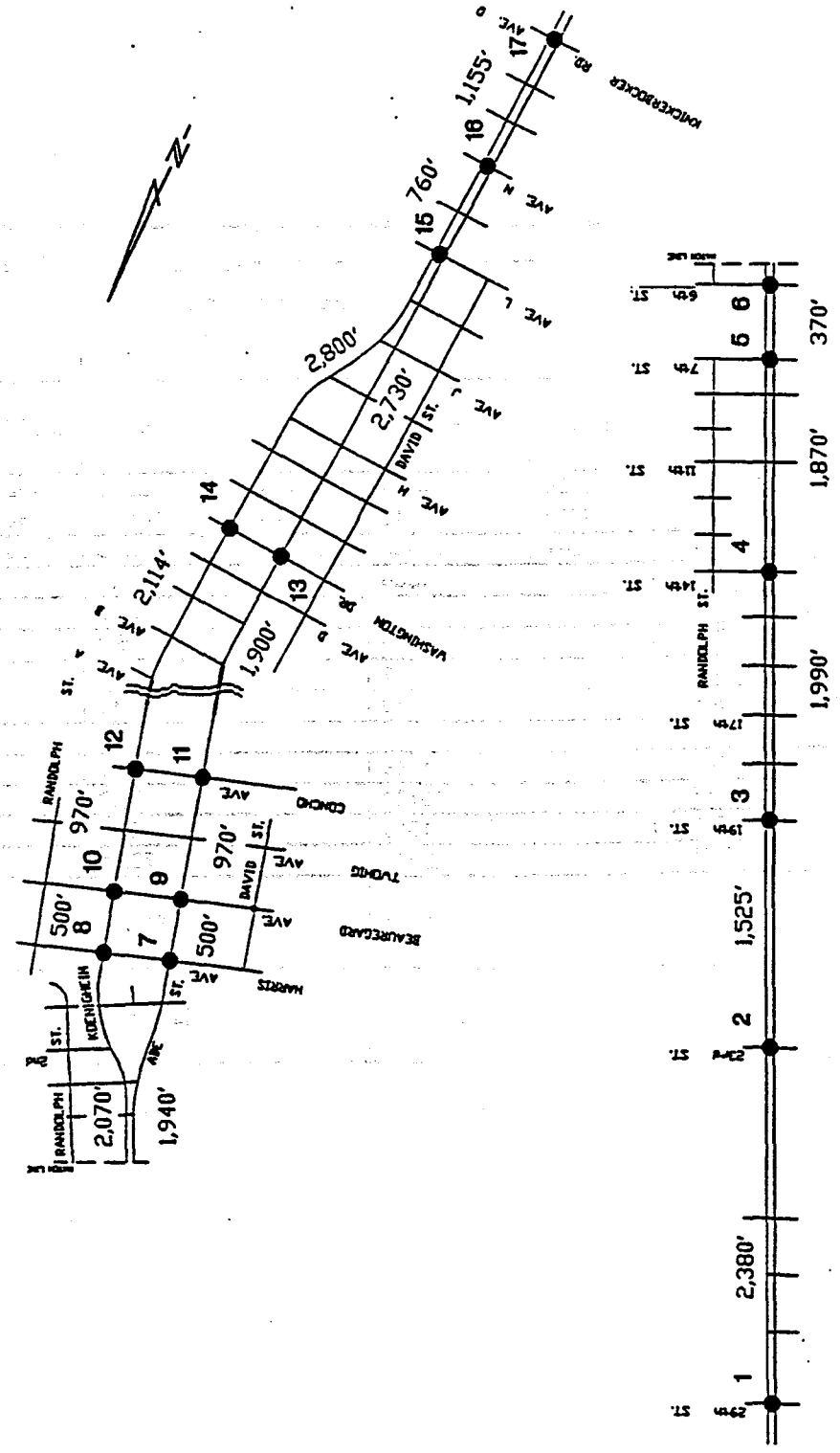
A single timing plan was utilized at all the intersections in the system with a few minor modifications at a few intersections. An 80 second cycle length was used at all the intersections. Eight of the seventeen intersections were actuated while the rest were pretimed. The controllers were using between two and five phases. None of the intersections had any pedestrian controls. A variety of controllers were operating the intersections. The modifications included installing a close-loop signal system. Hence, a new interconnect cable was needed. The existing controllers also needed to be replaced with NAZTEC 900 series controllers. New system detectors, mastarms, signal heads, and a microcomputer station were also proposed to be installed.

In order to evaluate the system performance, the "before" TLS traffic conditions were monitored and various field data were collected. The data included traffic volumes, saturation flow rates, travel times, travel delays, and an operating cost study. The floating car technique was used to evaluate the travel time data. This data included total travel time, link travel times, stopped delay, and running speeds. This data was used to calibrate the TRANSYT-7F simulation model.

TRANSYT-7F simulation model was used to optimize the signal timings, and to estimate offsets and delays. Minor fine-tuning of the offsets was done. Based on the TRANSYT-7F results, the project had an estimated $383,263 savings in annual operating cost. On an annual basis, the number of stops decreased by a total of 6.7 million (a 9.7 percent reduction), the fuel consumption decreased by 77,733 gallons (a 3.9 percent reduction), and the delay decreased by 21,153 veh-hrs (a 3.9 percent reduction). The new timings had a positive effect on reducing the travel times in the PM peak period. While, travel times slightly increased in the south-bound direction in the AM peak, they decreased by about 55 to 80 percent in the PM peak. The total cost of the project was $238,777 with a benefit to cost ratio of 2 to 1.

		STOPS		TOTAL SYSTEM DELAY (veh-hrs)		FUEL (gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	AM	16180	14814	129.84	122.33	490.53	477.05
	OFF	19028	17118	144.9	141.23	547.9	527.48
	PM	22847	20932	220.05	193.75	690.3	648.87
DIFFERENCES	AM	1366		7.51		13.48	
	OFF	1910		3.67		20.42	
	PM	1915		26.3		41.43	
HRS/DAY	AM	1		1		1	
	OFF	10		10		10	
	PM	1		1		1	
DAILY	AM	1366		7.51		13.48	
	OFF	19100		36.7		204.2	
	PM	1915		26.3		41.43	
	TOTAL	22381		70.51		259.11	
UNIT VALUES		$0.014		$10.00		$1.00	
ANNUAL SAVINGS		$94,000		$211,530		$77,733	

PROJECT COST:	$238,777	TOTAL ANNUAL SAVINGS:	$383,263
BENIFIT/COST RATIO:	1.61		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1,155'
760'
2,800'
2,730'
2,114'
1,900'
970'
970'
500'
500'
2,070'
1,940'
370'
1,870'
1,990'
1,525'
2,380'
RANDOLPH
DAVID
WASHINGTON
HARRIS
BEAUREGARD
TYDINGS
CONCHO
KOENIGHEIM
HANCKEBOCKER

Central Business District

The City of San Angelo worked in conjunction with Barton Aschman Inc. on the following project. San Angelo CBD system has 10 arterials and consists of 22 intersections. The attached figure illustrates the project network details, cross streets, and link distances.

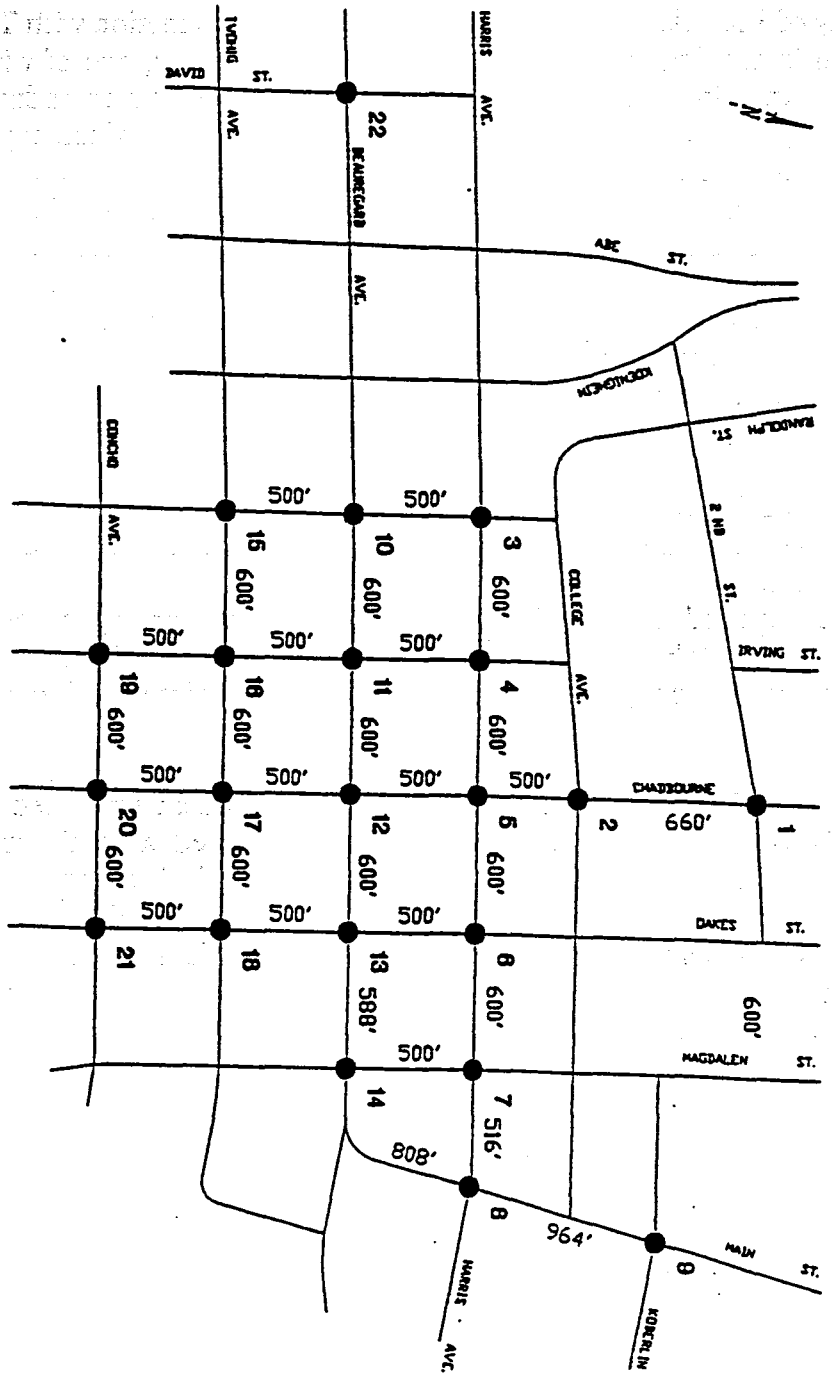
The existing signal system is a fixed-time coordinated system. The electromechanical controllers are interconnected by hardwire and coordinated from a central time-base coordinator. An 80 second cycle length was used at all the intersections. The modifications included installing a close-loop signal system. The existing controllers also needed to be replaced with NAZTEC 900 series controllers. New system detectors, mastarms, signal heads, and a microcomputer station were also proposed to be installed. The city decided to use the existing interconnect cable after making some repairs and modifications.

In order to evaluate the system performance, the "before" TLS traffic conditions were monitored and various field data were collected. The data included traffic volumes, saturation flow rates, travel times, travel delays, and an operating cost study. The floating car technique was used to evaluate the travel time data on three arterials. This data included total travel time, link travel times, stopped delay, and running speeds. This data was used to calibrate the TRANSYT-7F simulation model.

TRANSYT-7F simulation model was used to optimize the signal timings, and to estimate offsets and delays. Minor fine-tuning of the offsets was done to improve progression. Based on the TRANSYT-7F simulation, the project had an estimated $595,592 savings in annual operating cost. On an annual basis, the number of stops decreased by a total of 1.46 million (a 3.4 percent reduction), the fuel consumption decreased by 49,557 gallons (a 6.4 percent reduction), and the delay decreased by 52,551 veh-hrs (a 18.3 percent reduction). The new timings had a positive effect on reducing the travel times in all the time periods for the three arterials which were studied. The total cost of the project was $179,668 with a benefit to cost ratio of 3 to 1.

		STOPS		TOTAL SYSTEM DELAY (veh-hrs)		FUEL (gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	AM	7437	6879	46.17	44.73	132.99	128.62
	OFF	12541	12146	83.23	65.92	221.87	206.01
	PM	11453	11074	74.78	74.15	208.42	206.2
DIFFERENCES	AM	558		1.44		4.37	
	OFF	395		17.31		15.86	
	PM	379		0.63		2.22	
HRS/DAY	AM	1		1		1	
	OFF	10		10		10	
	PM	1		1		1	
DAILY	AM	558		1.44		4.37	
	OFF	3950		173.1		158.6	
	PM	379		0.63		2.22	
	TOTAL	4887		175.17		165.19	
UNIT VALUES		$0.014		$10.00		$1.00	
ANNUAL SAVINGS		$20,525		$525,510		$49,557	

PROJECT COST:	$179,668	TOTAL ANNUAL SAVINGS:	$595,592
BENIFIT/COST RATIO:	3.31		


IRVING ST.
HARRIS AVE.
BEAUREGARD AVE.
ABE ST.
COLLEGE AVE.
RANDOLPH ST.
N NB ST.
IRVING ST.
CHADBOURNE
DAKES ST.
MAGDALEN ST.
MAIN ST.
HARRIS AVE.
KOKERLIN
500'
600'
660'
588'
808'
964'
516'
22
15
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9

Navarro Street

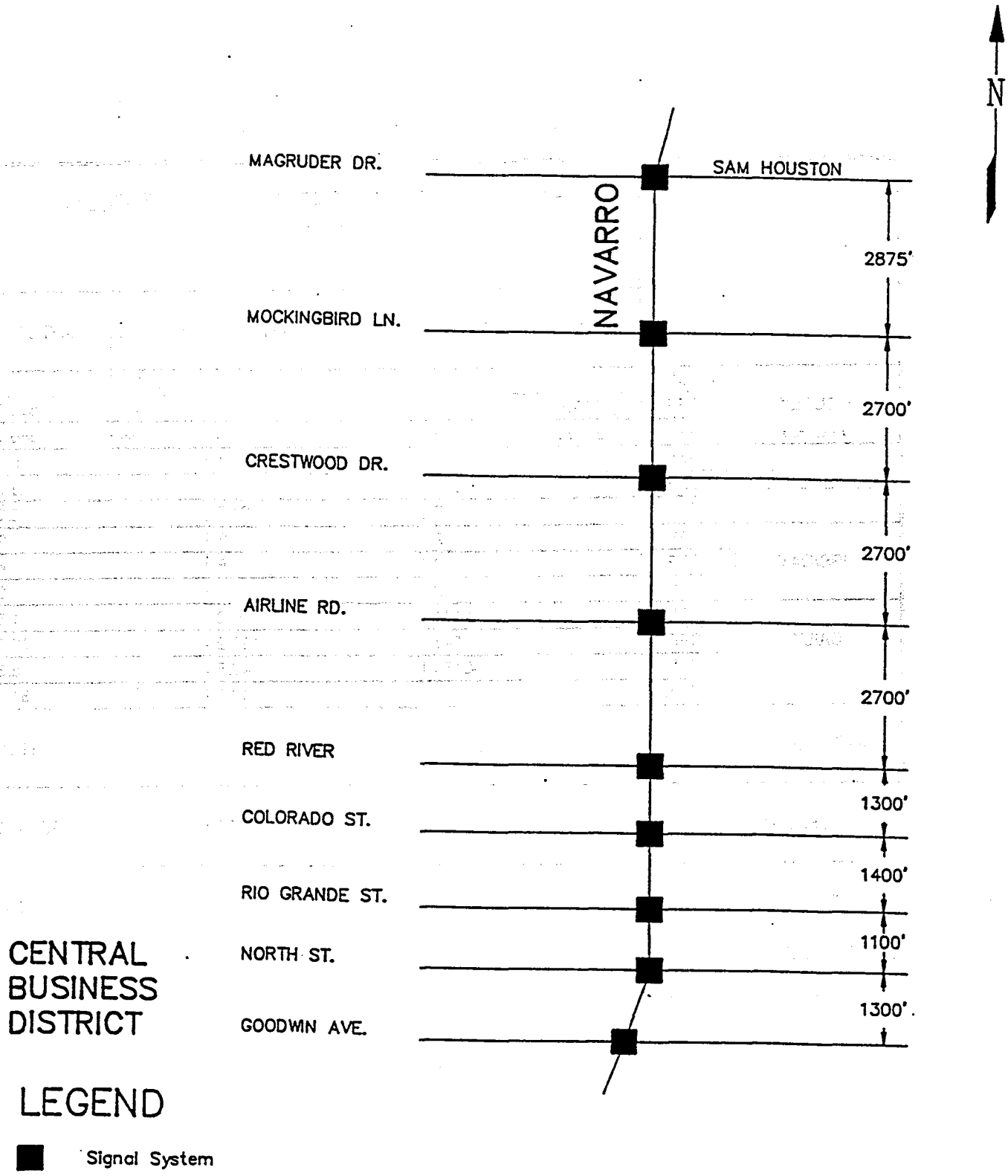
The City of Victoria Engineering Department, in conjunction with Traffic Engineers, Inc., worked on improving traffic signal timing on two arterials, one of which was Navarro Street. The Navarro Street System consists of nine traffic signals extending form Goodwin Avenue in the city's central business district to the northern area of the city. Navarro Street is the major north-south arterial in the City of Victoria. The signal system is interconnected with hardwire and under closed loop system monitoring. Intersection controllers were upgraded from electromechanical to solid state NEMA controllers as part of the TLS program. Before TLS, Airline Drive and Sam Houston Drive were operating isolated from the system under fully actuated control. These two intersections were incorporated into the overall signal coordination plans of the system. All the signals are actuated with various number of phases and some intersections have pedestrian controls. The attached map displays the project arterial, cross streets, and link distances.

"Before" and "after" conditions of the study were monitored in order to evaluate the system's performance of the TLS program. Basic traffic and intersection data (travel times and travel delays at each node), signal phasing, vehicle turning movements, and saturation flow rates were required at each intersection. The vehicle turning movement counts and intersection data were taken by collecting data during actual field studies during two hour periods in the morning, noon, and afternoon. The remaining information was obtained from data files.

Based on the PASSER II simulation, the project had an estimated total annual cost savings of $934,543. This operating cost savings included a total annual increase of 2,491,214 stops (a 4.2 percent increase), but a total annual fuel savings of 24,420 gallons (a 1.5 percent reduction), and a total annual delay savings of 94,500 veh-hrs (a 17.2 percent reduction). Travel times were reduced by an average of 5 percent and visual observation indicates improved traffic flow and reduced congestion. The total cost of the project was $62,679 and the resultant benefit to cost ratio was 15 to 1.

		STOPS		TOTAL SYSTEM DELAY (veh-hrs)		FUEL (gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	AM	17219	16172	149.9	111.8	464.9	464
	OFF	20346	21554	190.9	158.2	549	536.7
	PM	20939	22514	195.3	174	553	550.1
DIFFERENCES	AM	1047		38.1		0.9	
	OFF	-1208		32.7		12.3	
	PM	-1575		21.3		2.9	
HRS/DAY	AM	2		2		2	
	OFF	6		6		6	
	PM	2		2		2	
DAILY	AM	2094		76.2		1.8	
	OFF	-7248		196.2		73.8	
	PM	-3150		42.6		5.8	
	TOTAL	-8304		315		81.4	
UNIT VALUES		$0.014		$10.00		$1.00	
ANNUAL SAVINGS		($34,877)		$945,000		$24,420	

PROJECT COST:	$62,679	TOTAL ANNUAL SAVINGS:	$934,543
BENIFIT/COST RATIO:	14.91		


N
MAGRUDER DR.
SAM HOUSTON
NAVARRO
2875'
MOCKINGBIRD LN.
2700'
CRESTWOOD DR.
2700'
AIRLINE RD.
2700'
RED RIVER
1300'
COLORADO ST.
1400'
RIO GRANDE ST.
1100'
NORTH ST.
1300'
GOODWIN AVE.
CENTRAL BUSINESS DISTRICT
LEGEND
Signal System

Rio Grande Street

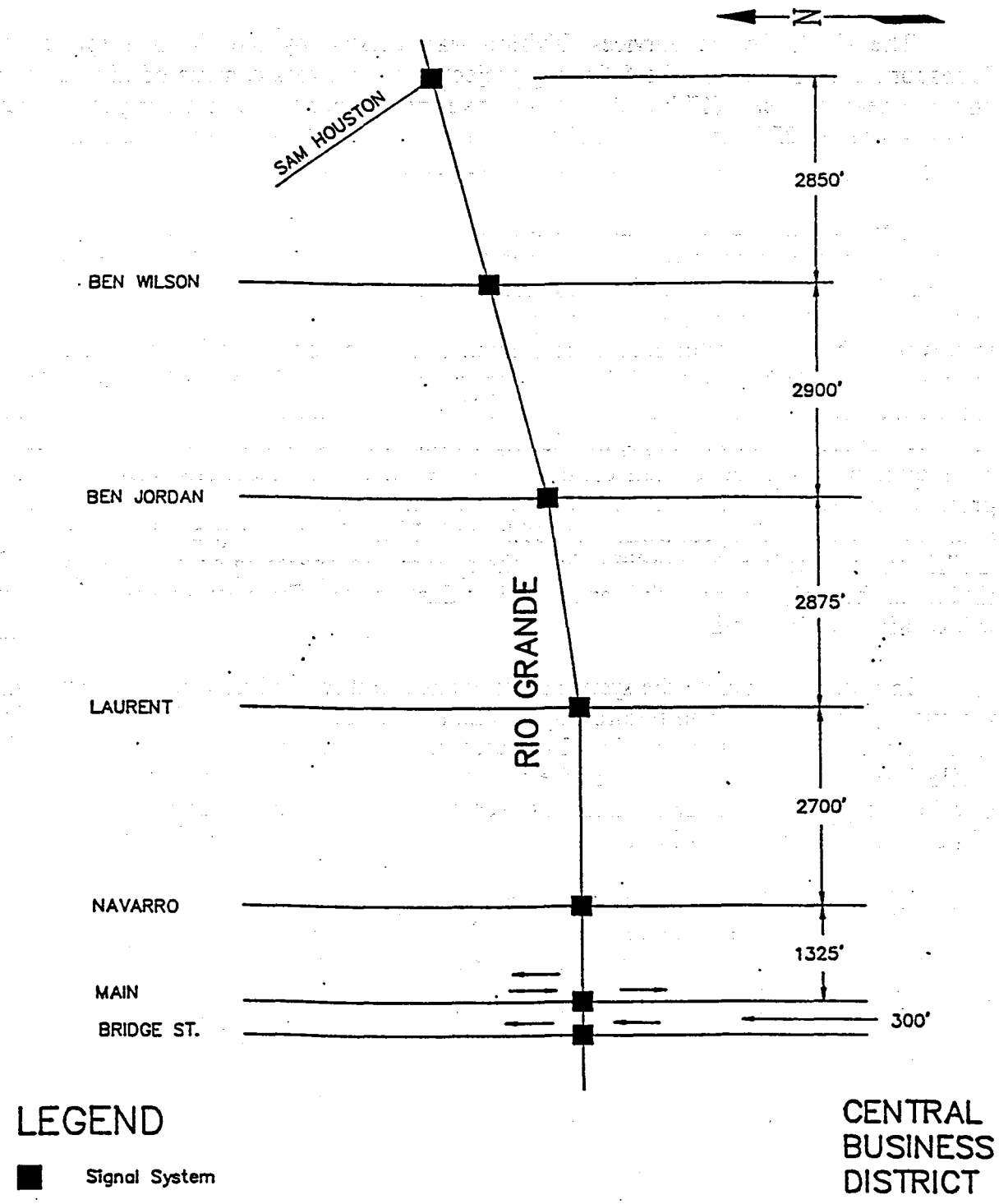
The City of Victoria Engineering Department, in conjunction with Traffic Engineers, Inc., worked on improving traffic signal timing on two arterials, one of which was Rio Grande Street. The Rio Grande Street System consists of seven traffic signals extending from Bridge Street to Sam Houston Street. The signal controllers were upgraded as part of the TLS project from electromechanical units to solid state NEMA controllers. Rio Grande is an east-west major arterial carrying tremendous traffic volumes, especially on the western segment closest to the central business district located just to the south. Bridge and Main streets are key crossing streets carrying traffic in and out of the downtown area. Navarro and Laurent streets are major north-south crossing arterials carrying large volumes of traffic. All the signals in the system are actuated with no pedestrian controls and under TBC control. The attached map displays the project arterial, cross streets, and link distances.

"Before" and "after" conditions of the study were monitored in order to evaluate the system's performance of the TLS program. Basic traffic and intersection data (travel times and travel delays at each node), signal phasing, vehicle turning movements, and saturation flow rates were required at each intersection. The vehicle turning movement counts and intersection data were taken by collecting data during actual field studies during two hour periods in the morning, noon, and afternoon. The remaining information was obtained from data files.

Based on the PASSER II simulation, the project had an estimated total annual cost savings of $464,960. This operating cost savings included a total annual savings of 2,838,571 stops (a 6.6 percent reduction), a total annual fuel savings of 17,220 gallons (a 1.5 percent reduction), and a total annual delay savings of 40,800 veh-hrs (a 10.8 percent reduction). Travel times were reduced by an average of 3 percent and visual observation indicates improved traffic flow and reduced congestion. The total cost of the project was $66,020 and the resultant benefit to cost ratio was 7 to 1.

		STOPS		TOTAL SYSTEM DELAY (veh-hrs)		FUEL (gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	AM	13353	11219	115.6	87.2	363	353
	OFF	14049	13591	120.7	115.4	382	379.1
	PM	16065	14842	151.1	127.4	414	404
DIFFERENCES	AM	2134		28.4		10	
	OFF	458		5.3		2.9	
	PM	1223		23.7		10	
HRS/DAY	AM	2		2		2	
	OFF	6		6		6	
	PM	2		2		2	
DAILY	AM	4268		56.8		20	
	OFF	2748		31.8		17.4	
	PM	2446		47.4		20	
	TOTAL	9462		136		57.4	
UNIT VALUES		$0.014		$10.00		$1.00	
ANNUAL SAVINGS		$39,740		$408,000		$17,220	

PROJECT COST:	$66,020	TOTAL ANNUAL SAVINGS:	$464,960
BENIFIT/COST RATIO:	7.04		


N
SAM HOUSTON
2850'
BEN WILSON
2900'
BEN JORDAN
2875'
RIO GRANDE
LAURENT
2700'
NAVARRO
1325'
MAIN
BRIDGE ST.
300'
LEGEND
Signal System
CENTRAL BUSINESS DISTRICT

S. 17th and S. 18th Streets

The City's Traffic Services Division was assisted by the Texas Department of Transportation to work on the following project. The network consists of 18 intersections on two one-way streets (17th and 18th) and five intersections on two other parallel pair of one-way streets (25th and 26th). All streets are north-south oriented. The attached map displays the project network system, cross streets, and link distances.

The pair of 17th and 18th streets is the only continuous north-south major arterial through the central part of Waco. It connects the outlying communities and the south Waco residential areas with downtown and north Waco. Prior to the project, the east-west progression in the project area was very poor. Thus motorists were diverting to Waco Drive to travel in the east-west direction resulting in congestion on Waco Drive. All except the intersection at 26th and Franklin were operating on two-phases before and after the modifications. The signal phasing at 26th and Franklin (master) was modified to operate in three phases by introducing split phasing on the cross-street. None of the intersections were equipped with pedestrian controls. While all the intersections were operating in pretimed mode before modifications, the intersection at 26th and Franklin was changed to actuated mode. The controller at 26th and Franklin was replaced as part of the modifications. Before the modifications, the system was operating on a single cycle length till late in the night after which it operated in a flash mode. The existing interconnect cable will continue to be used.

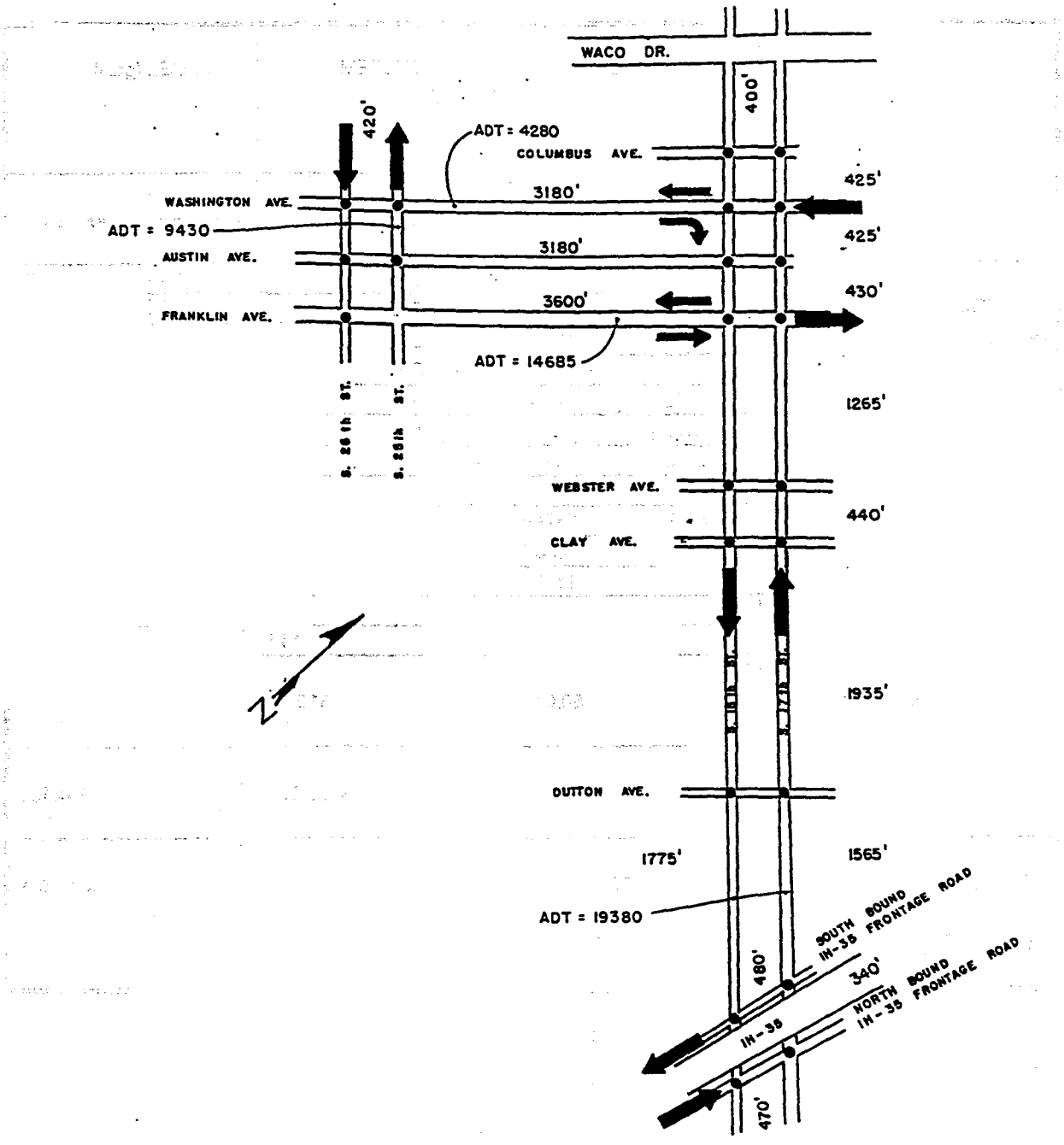
In order to evaluate the system performance, traffic conditions were monitored and various data were collected before implementation of any changes. This data was in the form of traffic volumes, saturation flow rates, travel times, and delays. EZ-TRANSYT PLUS Ver. 6.0 was used to estimate the saturation flow rates, lost times, and the extension of effective green. Test car method was used to collect link travel times, average number of stops, and the stop locations.

TRANSYT-7F simulation model was employed to obtain the phase splits and offsets for the network for the three peak periods. Significant fine tuning of the splits and offsets was done to improve the progression. Implementing the new signal timings resulted in a total annual savings of about $547,952 to the motorists using the network. While the number of stops decreased by about 2.7 million, there were about 46,575 fewer hours of delay, and a fuel savings of about 43,950 gallons in a year. While the values of stops, delays, and fuel consumption for the PM peak period indicate an increase, this increase can be attributed to the increase in the duration of the study period for the PM peak by about 1.5 hours. The average travel times decreased significantly on most of the links in the network. A few links consistently indicating an increase in the travel times were identified as bottle necks requiring further modifications. The total cost of the project was $25,211 with a benefit to cost ratio of 22 to 1.

		STOPS		TOTAL SYSTEM DELAY (veh-hrs)		FUEL (gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	AM	12637	10415	198	172	365	326
	OFF	9314	8418	57	47	213	196
	PM	14485	11769	112	67	346	285
HRS/SAY	AM	1.50	1.50	1.5	1.5	1.5	1.5
	OFF	6.75	5.25	6.75	5.25	6.75	5.25
	PM	1.75	3.25	1.75	3.25	1.75	3.25
VALUES/DAY	AM	18956	15623	297	258	548	489
	OFF	62870	44195	385	247	1438	1029
	PM	25349	38249	196	218	606	926
DIFFERENCES	AM	3333		39		59	
	OFF	18675		138		409	
	PM	-12900		-22		-320	
	TOTAL	9108		155		148	
UNIT VALUES		$0.014		$10.00		$1.00	
ANNUAL SAVINGS		$38,254		$465,000		$44,400	

PROJECT COST:	$25,211	TOTAL ANNUAL SAVINGS:	$547,654
BENIFIT/COST RATIO:	21.72		

Note: The PM peak study period has been increased by 1.5 hours and the Off peak study period has been decreased by 1 hour.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400'
420'
ADT = 4280
COLUMBUS AVE.
425'
WASHINGTON AVE.
3180'
ADT = 9430
425'
AUSTIN AVE.
3180'
430'
FRANKLIN AVE.
3600'
ADT = 14685
1265'
S. 26th ST.
S. 25th ST.
WEBSTER AVE.
440'
CLAY AVE.
1935'
DUTTON AVE.
1775'
1565'
ADT = 19380
SOUTH BOUND IH-35 FRONTAGE ROAD
480'
340'
NORTH BOUND IH-35 FRONTAGE ROAD
IH-35
470'

N. 25th and N. 26th Streets

The City's Traffic Services Division was assisted by the Texas Department of Transportation and Texas Transportation Institute to work on the following project. The project is located 0.7 miles north of Waco Drive. The network consists of two one-way streets. It is north-south oriented and consists of seven intersections. The attached map displays the project network system, cross streets, and link distances.

The area around the network is predominantly residential. Stops and unnecessary delays are observed in the morning peak and the evening peak as well as during the two school peak periods. The short cycle does not clear the queues formed in between 25th and 26th streets when the schools are let out.

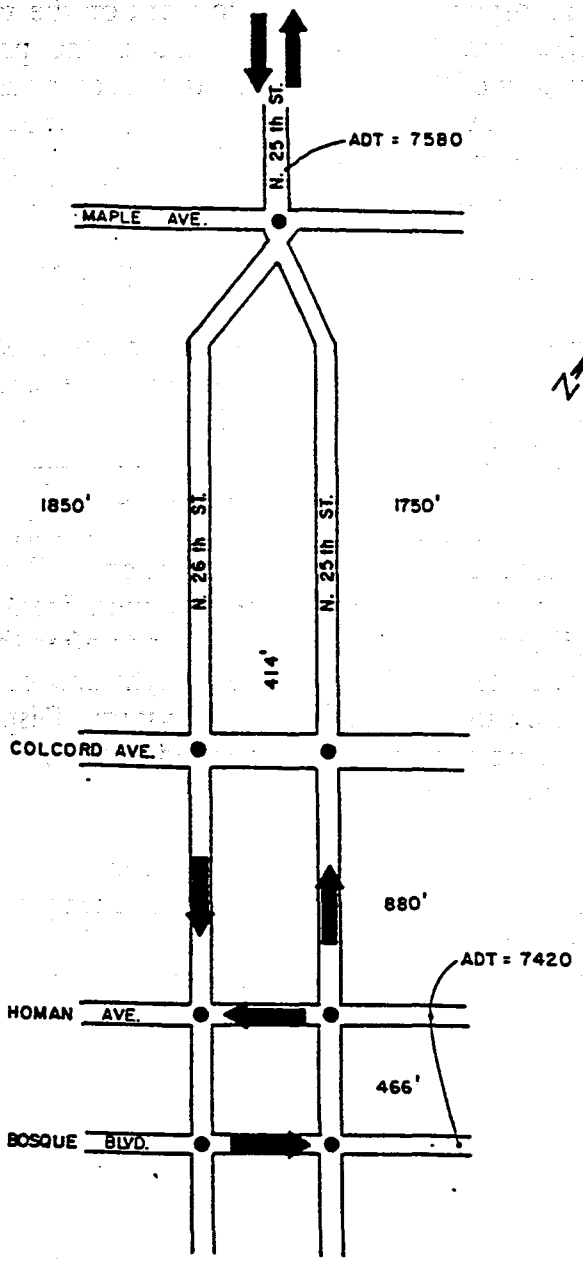
The intersections were operating on two-phases before and after the modifications. While only three of the intersections had pedestrian controls before the modifications, all the intersections were equipped with pedestrian controls as part of the TLS program. Three of the intersections were under actuated control. The remaining intersections were under pretimed control. Four controllers were replaced as part of the modifications. A master controller was located at 25th and Colcord and is capable of providing three cycles with three splits and offsets. However before the modifications, the system was operating on a single cycle length till late in the night after which it operated in a flash mode. Display upgrades like new mast arms and intersection wiring upgrades were provided by the city of Waco. The existing interconnect cable will continue to be used.

In order to evaluate the system performance, traffic conditions were monitored and various data were collected before implementation of any changes. This data was in the form of traffic volumes, saturation flow rates, travel times, and delays. EZ-TRANSYT PLUS Ver. 6.0 was used to estimate the saturation flow rates, lost times, and the extension of effective green. Test car method was used to collect link travel times, average number of stops, and the stop locations.

TRANSYT-7F simulation model was employed to obtain the phase splits and offsets for the network. Separate timing plans were obtained for the three peak periods. Significant fine tuning of the splits and offsets was done to improve the progression. Implementing the new signal timings resulted in a total annual savings of about $170,936 to the motorists using the network. While the number of stops decreased by about 2.61 million (a decrease of about 24.7 percent), there were about 11,049 fewer hours of delay (a reduction of 14 percent), and a fuel savings of about 24,000 gallons (a reduction of 13.3 percent) in a year. The average travel times decreased significantly on all the links in the network with the decrease more pronounced in the peak periods. In some of the links, the travel times decreased by as much as 91 seconds. The total cost of the project was $40,580 with a benefit to cost ratio of 4 to 1.

		STOPS		TOTAL SYSTEM DELAY (veh-hrs)		FUEL (gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	AM	4399	3131	31	25	75	61
	OFF	2039	1653	13	10	36	32
	NOON	3183	2622	20	20	54	50
	PM	5481	3878	37	31	93	79
DIFFERENCES	AM	1268		6		14	
	OFF	386		3		4	
	NOON	561		0		4	
	PM	1603		6		14	
HRS/DAY	AM	1		1		1	
	OFF	4.25		4.25		4.25	
	NOON	1.75		1.75		1.75	
	PM	3		3		3	
DAILY TOTALS	AM	1268		6		14	
	OFF	1641		12.75		17	
	NOON	982		0		7	
	PM	4809		18		42	
	TOTAL	8699		36.75		80	
UNIT VALUES		$0.014		$10.00		$1.00	
ANNUAL SAVINGS		$36,537		$110,250		$24,000	

PROJECT COST:	$40,579	TOTAL ANNUAL SAVINGS:	$170,787
BENIFIT/COST RATIO:	4.21		


N. 25 th ST.
ADT = 7580
MAPLE AVE.
N
1850'
N. 26 th ST.
414'
N. 25 th ST.
1750'
COLCORD AVE.
880'
ADT = 7420
HOMAN AVE.
466'
BOSQUE BLVD.

Waco Drive

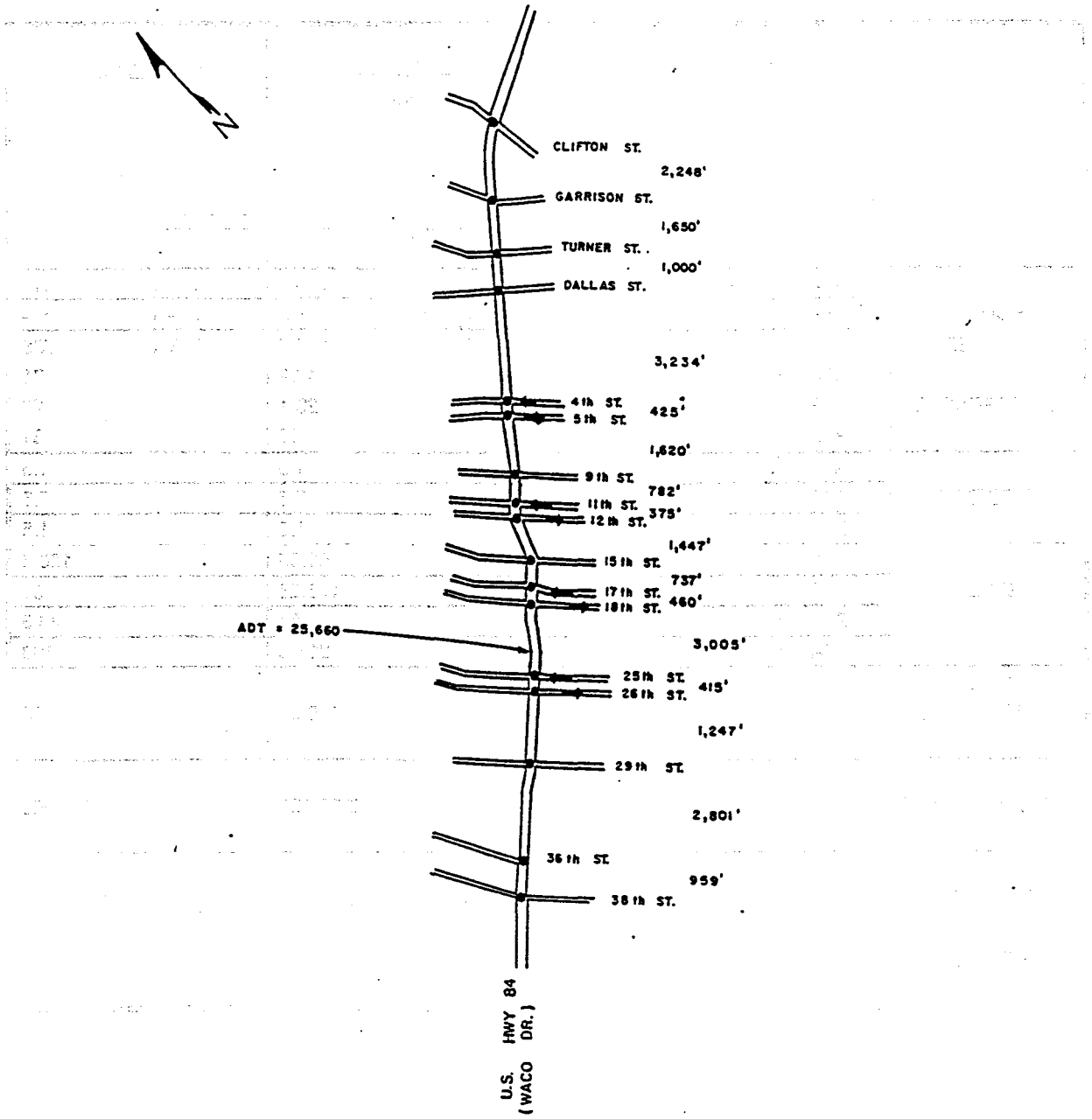
The City's Traffic Services Division was assisted by the Texas Department of Transportation and Texas Transportation Institute to work on the following project. The Waco Drive (US 84) project has 17 intersections and is the principal traffic carrier connecting the southwestern part of the town, which has a lot of industries, with the eastern part of the town. During the peak periods, Waco Drive is inundated by work trips and many motorists using shorter segments of the arterial for the same purpose. The attached map displays the project network system, cross streets, and the link distances.

Waco Drive is a median-divided, east-west, primary arterial carrying three traffic lanes in each direction from Clifton to N. 8th Street and two lanes each way between N. 8th and 38th Street. Left turn bays are present on all major and most minor cross-streets. Some bottle-necks exist in the segment containing two lanes in each directions. Modifying the phasing to protected-permissive is a viable solution to improve the operation at many intersections. Before the modifications, the intersections were using between two and five phases. However, minor modifications in the phasing were made and in after condition, between two and four phases were being used. Pedestrian controls were provided at only one of the intersections before and after the modifications. While only three of the intersections were under actuated control before the modifications, about eight new intersections had the capability to operate in actuated mode after the modifications. The remaining intersections were under pretimed control. Eight new controllers including the master controller were replaced to create a close loop system. Display upgrades like new mast arms and intersection wiring upgrades were provided by the city of Waco. The existing interconnect cable will continue to be used.

In order to evaluate the system performance, traffic conditions were monitored and various data were collected before implementation of any changes. This data was in the form of traffic volumes, saturation flow rates, travel times, and delays. PASSER II 90 was used to estimate the saturation flow rates, lost times, and the extension of effective green. Test car method was used to collect link travel times, average number of stops, and the stop locations.

PASSER II simulation model was employed to obtain the phase splits and offsets for the network. Minor fine tuning of the splits and offsets was needed to improve the progression. Implementing the new signal timings resulted in a total annual savings of about $1,117,157 to the motorists using the arterial. While the number of stops decreased by about 5 million (a decrease of about 6 percent), there were about 95,610 fewer hours of delay (a reduction of 20 percent), and a fuel savings of about 90,900 gallons (a reduction of 4.5 percent) in a year. The average travel times decreased by 151 seconds in the AM peak period (west-bound) and by 450 seconds in the PM period (east-bound). The total cost of the project was $40,580 with a benefit to cost ratio of 4 to 1.

		STOPS		TOTAL SYSTEM DELAY (veh-hrs)		FUEL (gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	AM	28981	26005	165.6	124.7	688	617
	OFF	25496	24138	142.3	119.2	594	574
	PM	30703	29333	220.5	164.5	769	738
DIFFERENCES	AM		2976		40.9		71
	OFF		1358		23.1		20
	PM		1370		56		31
HRS/DAY	AM		1.5		1.5		1.5
	OFF		7.5		7.5		7.5
	PM		1.5		1.5		1.5
DAILY	AM		4464		61.35		106.5
	OFF		10185		173.25		150
	PM		2055		84		46.5
	TOTAL		16704		318.6		303
UNIT VALUES			$0.014		$10.00		$1.00
ANNUAL SAVINGS			$70,157		$955,800		$90,900
PROJECT COST:			$45,417	TOTAL ANNUAL SAVINGS:			$1,116,857
BENIFIT/COST RATIO:			24.59				


N
CLIFTON ST.
2,248'
GARRISON ST.
1,650'
TURNER ST.
1,000'
DALLAS ST.
3,234'
4th ST.
5th ST.
425'
1,620'
9th ST.
782'
11th ST.
12th ST.
375'
1,447'
15th ST.
737'
17th ST.
18th ST.
460'
ADT = 25,660
3,005'
25th ST.
26th ST.
415'
1,247'
29th ST.
2,801'
36th ST.
959'
38th ST.
U.S. 84 HWY
(WACO DR.)

APPENDIX G

INDIVIDUAL PROJECT SUMMARIES

SMALL CITIES

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Individual Project Summaries - Small Cities

City	System	Reduction In Daily Totals			Total Annual Savings ($)	Total Cost ($)	B/C Ratio	Page
		Stops	Delay (veh-hrs)	Fuel (gals)				
Addison	Addison System	45,558	5,239.09	1,594.11	16,386,845	84,891	192.83	G- 5
Brownwood	Brownwood CBD	29,218	70,260.00	26,376.00	125,854	39,427	3.19	G- 8
Corsicana	Corsicana CBD	32	2.76	(2.45)	7,679	59,771	0.13	G-11
Del Rio	US 90-Avenue	39,317	517.20	230.40	1,785,851	41,806	42.72	G-14
DeSoto	Hampton	20,327	261.43	390.65	986,841	56,279	17.53	G-17
Duncanville	Santa Fe	2,061	8.31	12.03	37,195	18,021	2.06	G-20
Euless	Main Street	7,896	435.80	1,102.55	1,671,326	28,518	58.61	G-23
Highland	Mockingbird/Preston	28,923	1,235.04	995.61	4,125,280	82,500	50	G-26
Hurst	Hurst Boulevard	4,911	35.14	(6,065.00)	124,049	46,842	2.65	G-29
	Pipeline Road	1,933	26.95	35.97	99,758	25,920	3.85	G-32
Marble Falls	US 281	29,522	139.95	387.63	660,129	30,041	21.97	G-35
Mineral Wells	Central Business District	5,410	55.66	64.86	209,160	35,383	5.91	G-38
Orange	Green Avenue (BU 90Y)	67,235	3,044.40	1,186.66	9,771,585	31,147	313.72	G-41
Round Rock	RM 620	26,239	360.00	480.00	1,333,784	12,151	109.77	G-44
San Marcos	Central Business District	28,562	3,485.00	1,080.00	10,898,960	41,687	261.45	G-47
Taylor	SH 95 System	10,947	4.85	85.13	86,066	61,188	1.41	G-50
Temple	1st/3rd	39,707	122.15	80.36	557,329	12,123	45.97	G-53
	31st Street	95,327	1,879.75	475.53	6,182,284	2,324	2660.19	G-56
	57th Street	5,048	(150.46)	47.93	(415,787)	7,692	-54.06	G-59
	Avenue H	10,184	15.10	25.35	95,679	5,520	17.33	G-62
	Avenue M	33,865	273.15	160.59	1,009,858	5,076	198.95	G-65
	Central/ Adams	45,254	921.33	1,034.89	3,264,530	10,374	314.68	G-68
Texarkana	Highway US 82	12,937	89.73	61.36	341,991	38,326	8.92	G-71
University Park	Hillcrest Road System	33,074	62.00	218.00	390,311	42,347	9.22	G-74
	Preston Road System	17,984	(25.00)	85.00	26,033	42,347	0.61	G-77
West Lake Hills	RM 2244	43,885	1,018.00	923.50	3,515,365	110,563	31.8	G-80

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Addison System

The Town of Addison worked on the following project. They were assisted by Barton-Aschman Associates, Inc. The study network consisted of 22 intersections on 4 arterials. The attached map displays the project network system, cross streets, and link distances. Numerous types of controllers were operating the intersections before any changes were made to the operation. However, nineteen new multisonic 820A traffic signal controllers were purchased and have replaced the old controllers. All the intersections, except for the seven on Belt Line, were isolated and "ran free" throughout the entire day for the "before" study. The isolated/actuated intersections had a minimum green time of five seconds for through movement and the left turn movement, with a combined yellow and all red time of approximately four seconds. Each of the intersections had between three to six phases. All of the intersections were equipped with pedestrian controls.

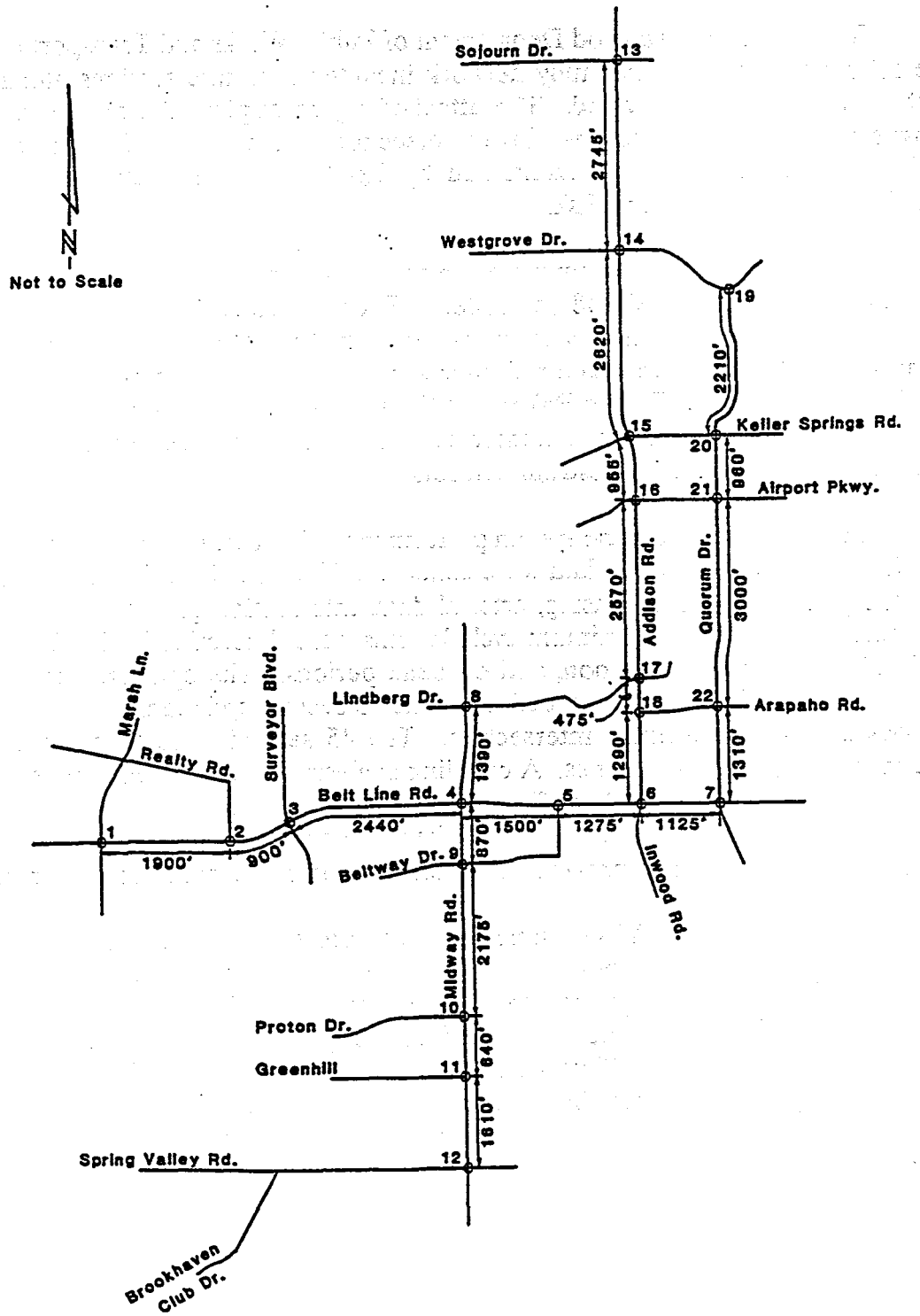
The "before" and "after" TLS traffic conditions were collected and calibrated. TRANSYT-7F and PASSER II signal timing optimization computer programs were used to calibrate/evaluate and optimize the network, respectively. The arterial data was collected in the form of peak hour turning movement volumes, signal phasing and timings, and network travel time data using the floating car technique. Hourly volumes were collected in the AM, noon, and PM peak periods and an off-peak period in 15 minute intervals.

Calibration studies for "before" and "after" conditions were conducted to check the validity of TRANSYT-7F replicating actual field measurements. Travel time studies were conducted and compared with the output from TRANSYT. The differences between the observed and theoretical (TRANSYT output) travel times were less than 20 percent. Signal timing, phasing, and offsets were obtained using PASSER II. Cycle lengths for each peak period were dictated by the cycle length of Belt Line Rd. While the cycle length for Midway Rd and Addison Rd matches the cycle length on the Belt Line Rd, Quorum Dr was found to run better "free" than at "fixed" cycle length for all peak periods.

Implementing the new signal-timings resulted in a total annual savings of about 16.3 million dollars to the motorists using these routes. These savings included 13.6 million fewer stops (a reduction of about 11 percent), 1.5 million veh-hrs of lesser delay (a reduction of about 54 percent), and a reduced fuel consumption of about 0.5 million gallons (a reduction of about 12.5 percent) in an year. The average travel times (ATT) in the north-bound and south-bound directions remained nearly constant on Quorum Rd. The ATT on the remaining arterials decreased significantly for the peak as well as off-peak periods in the north/east-bound and south/west directions, with the exception of Addison Rd in the south-bound direction for which the ATT increased slightly. The signal timing and coordination for the Addison System has improved the progression in the area and has been a worthwhile project. The project has cost roughly about $85,000 and has a benefit to cost ratio of 193 to 1.

		STOPS		TOTAL SYSTEM DELAY (veh-hrs)		FUEL (gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	AM	39955	38533	1268.75	537.75	1519.91	1225.64
	OFF	32513	28917	557.49	315.03	812.94	872.32
	NOON	36120	30429	1198.91	630.19	1449.1	1131.02
	PM	45762	39679	2325	567.77	2432.81	916.63
DIFFERENCES	AM	1422		731		294.27	
	OFF	3596		242.46		-59.38	
	NOON	5691		568.72		318.08	
	PM	6083		1757.23		1516.18	
HRS/DAY	AM	1		1		1	
	OFF	9		9		9	
	NOON	1		1		1	
	PM	1		1		1	
DAILY TOTALS	AM	1422		731		294.27	
	OFF	32362		2182.14		-534.42	
	NOON	5691		568.72		318.08	
	PM	6083		1757.23		1516.18	
	TOTAL	45558		5239.09		1594.11	
UNIT VALUES		$0.014		$10.00		$1.00	
ANNUAL SAVINGS		$191,342		$15,717,270		$478,233	

PROJECT COST:	$84,981	TOTAL ANNUAL SAVINGS:	$16,386,845
BENIFIT/COST RATIO:	192.83		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Not to Scale
Sojourn Dr.
13
2745'
Westgrove Dr.
14
19
2820'
2210'
15
Keller Springs Rd.
20
955'
960'
16
21
Airport Pkwy.
2870'
Addison Rd.
Quorum Dr.
3000'
17
Lindberg Dr.
8
18
22
Arapaho Rd.
475'
1390'
1290'
1310'
Marsh Ln.
Surveyor Blvd.
Realty Rd.
Belt Line Rd.
4
5
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7
3
1
2
2440'
1500'
1275'
1125'
870'
1900'
900'
Beltway Dr.
9
Inwood Rd.
Midway Rd.
2175'
10
Proton Dr.
Greenhill
11
640'
1610'
Spring Valley Rd.
12
Brookhaven Club Dr.

Brownwood CBD

The City of Brownwood Department of Public Works and Transportation worked on the following project. The study network included nine intersections along five arterials within the City of Brownwood. The attached figure displays the project network system, cross streets, and link distances. Five intersections are maintained by the city and four by TxDOT. The intersections maintained by TxDOT include Main/Baker, Main/Austin, Austin/Center, and Austin/Fisk.

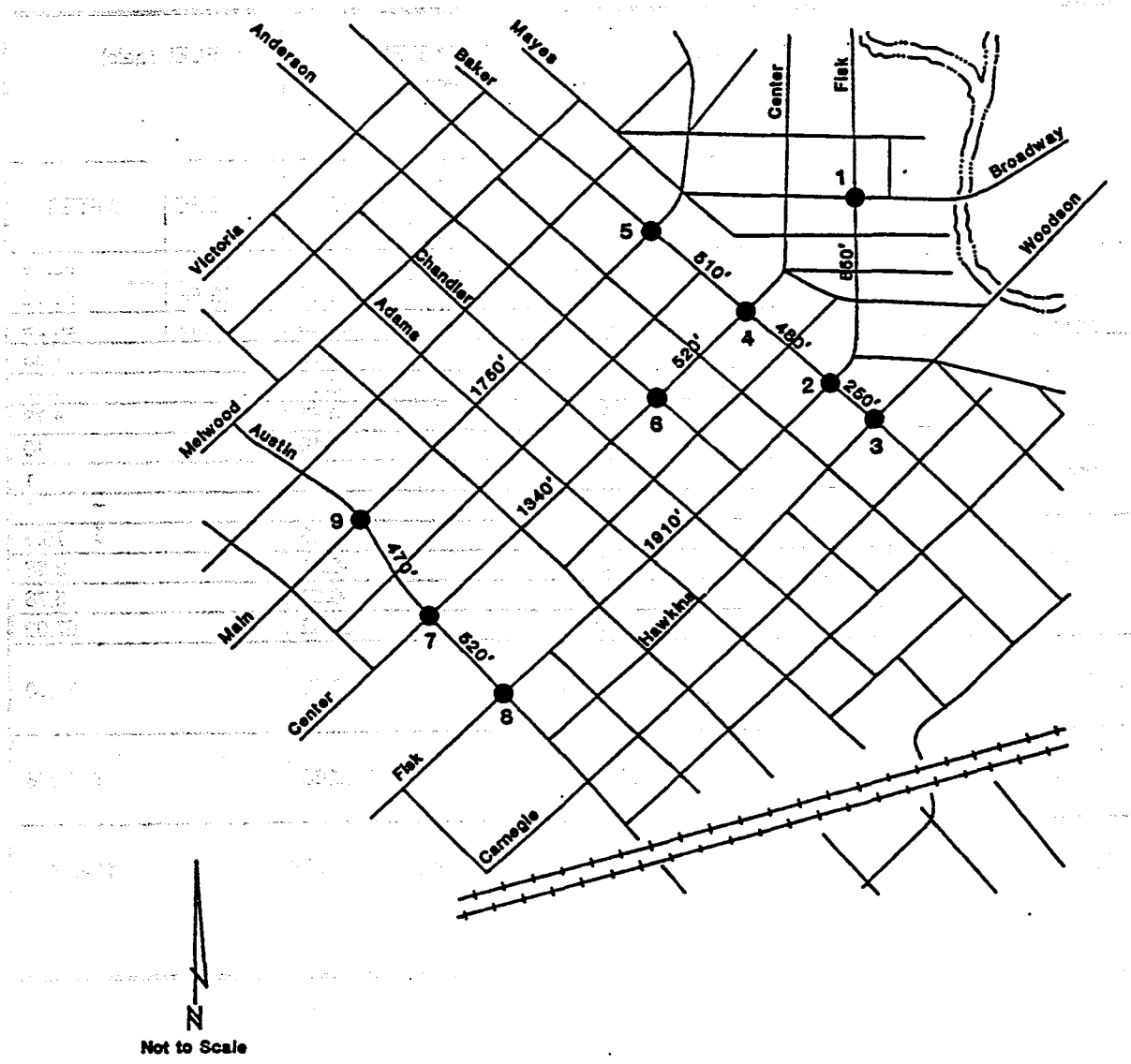
The signals in this system were controlled by five new NAZTEC 900 controllers and four existing NAZTEC NT848 controllers. Each controller was installed with time-based coordination. Loop detectors were installed at the five city maintained intersections. The signals at Austin/Main and Baker/Center were full-actuated signals. All other signals were semi-actuated signals. Except Baker and Center, each intersection was resting in green on the non-actuated movements. All intersections had two or three signal phases. The signals were not equipped with pedestrian controls.

In order to evaluate the system performance, the "before" TLS traffic conditions were monitored and various field data were collected. 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 morning, afternoon, and off-peak periods. The optimized cycle lengths were between 45 and 75 seconds, respectively. The 75 second cycle length occurred during peak periods at the Main/Austin intersection. The 45 second cycle length was predicted on minimum pedestrian walk times. A coupling analysis was conducted for the Off, Noon, and PM peak periods using 1991 traffic counts conducted by Barton-Aschman Associates, Inc. This was used to identify the locations where coordination was needed between adjacent signalized intersections to provide smoother flow of traffic along specific corridors.

Based on TRANSYT-7F simulation, the project resulted in an estimated $125,000 savings per year on total operating cost, a direct benefit to motorists using these routes. This operating cost savings included a total savings of 2,086,980 stops (a 12.7 percent reduction), a total annual fuel savings of 26,376 gallons (a 9.5 percent reduction), and a delay annual savings of 7,026 veh-hrs (a 7.7 percent reduction). The results also revealed a reduction in travel and running times as well as an increase in average run speeds during each period in each direction. The total cost of the project was $39,000, and the resultant benefit to cost ratio was 3 to 1.

		STOPS		TOTAL SYSTEM DELAY (veh-hrs)		FUEL (gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	OFF	4352	3810	24.1	20.87	73.62	65.79
	NOON	5478	4862	30.16	38.37	93.58	89.72
	PM	5812	4892	33.41	34.08	96.05	90.29
DIFFERENCES	OFF	542		3.23		7.83	
	NOON	615		-8.21		3.86	
	PM	920		-0.67		5.76	
HRS/DAY	OFF	10		10		10	
	NOON	1		1		1	
	PM	1		1		1	
DAILY	OFF	5421		32.3		78.3	
	NOON	615		-8.21		3.86	
	PM	920		-0.67		5.76	
	TOTAL	6957		23.42		87.92	
UNIT VALUES		$0.014		$10.00		$1.00	
ANNUAL SAVINGS		$29,218		$70,260		$26,376	

PROJECT COST:	$39,427	TOTAL ANNUAL SAVINGS:	$125,854
BENIFIT/COST RATIO:	3.19		


Anderson
Baker
Mayes
Center
Flak
Broadway
Woodson
Victoria
Chandler
Adams
Melwood
Austin
Main
Center
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Carnegie
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1340'
1910'
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520'
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Not to Scale

Corsicana CBD

The Corsicana Engineering Department along with Barton-Aschman Inc. worked on the following project. Fourteen intersections formed by eight streets were included in the CBD project. The attached map displays the project network system, cross streets, and link distances.

Each of the intersections in the CBD system were controlled by an electromechanical three dial controller with a two-phase operation. A single timing plan having a cycle length of 60 seconds was utilized throughout the day. Five of the fourteen intersections had pedestrian controls. The system was operated in a flashing mode from 6:30 p.m. to 7:00 a.m. As part of the improvements, the existing electromechanical controllers were replaced by NAZTEC 124F controllers. This was done to improve the reliability as well as to reduce the maintenance costs of the controllers.

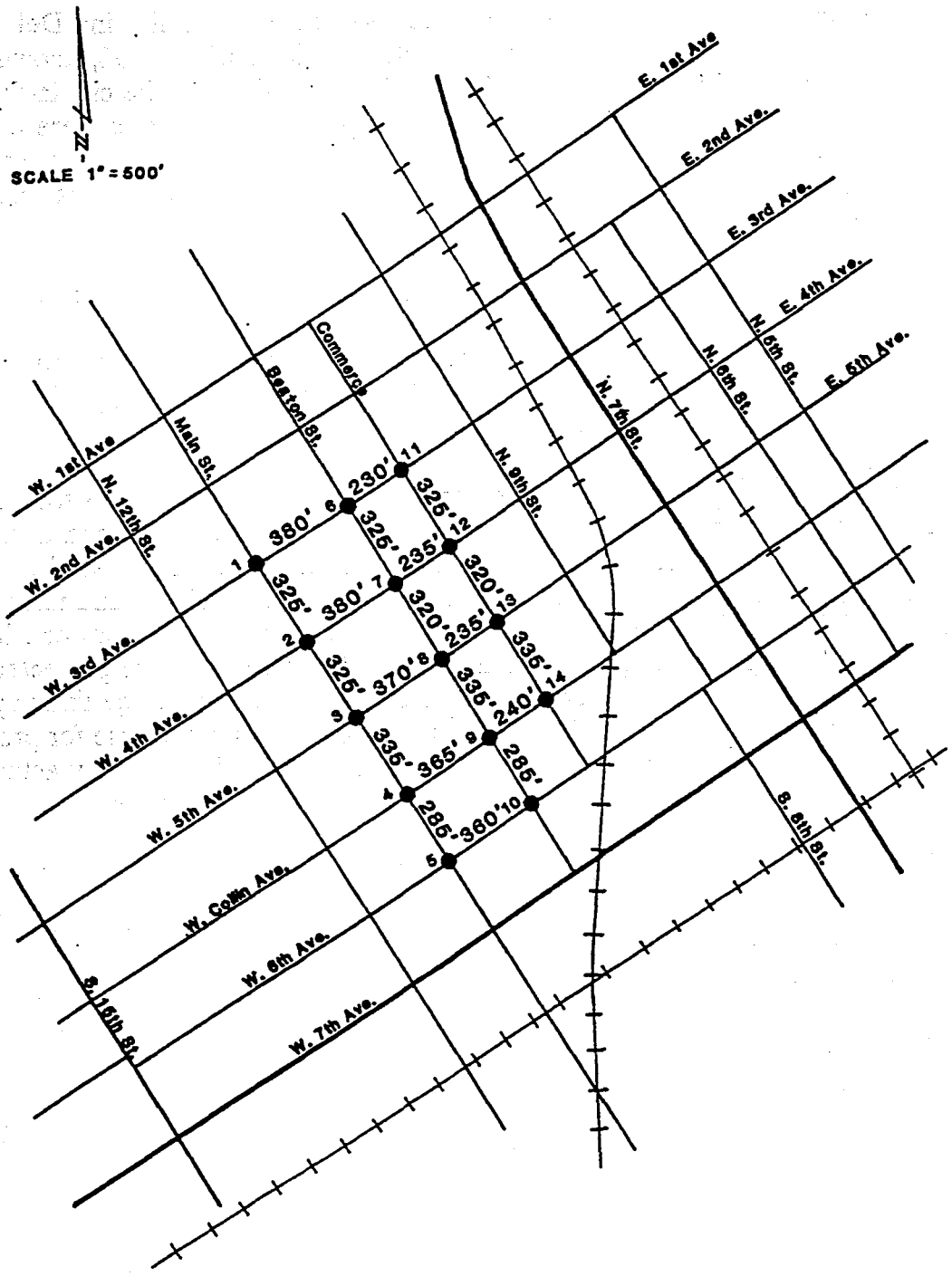
In order to evaluate the system performance, traffic conditions were monitored and various data were collected before implementation of any changes. This data was in the form of traffic volumes, travel times, and delays. Twenty four counts were made at the intersections. Hourly volumes were later collected for the study periods. Test car method was used to collect link travel times, stopped delay, and running speeds. While 28 seconds of green was provided at all the intersections in the north-south direction, 26 seconds of green was provided in the east-west direction. Three seconds of yellow was provided in both the directions.

TRANSYT-7F simulation model was employed to optimize the phase splits and to estimate delays. Timings were fine tuned in the field after implementing the improvements. Several timing plans were developed for different time periods. However, it was later found that only one of the hardwire interconnect cable could be used. Hence, only the PM peak timing plan could be maintained with coordination and the same was used for the entire day. The system was operated in a flashing mode from 6:30 p.m. to 6:30 a.m.

Implementing the new signal timings resulted in a total annual savings of about $7,679 to the motorists using this route. The number of stops decreased by about 9,600 (a decrease of under 1 percent) and the delay decreased by about 828 veh-hrs (a decrease of 2.3 percent). However, the fuel consumption increased by about 735 gallons (a marginal increase of about 0.9 percent) in an year. The travel times were observed to decrease marginally in the PM peak period. Implementation of this timing plan resulted in an expenditure of about $59,770. A major component of the expenditure was the purchase of Naztek controllers. Even though the benefit to cost ratio was 0.13 to 1, there was a marginal improvement in the traffic performance in the network. A revised timing plan to be implemented in future and applicable for all times of the day is expected to increase the savings to about $64, 271 with a benefit to cost ratio of about 1 to 1.

		STOPS		TOTAL SYSTEM DELAY (veh-hrs)		FUEL (gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	AM	1519	1499	8.41	8.29	16.88	18.65
	OFF	1718	1714	9.51	9.27	21.7	21.51
	PM	2593	2621	14.67	14.43	29.83	32.41
DIFFERENCES	AM		20		0.12		-1.77
	OFF		4		0.24		0.19
	PM		-28		0.24		-2.58
HRS/DAY	AM		1		1		1
	OFF		10		10		10
	PM		1		1		1
DAILY	AM		20		0.12		-1.77
	OFF		40		2.4		1.9
	PM		-28		0.24		-2.58
	TOTAL		32		2.76		-2.45
UNIT VALUES			$0.014		$10.00		$1.00
ANNUAL SAVINGS			$134		$8,280		($735)

PROJECT COST:	$59,771	TOTAL ANNUAL SAVINGS:	$7,679
BENIFIT/COST RATIO:	0.13		


N
SCALE 1" = 500'
E. 1st Ave
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E. 3rd Ave.
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E. 5th Ave.
W. 1st Ave
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W. 3rd Ave.
W. 4th Ave.
W. 5th Ave.
W. Colin Ave.
W. 6th Ave.
W. 7th Ave.
N. 12th St.
Main St.
Beaton St.
Commerce
N. 9th St.
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336'
285'

US 90 - Avenue F

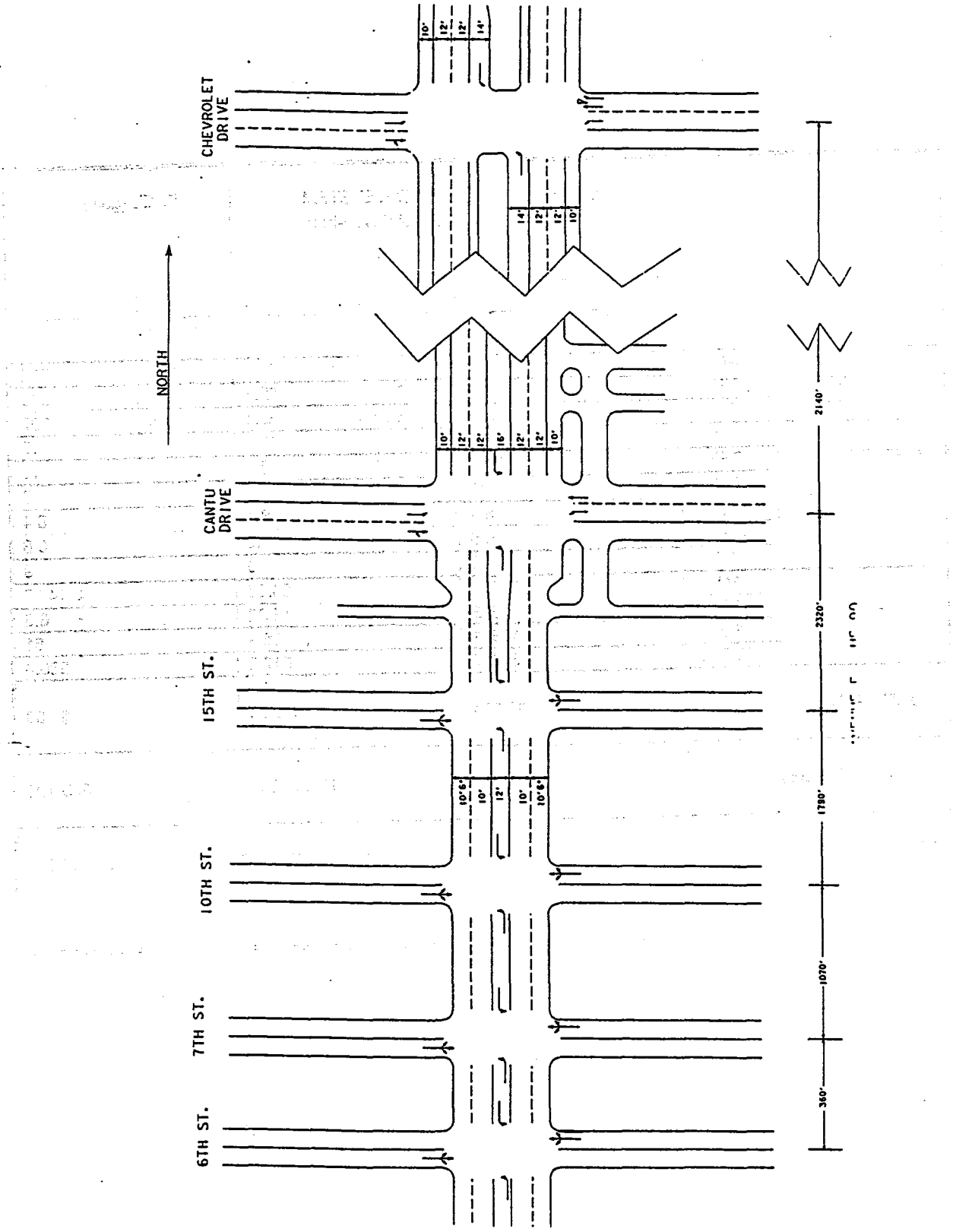
The District 7 Traffic Office of TxDOT worked on the following Del Rio project. Del Rio is a small city with an estimated population of 33,000. US 90, known as Avenue F, is the major arterial in Del Rio, carrying traffic into and out of the city in the north and west directions. Before this project began, the signals in this system were controlled by mechanical pretimed controllers and one solid state traffic actuated controller. New time base solid state controllers were installed before timing and phasing changes were implemented.

A total of six intersections along a 1.4 mile section of roadway were included in the US 90 project. The attached map displays the project arterial, cross streets, and link distances. All intersections have between two and four phases. None of the signals in this system are equipped with pedestrian controls. Phasing modification was performed for three signals.

In order to evaluate the system's performance, the "before" TLS traffic conditions were monitored and various field data were collected. The data included traffic volumes, saturation flow rates, travel times, travel delays, and an operating cost study. Overall, the hardware changes consisted of installing new Naztec 900 controllers, and removing both a protected left signal head and a protected left on green arrow sign from one intersection. In fine-tuning the signal timing plans, additional time was added to the protected left phase for the Northbound direction of Avenue F at Cantu Dr.. Changes in the timing plan for the signal at Avenue F and Chevrolet Dr. were also made to allow more time for protected lefts on the side street. The intersection of Avenue F and Chevrolet was fully actuated before this project, so a comparison to existing conditions could not be made.

Based on the PASSER II-87 simulation, the project had an estimated 1.8 million dollar reduction in annual operating cost, a direct benefit to motorists using these routes. This operating cost reduction included a total annual savings of 11,795,071 stops (a 23.4 percent reduction), a total annual fuel savings of 69,120 gallons (a 37.5 percent reduction), and a delay annual savings of 155,160 veh-hrs (a 5.6 percent reduction). The majority of these benefits will be in the reductions of delays and stops. For Avenue F, the maximum increase in travel time was 4 seconds for the Southbound AM peak, a 7.3 percent increase. The maximum reduction in travel time was 24 seconds for the Northbound PM peak, a 32.9 percent reduction. The total cost of the project was $14,800, and the resultant benefit to cost ratio was 43 to 1.

		STOPS		TOTAL SYSTEM DELAY (veh-hrs)		FUEL (gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	AM	9730	6494	90.6	42.4	224	207
	OFF	9730	7191	90.6	62.4	224	213
	PM	8897	7718	62.7	52.1	236	227
DIFFERENCES	AM	3236		48.2		17	
	OFF	2539		28.2		11	
	PM	1179		10.6		9	
HRS/DAY	AM	8.4		8.4		8.4	
	OFF	0.6		0.6		0.6	
	PM	9		9		9	
DAILY	AM	27182		404.88		142.8	
	OFF	1523		16.92		6.6	
	PM	10611		95.4		81	
	TOTAL	39317		517.2		230.4	
UNIT VALUES		$0.014		$10.00		$1.00	
ANNUAL SAVINGS		$165,131		$1,551,600		$69,120	
PROJECT COST:		$41,806		TOTAL ANNUAL SAVINGS:		$1,785,851	
BENIFIT/COST RATIO:		42.72					


CHEVROLET DRIVE
CANTU DRIVE
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10'
10'6"
2140'
2320'
1780'
1070'
360'

Hampton

The City of DeSoto Department of Public Works and Transportation worked on the following project. A total of six (6) signalized intersections were included in this traffic signal network at spacing that varied between 1,240 feet and 3,680 feet. Hampton Road is a standard urban arterial traversing the center axis of the city. Prior to this study, all the six intersections were operating in isolated mode without a uniform cycle length or coordination. The attached figure shows the project network system, cross streets, and link distances.

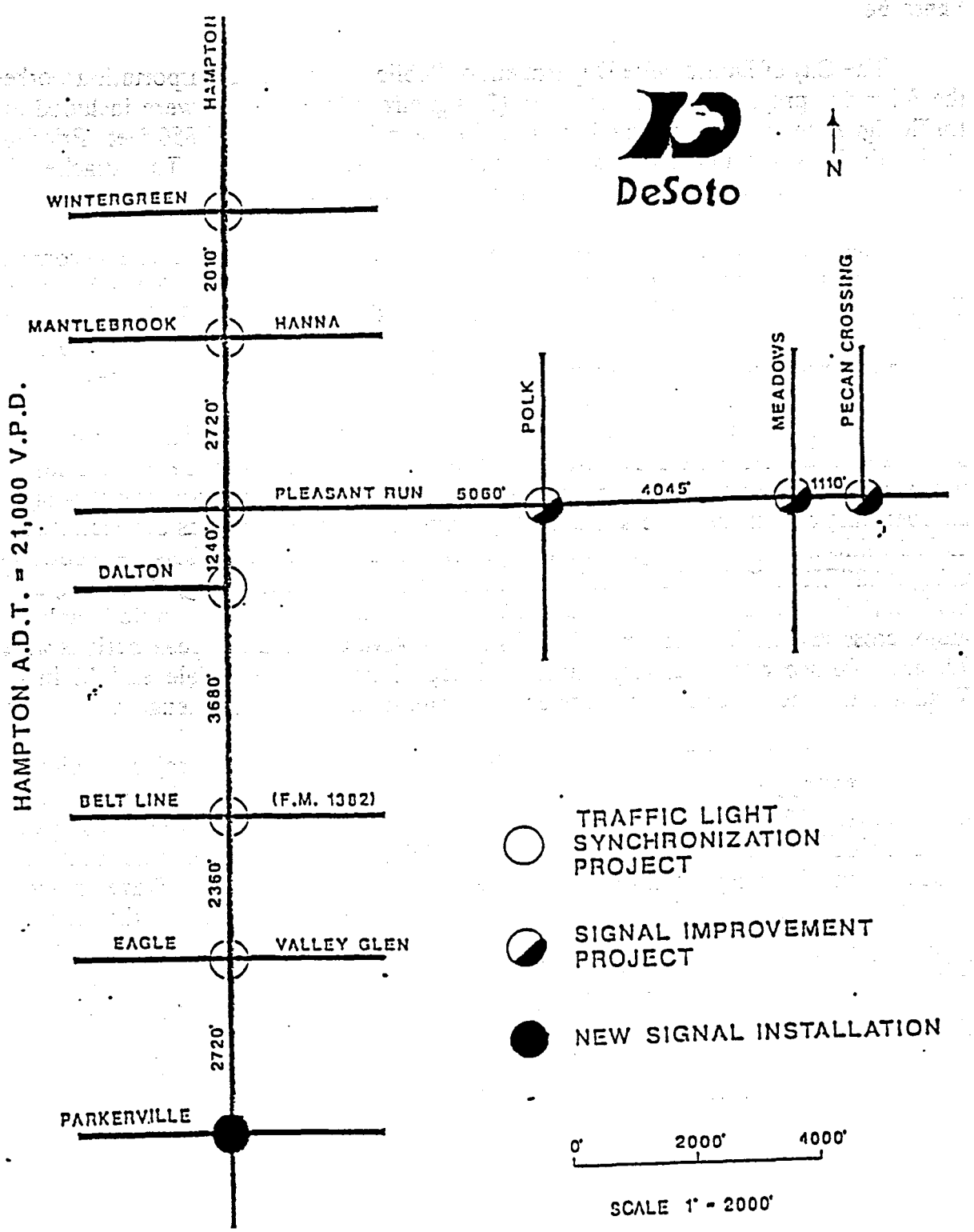
New mast alarm signals and control equipment was installed at one new location and six existing locations on Hampton Road and at three existing locations on Pleasant Run Road. The Eagle EPAC 300 controller with minor movement actuation and internal time base coordinator was selected for this project. The intersections were controlled by a mixture of pretimed and fully actuated controllers. The intersections had between two and six signal phases.

In order to evaluate the system performance, the "before" TLS traffic conditions were monitored and various field data were collected. 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-87 for the "after" conditions for each of the morning, afternoon, and off-peak periods. Minor modifications to clearance interval and minor movement timing were made in the field to conform to driving habits in DeSoto as motorists became familiar with the operation of the new signals.

Based on PASSER II-87 simulation, the project resulted in an estimated $986,800 savings per year on total operating cost, a direct benefit to motorists using these routes. This operating cost savings included a total savings of 6,098,100 stops (an 18.6 percent reduction), a total annual fuel savings of 117,195 gallons (a 13.7 percent reduction), and a delay annual savings of 78,428 veh-hrs (a 31.2 percent reduction). No statistical analyses were carried out on travel times due to a limited sample size. The average system speed from the travel time studies after the new signal timing was implemented were compared to the progression band speed predicted by PASSER II and found to be in close agreement. The before-field data was not compared to the predictions of a PASSER II simulation because of a lack of a uniform system cycle length. Minimal difficulties were experienced with the operation of the PASSER II program. The main problem was the complexity of the input coding scheme. Further work should be carried out in this area to simplify the coding process through such means as interactive preprocessers, data bases or similar methods. The total cost of the project was $56,279, and the resultant benefit to cost ratio was 18 to 1.

		STOPS		TOTAL SYSTEM DELAY (veh-hrs)		FUEL (gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	AM	12251	9981	112.5	70.4	315.3	264.3
	OFF	6805	5499	44.4	31.9	179.8	157.8
	PM	13702	11300	115.6	83.5	356.8	307
DIFFERENCES	AM	2270		42.1		51	
	OFF	1306		12.5		22	
	PM	2402		32.1		49.8	
HRS/DAY	AM	2.5		2.5		2.5	
	OFF	8		8		8	
	PM	1.75		1.75		1.75	
DAILY	AM	5675		105.25		127.5	
	OFF	10448		100		176	
	PM	4204		56.17		87.15	
	TOTAL	20327		261.43		390.65	
UNIT VALUES		$0.014		$10.00		$1.00	
ANNUAL SAVINGS		$85,371		$784,275		$117,195	

PROJECT COST:	$56,279	TOTAL ANNUAL SAVINGS:	$986,841
BENIFIT/COST RATIO:	17.53		


HAMPTON
WINTERGREEN
2010'
MANTLEBROOK
HANNA
2720'
PLEASANT RUN
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POLK
4045'
MEADOWS
1110'
PECAN CROSSING
3240'
DALTON
3680'
BELT LINE
(F.M. 1382)
2360'
EAGLE
VALLEY GLEN
2720'
PARKERVILLE
HAMPTON A.D.T. = 21,000 V.P.D.
DeSoto
N
TRAFFIC LIGHT SYNCHRONIZATION PROJECT
SIGNAL IMPROVEMENT PROJECT
NEW SIGNAL INSTALLATION
0'
2000'
4000'
SCALE 1" = 2000'

Santa Fe

The City of Duncanville Department of Public Works and Transportation worked on the following project. A total of seven (7) signalized intersections were included in this traffic signal network at spacing that varied between 1,000 feet and 2,850 feet. Prior to this study, all the seven intersections were operating in isolated mode. The attached figure shows the project network system, cross streets, and link distances.

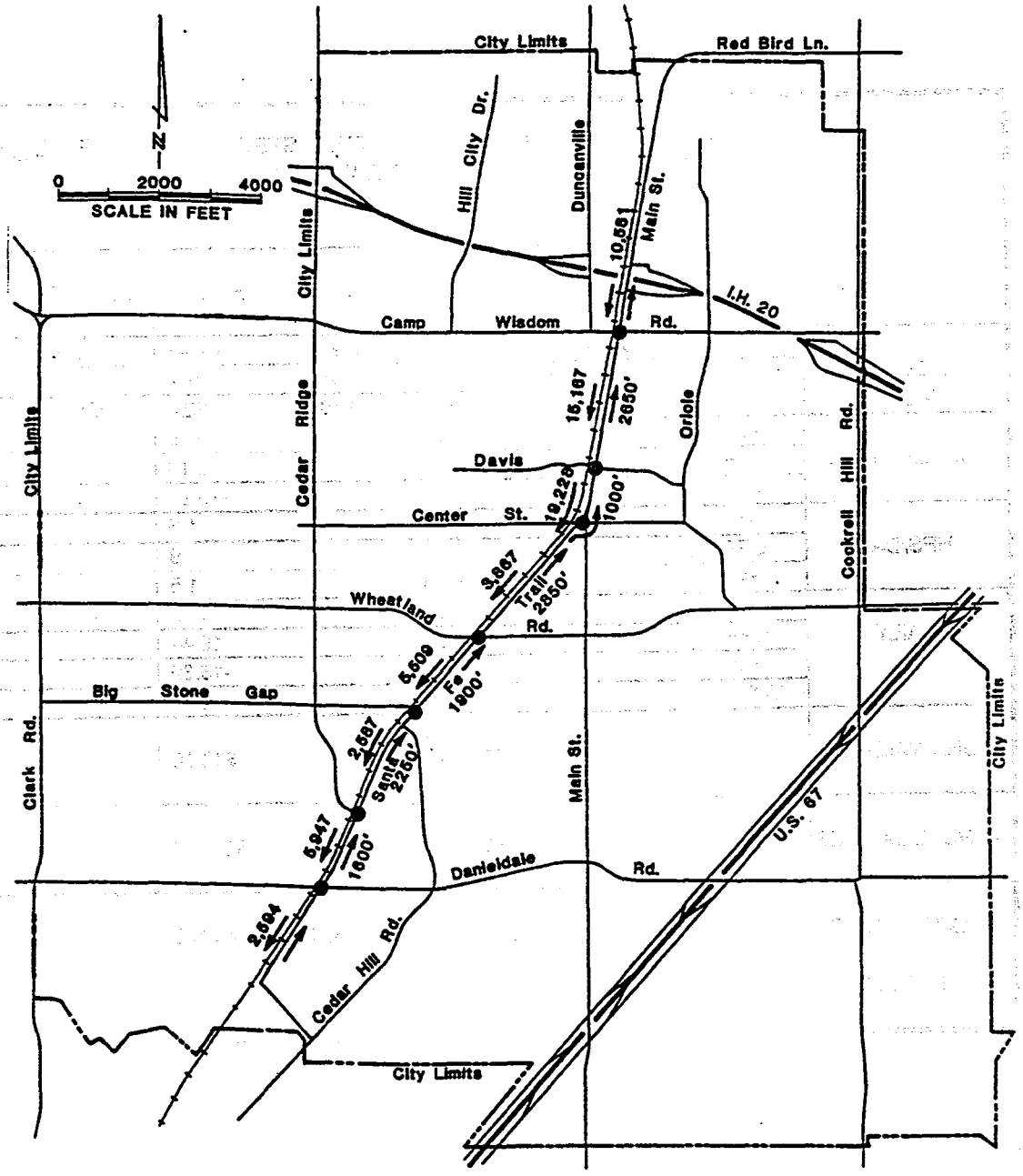
The signals in this system were controlled by four (4) new NAZTEC 900 controllers. The other three intersections were controlled by the existing Eagle DP 9000 controllers. Each controller was installed with time base coordination capabilities. Six intersections were controlled by fully actuated controllers. The intersection at Davis was controlled by semi-actuated controllers. The intersections had between two and six signal phases.

In order to evaluate the system performance, the "before" TLS traffic conditions were monitored and various field data were collected. The data included traffic volumes, travel times, signal timings and phasing, arterial data, intersection geometrics, travel delays, and an operating cost study. The average daily traffic on this network was between 2,587 and 19,228 vehicles. Optimum signal phasing patterns and intersection offsets were determined using PASSER II-87 for the "after" conditions for each of the morning, afternoon, and off-peak periods. Cycle lengths for each peak period were dictated by the cycle lengths of the major cross streets. The new cycle lengths for the AM, Off, and PM peak periods were 90, 72, and 100 seconds long, respectively. Except Santa Fe/Danieldale and Main/Camp Wisdom, all other intersections were able operate under these cycle lengths.

Based on PASSER II-87 and TRANSYT-7F simulations, the project resulted in an estimated $37,195 savings per year on total operating cost, a direct benefit to motorists using these routes. This operating cost savings included a total savings of 618,300 stops (a 4.1 percent reduction), a total annual fuel savings of 3,609 gallons (a 1.1 percent reduction), and a delay annual savings of 2,493 veh-hrs (a 2.0 percent reduction). Travel times were reduced in the range of 3.6 to 13 percent for the northbound traffic and in the range of 6% to 17 percent for the southbound traffic. Coordination was achieved between all the intersections except Main at Camp Wisdom during Off peak and at Santa Fe and Danieldale during the AM and PM peaks. Coordination was not achieved at these locations during these times due to the fact that each intersection was part of a major east/west signal system. Progression was increased along Main Street and Santa Fe Trail for both the northbound and southbound traffic. The total cost of the project was $18,021 and the resultant benefit to cost ratio was 2 to 1.

		STOPS		TOTAL SYSTEM DELAY (veh-hrs)		FUEL (gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	AM	5720	5582	50.21	47.42	126.29	123.5
	OFF	3356	3197	25.36	23.2	70.68	68.82
	PM	7659	7376	72.19	82.4	167.66	173.59
DIFFERENCES	AM		138		2.79		2.79
	OFF		159		2.16		1.86
	PM		283		-10.21		-5.93
HRS/DAY	AM		1.5		1.5		1.5
	OFF		9		9		9
	PM		1.5		1.5		1.5
DAILY	AM		206		4.18		4.19
	OFF		1430		19.44		16.74
	PM		425		-15.32		-8.90
	TOTAL		2061		8.31		12.03
UNIT VALUES			$0.014		$10.00		$1.00
ANNUAL SAVINGS			$8,656		$24,930		$3,609

PROJECT COST:	$18,021	TOTAL ANNUAL SAVINGS:	$37,195
BENIFIT/COST RATIO:	2.06		



LEGEND

10,000–Two direction, 24–hour traffic volume

FIGURE 2

24–HOUR TRAFFIC VOLUMES AND LINK DISTANCES

Main Street

The City of Euless, District 2 Traffic Office of TxDOT, and DeShazo, Starek & Tang, Inc. worked on the following project. Main Street is a north-south arterial and consists of five intersections and one diamond interchange. The attached map illustrates the project network, cross streets, and link distances.

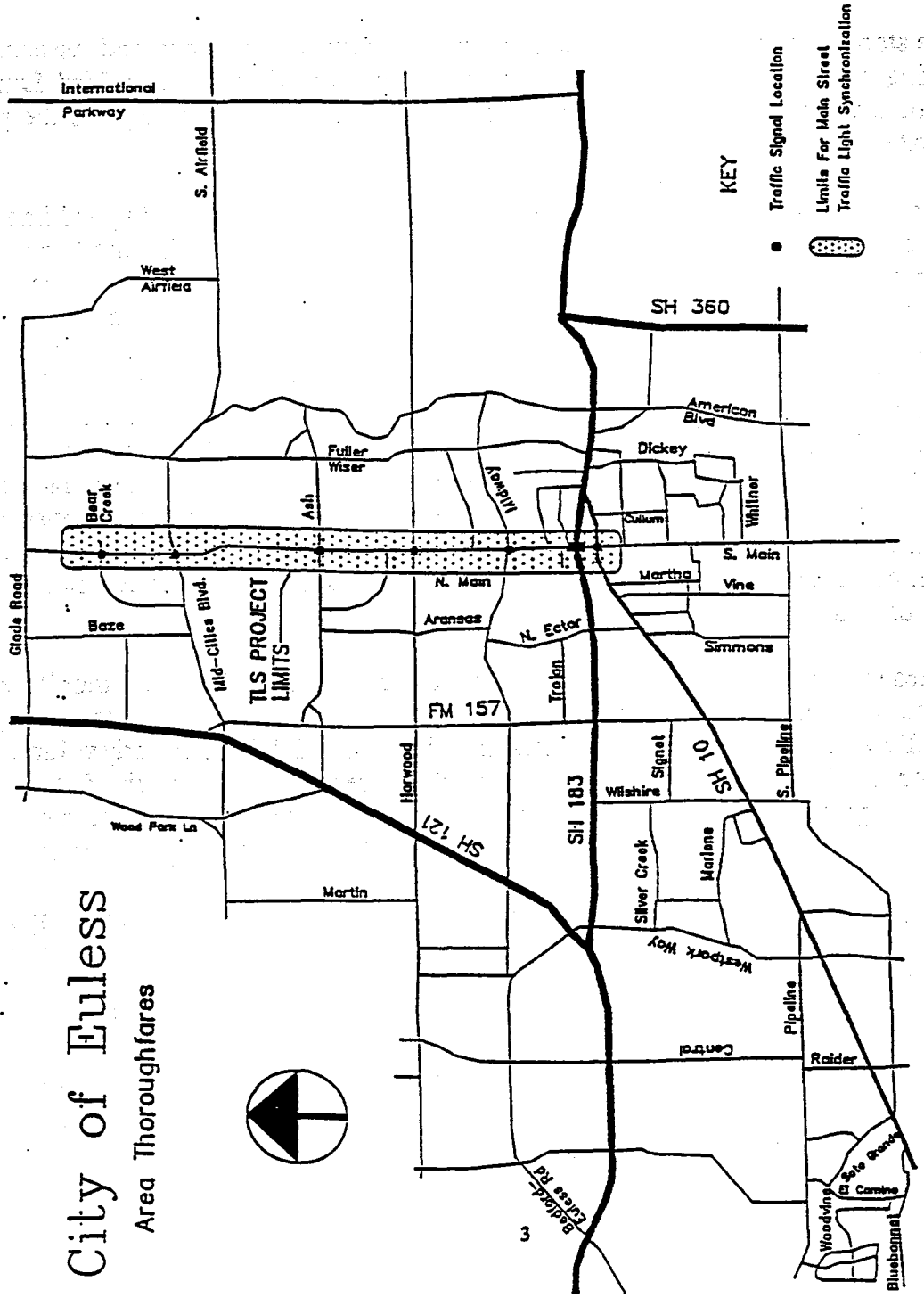
While PASSER II-87 was used to develop signal timings for intersections, PASSER III-88 was used to develop signal timings at the diamond interchange. The phasing pattern selected at the interchange was TTI-Lead phase.

In order to evaluate the system performance, traffic conditions were monitored and various data were collected before the implementation of any changes. This data was in the form of traffic volumes, saturation flow rates, travel times, and delays. Fifteen minute volumes were collected for peak and off-peak periods. Saturation flow rates, lost time, and extension of effective green were estimated using the PASSER II assistant key. Floating test car method was used to collect average link travel times and delays.

Implementing the improved signal timings resulted in a total savings of about 1.6 million dollars. These savings were in the form of 2.36 million fewer stops (a reduction of 12.6 percent), 130,740 fewer hours of delay (a reduction of 51 percent), and 330,765 gallons of fuel savings (a savings of 37.5 percent) in an year. Travel times generally decreased in all the directions but more so in the morning peak. The total cost of the project was about $28,518 with a benefit to cost ratio of 58 to 1.

		STOPS		TOTAL SYSTEM DELAY (veh-hrs)		FUEL (gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	AM	5412	3675	104	28	379.5	136.9
	OFF	6187	5878	78.9	45.5	141.2	186.8
	PM	2218	1662	17.3	12.5	399.8	73.7
DIFFERENCES	AM		1737		76		242.6
	OFF		309		33.4		-45.6
	PM		556		4.8		326.1
HRS/DAY	AM		2.5		2.5		2.5
	OFF		7		7		7
	PM		2.5		2.5		2.5
DAILY	AM		4343		190		606.5
	OFF		2163		233.8		-319.2
	PM		1390		12		815.25
	TOTAL		7896		435.8		1102.55
UNIT VALUES			$0.014		$10.00		$1.00
ANNUAL SAVINGS			$33,161		$1,307,400		$330,765

PROJECT COST:	$28,518	TOTAL ANNUAL SAVINGS:	$1,671,326
BENIFIT/COST RATIO:	58.61		


City of Euless
Area Thoroughfares
KEY
Traffic Signal Location
Limits For Main Street Traffic Light Synchronization
International Parkway
S. Airfield
West Airfield
SH 360
American Blvd
Dickey
Fuller Wiser
Bear Creek
Ash
Industry
Whitner
Cullum
S. Main
Martha
Vine
N. Main
Aransas
N. Ector
Simmons
Glade Road
Baze
Mid-Cities Blvd.
TLS PROJECT LIMITS
FM 157
Trakan
Harwood
SH 121
SH 183
Signal
SH 10
S. Pipeline
Wilshire
Wood Park Ln
Martin
Silver Creek
Marlene
Westpark Way
Pipeline
Central
Raider
Ballinger-Cuess Rd
Woodvine
El Camino
Bluebonnet
3

Mockingbird/Preston

The staff of the town of Highland Park worked with Kimley-Horn and Associates on the following project. The signal timings of two major arterials, Mockingbird Lane and Preston Road, were improved under this project. The attached map displays the project network system, cross streets, and link distances.

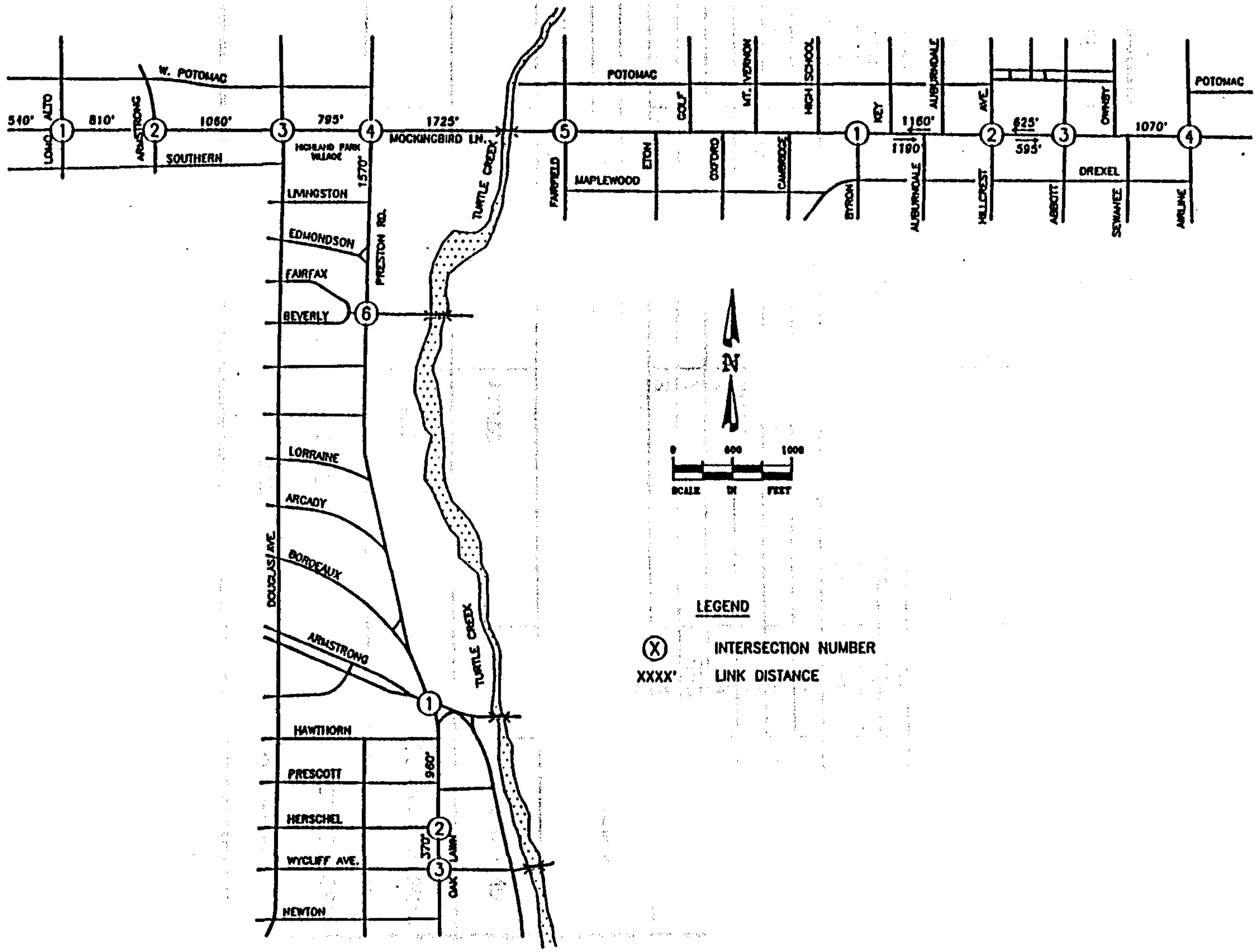
Thirteen intersections were included as part of this project. Mockingbird Lane is an east-west street which runs along the corporate limits of the town of Highland Park and the City of University Park. The street is a four lane facility in the east end of the project. However, west of Hillcrest, the four lanes reduce to two lanes. At most signalized intersections, a left turn bay is provided. Before the completion of the project, only two intersections were coordinated via time clocks using a 70 second cycle length. The speeds on the arterial were about 30-35 mph. Preston Road is a north-south arterial and has a four-lane undivided cross section. It has commercial development at the intersection with Mockingbird Lane. Left-turn bays are provided at the intersections of Mockingbird Lane and Beverly Drive. Unique geometry of the Preston Rd./Oak Lane Ave./Armstrong St. intersection required a unique phasing. All of the intersections are pretimed except the intersection of Mockingbird Lane and Hillcrest, which is actuated. Between two and four phases are used at these intersections.

In order to evaluate the system performance, traffic conditions were monitored and various data were collected before implementation of any changes. This data was in the form of traffic volumes, saturation flow rates, travel times, and delays. Hourly volumes were collected for the four peak periods. Saturation flows were estimated in the field by using the method suggested in the TLS PASSER II training manuals. The test car method was used to collect link travel times, average number of stops, and the stop locations.

PASSER II-87 simulation model was employed to optimize the phase splits and estimate delays. Implementing the new signal timings resulted in a total annual savings of about 4.1 million dollars to the motorists using these routes. The number of stops decreased by about 5.9 million (a decrease of about 11 percent), there were about 370,500 fewer hours of delay (a reduction of 30.5 percent), and there was a fuel savings of about 300,000 gallons (a reduction of about 17.5 percent) in a year. The travel times significantly decreased in all the time periods in almost all the directions. Travel times on Preston in the north bound direction indicated a marginal increase. The total cost of the project was $82,500 and the benefit to cost ratio was 50 to 1.

		STOPS		TOTAL SYSTEM DELAY (veh-hrs)		FUEL (gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	AM	25206	18082	251.02	190.67	484.27	392.08
	OFF	19596	21871	278.47	272.20	455.37	477.60
	PM	36692	21392	928.86	393.64	1056.51	573.09
DIFFERENCES	AM		7124		60.35		92.19
	OFF		-2275		6.27		-22.23
	PM		15300		535.22		483.42
HRS/DAY	AM		2		2		2
	OFF		7		7		7
	PM		2		2		2
DAILY	AM		14248		120.69		184.38
	OFF		-15925		43.90		-155.61
	PM		30600		1070.44		966.84
	TOTAL		28923		1235.04		995.61
UNIT VALUES			$0.014		$10.00		$1.00
ANNUAL SAVINGS			$121,477		$3,705,120		$298,683

PROJECT COST:	$82,500	TOTAL ANNUAL SAVINGS:	$4,125,280
BENIFIT/COST RATIO:	50.00		


W. POTOMAC
POTOMAC
MOCKINGBIRD LN.
SOUTHERN
LOMO ALTO
ARMSTRONG
HIGHLAND PARK VILLAGE
540'
810'
1060'
795'
1725'
1570'
1160'
1190'
625'
595'
1070'
960'
370'
LIVINGSTON
EDMONDSON
FAIRFAX
BEVERLY
PRESTON RD.
TURTLE CREEK
LORRAINE
ARCADY
BORDEAUX
DOUGLAS AVE.
ARMSTRONG
HAWTHORN
PRESCOTT
HERSCHEL
WYCLIFF AVE.
NEWTON
OAK LAWN
FAIRFIELD
MAPLEWOOD
ETON
GOLF
OXFORD
MT. VERNON
CAMBRIDGE
HIGH SCHOOL
BYRON
KEY
AUBURNDALE
AVE.
HILLCREST
ABBOTT
OWNBY
SEWANEE
DREXEL
AIRLINE
N
SCALE IN FEET
LEGEND
INTERSECTION NUMBER
XXXX'
LINK DISTANCE

Hurst Boulevard

The City of Hurst worked with Traffic Engineers, Inc. and Barton-Aschman, Inc. on the following project. Hurst Boulevard is an east-west arterial. The project section has eight intersections covering a distance of 3.3 miles. The attached map displays the project network system, cross streets, and link distances.

While two of these intersections were coordinated, the rest were operating as isolated fully actuated intersections. Most of the controllers operating at these intersections were Safetran 2000 controllers. Since the existing controllers were limited in their coordination capabilities, new Naztek 900 controllers were installed at all intersections. Capacity problems existed at three of the intersections in the system. Geometric modifications needed to be made at these intersections to alleviate the capacity problems. Hence, during the PM peak, these three intersections were programmed to operate in an isolated actuated mode. The presence of a parking lot in front of the Bell Helicopter facility close to the intersection at Bellaire Drive was resulting in heavy pedestrian traffic. Hence, an exclusive pedestrian phase of 30 seconds was included in the phasing plan at this intersection.

In order to evaluate the system performance, traffic conditions were monitored and various data were collected before implementation of any changes. This data was in the form of traffic volumes, saturation flow rates, travel times, and delays. Hourly volumes were collected for the four peak periods. Saturation flows were estimated in the field by using the method suggested in the TLS PASSER II and PASSER III training manuals. The test car method was used to collect link travel times, average number of stops, and the stop locations.

PASSER II-87 simulation model was employed to optimize the phase splits and estimate delays. Implementing the new signal timings resulted in a total annual savings of about $124,049 to the motorists using this route. While the number of stops decreased by about 1.47 million (a decrease of about 4.7 percent), and there were about 10,542 fewer hours of delay (a reduction of 4.0 percent), there was a slight increase in the fuel consumption of 2,000 gallons (an increase of under 1 percent) in an year. Progression was achieved in both the peak hours. There can be a more significant improvement in the travel conditions if geometric improvements were made at the three intersections. The total cost of the project was $46,842 and the benefit to cost ratio was 2 to 1.

		STOPS		TOTAL SYSTEM DELAY (veh-hrs)		FUEL (gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	AM	17700	15676	228.1	171.91	553.15	532.65
	OFF	6061	6061	33.2	33.2	183.15	183.15
	NOON	7931	6906	48.9	62.9	234.45	242.94
	PM	17527	16286	215.6	220.3	537.99	550.43
DIFFERENCES	AM	2024		56.19		20.5	
	OFF	0		0		0	
	NOON	1025		-14		-8.49	
	PM	1241		-4.7		-12.44	
HRS/DAY	AM	1		1		1	
	OFF	8.5		8.5		8.5	
	NOON	1		1		1	
	PM	1.5		1.5		1.5	
DAILY TOTALS	AM	2024		56.19		20.5	
	OFF	0		0		0	
	NOON	1025		-14		-8.49	
	PM	1862		-7.05		-18.66	
	TOTAL	4911		35.14		-6.65	
UNIT VALUES		$0.014		$10.00		$1.00	
ANNUAL SAVINGS		$20,624		$105,420		($1,995)	

PROJECT COST:	$46,842	TOTAL ANNUAL SAVINGS:	$124,049
BENIFIT/COST RATIO:	2.65		

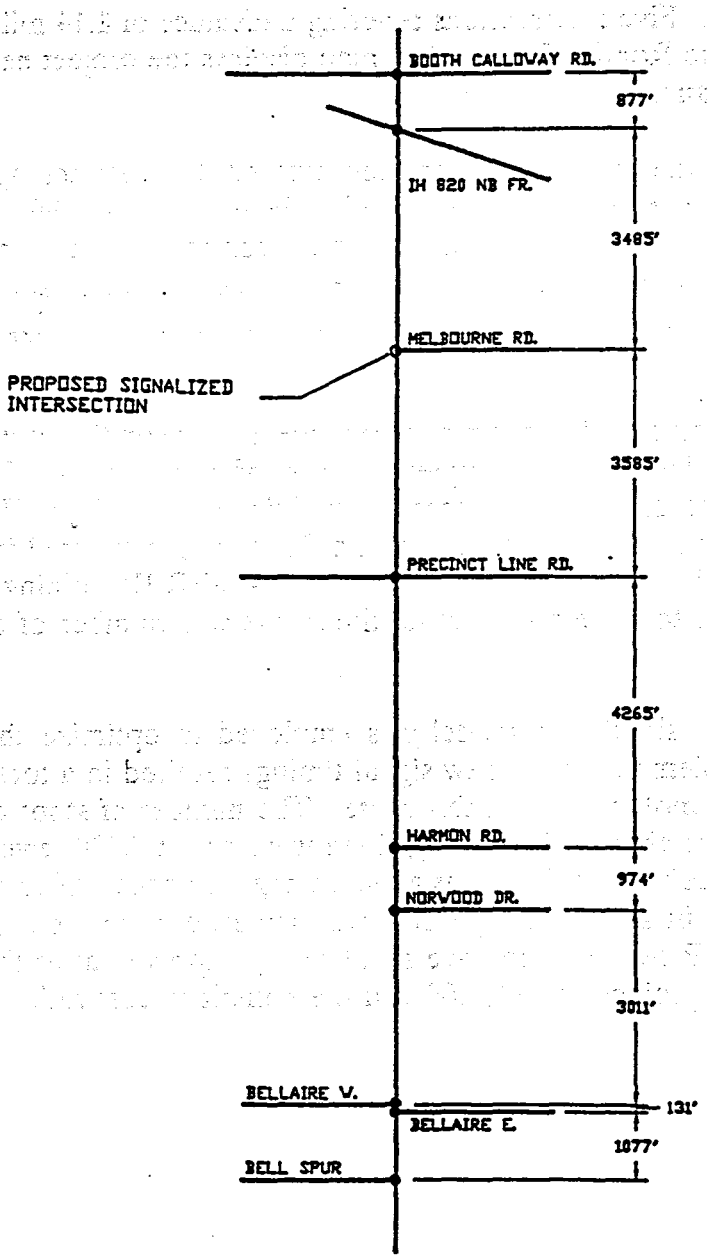


FIGURE 2

SIGNALIZED INTERSECTIONS
SH 10 (HURST BLVD.) SYSTEM
Hurst, Texas

Pipeline Road

The City of Hurst worked with Traffic Engineers, Inc. and Barton-Aschman, Inc. on the following project. Five intersections covering a distance of 1.14 miles were included in the project of Pipeline Road. The attached map displays the project network system, cross streets, and link distances.

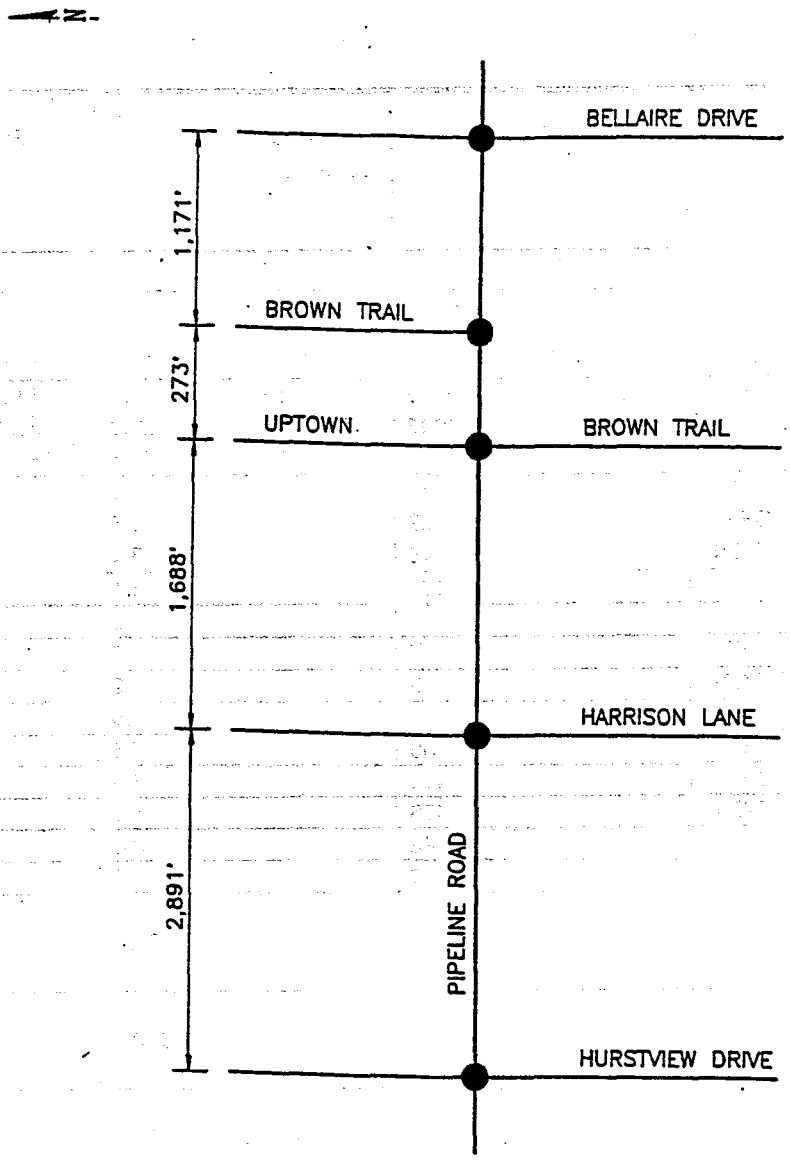
While two of the intersections are coordinated, the rest are operating as isolated intersections. These intersections were controlled by either EPAC 300 or TRANSYT 1880 controllers. As part of the improvements, new controllers were installed so that all intersections had EPAC 300 controllers. All the intersections were using four phases before and after the improvements. All of these intersections were equipped with pedestrian controls.

In order to evaluate the system performance, traffic conditions were monitored and various data were collected before implementation of any changes. This data was in the form of traffic volumes, saturation flow rates, travel times, and delays. Hourly volumes were collected for the four peak periods. Saturation flows were estimated in the field by using the method suggested in the TLS PASSER II and PASSER III training manuals. The test car method was used to collect link travel times, average number of stops, and the stop locations.

PASSER II-87 simulation model was employed to optimize the phase splits and estimate delays. Implementing the new signal timings resulted in a total annual savings of about $99,758 to the motorists using this route. The number of stops decreased by about 580,000 (a decrease of about 4.3 percent), there were about 8,000 fewer hours of delay (a reduction of 11.8 percent), and there was a fuel savings of about 10,800 gallons (a reduction of about 4.1 percent) in a year. Progression was achieved in both directions. The overall service conditions of Pipeline Road have significantly improved after the retiming project. The total cost of the project was $26,000 and the benefit to cost ratio was 4 to 1.

		STOPS		TOTAL SYSTEM DELAY (veh-hrs)		FUEL (gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	AM	4333	3803	23.4	18.4	81.62	73.63
	OFF	2541	2472	11.2	10.7	53.81	53.03
	NOON	4733	4285	24	20.6	92.76	86.7
	PM	7494	7655	44.7	38.6	133.67	129.4
DIFFERENCES	AM	530		5		7.99	
	OFF	69		0.5		0.78	
	NOON	448		3.4		6.06	
	PM	-161		6.1		4.27	
HRS/DAY	AM	1.5		1.5		1.5	
	OFF	7		7		7	
	NOON	2		2		2	
	PM	1.5		1.5		1.5	
DAILY TOTALS	AM	795		7.5		11.985	
	OFF	483		3.5		5.46	
	NOON	896		6.8		12.12	
	PM	-242		9.15		6.405	
	TOTAL	1933		26.95		35.97	
UNIT VALUES		$0.014		$10.00		$1.00	
ANNUAL SAVINGS		$8,117		$80,850		$10,791	

PROJECT COST:	$25,920	TOTAL ANNUAL SAVINGS:	$99,758
BENIFIT/COST RATIO:	3.85		



SIGNALIZED INTERSECTIONS
PIPELINE RD. SIGNAL SYSTEM
HURST, TEXAS

US 281

The District 14 Traffic Office of TxDOT worked on the following project. A total of seven (7) signalized intersections were included in this traffic signal network at spacing that varied between 390 feet and 2,275 feet. The two major arterials US 281 and RM 1431 were included in this network. Prior to this study, the signals were not coordinated and congestion was most pronounced during the morning and evening peak periods. The flow in the Off-peak period was also significant due to the location of various restaurants in the area. The attached figure shows the project network system, and cross streets.

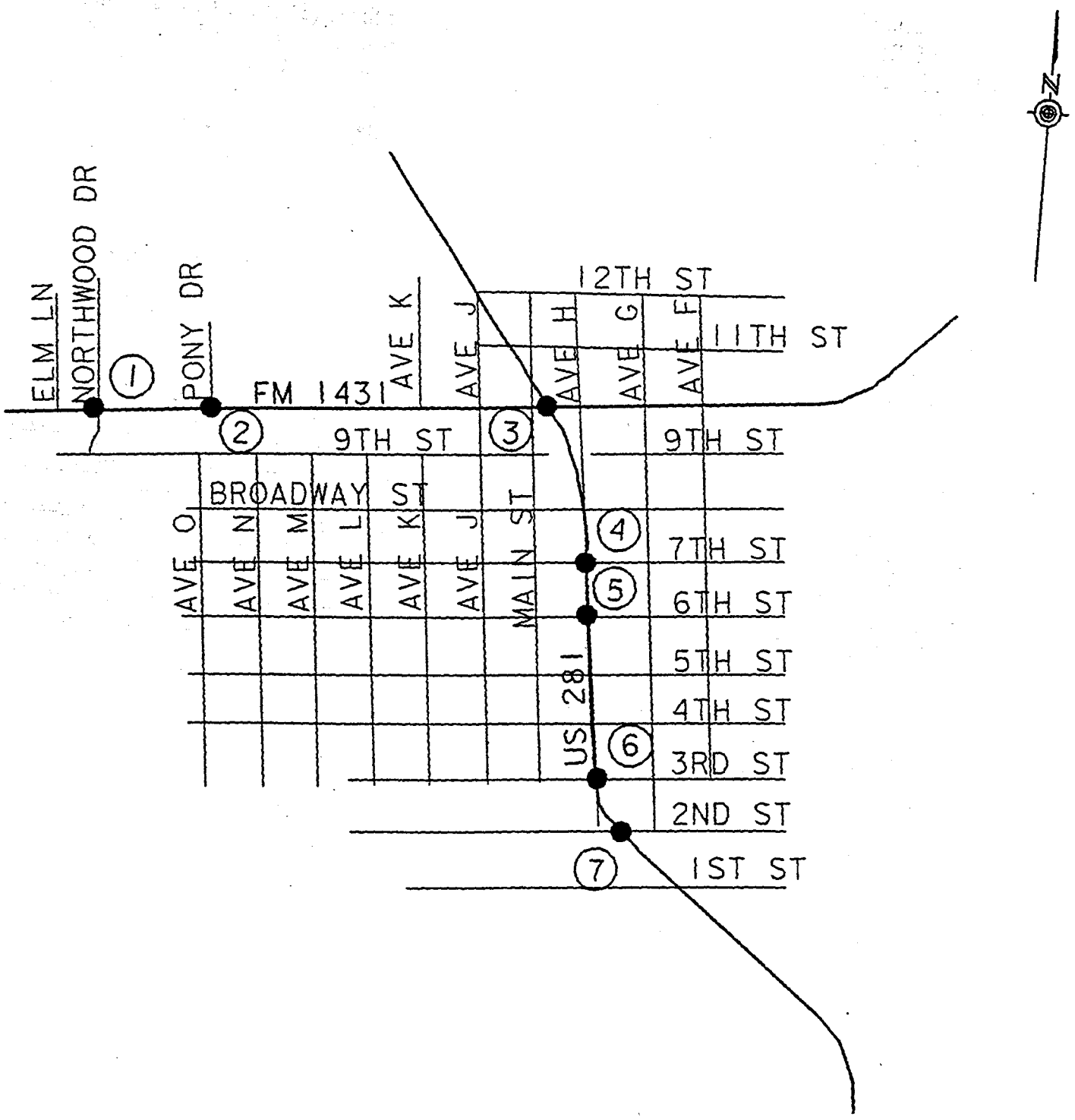
All the electromechanical controllers in this system were replaced by new signal controllers. Each controller was installed with time base coordination capabilities. All the intersections were controlled by pretimed controllers. The intersection at RM1431/US281 was not equipped with pedestrian controls. Other intersections were equipped with pedestrian controls. The intersections had between two and four signal phases.

In order to evaluate the system performance, the "before" TLS traffic conditions were monitored and various field data were collected. The data included traffic volumes, travel times, signal timings and phasing, arterial data, intersection geometrics, travel delays, and an operating cost study. Three floating car studies were performed on each link in both directions during each period in order to obtain the mean travel time. Optimum cycle lengths were determined using PASSER II-90 for the "after" conditions for each of the morning, evening, and off-peak periods. The new cycle lengths used for the AM, PM, and Off peak periods were 85, 90, and 90 seconds long, respectively. The phasing of RM 1431 and US 281 was modified according to the PASSER II-90 results. Minor changes were made to various offsets. These revised offsets were simulated using PASSER II-90 to obtain the final measures of effectiveness used in the evaluation.

Based on PASSER II-90 simulation, the project resulted in an estimated $660,000 savings per year on total operating cost, a direct benefit to motorists using these routes. This operating cost savings included a total savings of 8,856,600 stops (a 28.7 percent reduction), a total annual fuel savings of 116,289 gallons (a 23.0 percent reduction), and a delay annual savings of 41,985 veh-hrs (a 26.4 percent reduction). No statistical analyses were performed on the travel time data due to the limited sample sizes. Traffic flow improved with the synchronization of the traffic lights. The total cost of the project was $30,041 and the resultant benefit to cost ratio was 22 to 1.

		STOPS		TOTAL SYSTEM DELAY (veh-hrs)		FUEL (gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	AM	8393	6084	42.6	32.3	134.69	101.71
	OFF	9235	6579	46.8	34.6	151.75	117.51
	PM	10561	7492	57.2	40.7	173.38	132.7
DIFFERENCES	AM	2309		10.3		32.98	
	OFF	2656		12.2		34.24	
	PM	3069		16.5		40.68	
HRS/DAY	AM	1.5		1.5		1.5	
	OFF	7.5		7.5		7.5	
	PM	2		2		2	
DAILY	AM	3464		15.45		49.47	
	OFF	19920		91.5		256.8	
	PM	6138		33		81.36	
	TOTAL	29522		139.95		387.63	
UNIT VALUES		$0.014		$10.00		$1.00	
ANNUAL SAVINGS		$123,990		$419,850		$116,289	

PROJECT COST:	$30,041	TOTAL ANNUAL SAVINGS:	$660,129
BENIFIT/COST RATIO:	21.97		


N
ELM LN
NORTHWOOD DR
PONY DR
FM 1431
AVE K
AVE J
AVE H
AVE G
AVE F
12TH ST
11TH ST
9TH ST
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BROADWAY ST
AVE O
AVE N
AVE M
AVE L
AVE K
AVE J
MAIN ST
7TH ST
6TH ST
5TH ST
4TH ST
3RD ST
2ND ST
1ST ST
US 281
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7

Central Business District

The City of Mineral Wells Department of Public Works and Transportation worked on the following project. The study network comprised of three (3) main streets within the City of Mineral Wells. A total of eight (8) signalized intersections were included in this traffic signal network at spacing that varied between 274 feet and 1,548 feet. Prior to this study, a single timing plan was utilized throughout the day. A 70 second cycle length was used at each pretimed intersection with the exception of Oak Avenue and NW 2nd Street, which had a 65 second cycle. The attached figure shows the project network system, cross streets, and link distances.

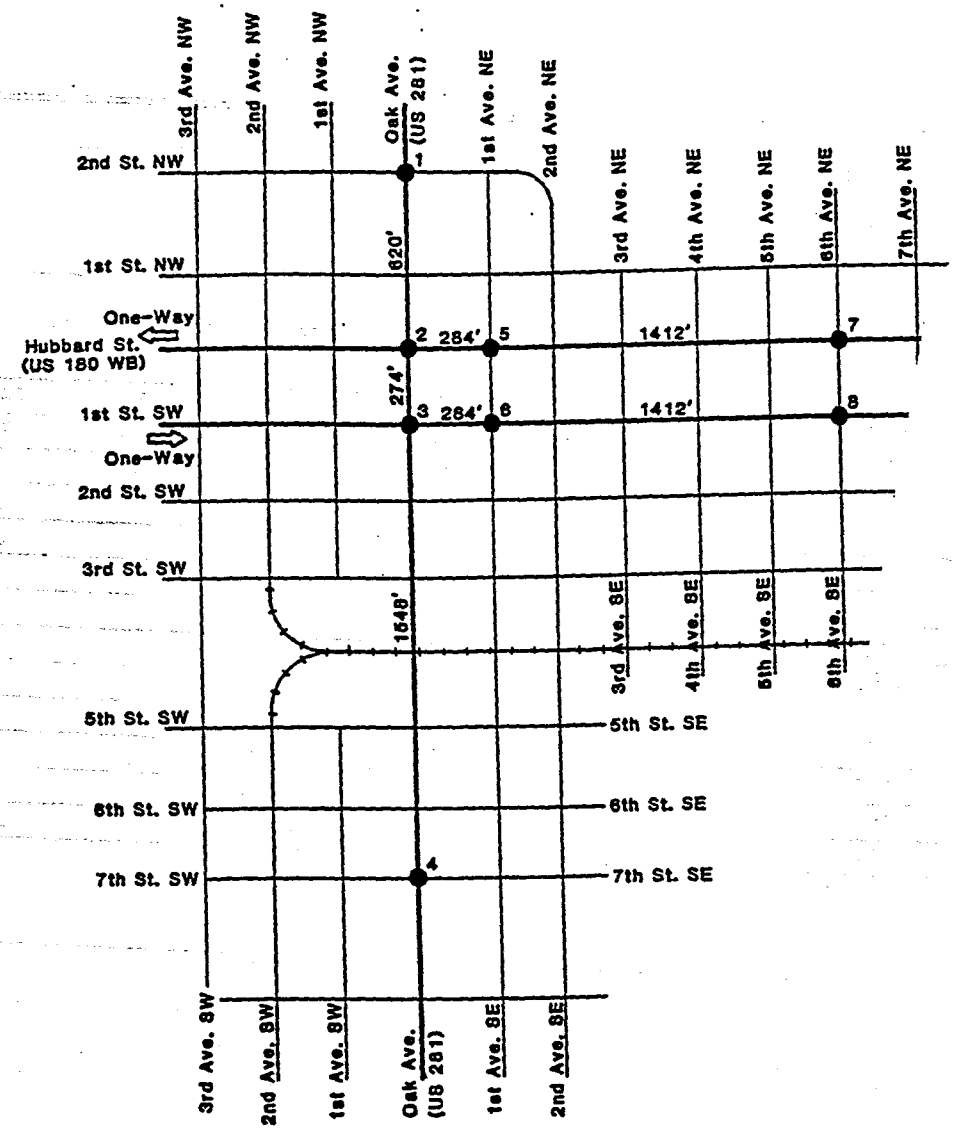
The signals in this system were controlled by seven (7) new NAZTEC 900 traffic signal controllers. Each controller was installed with internal time base coordination capabilities. Except Oak/SW 7th Street, all other intersections were controlled by pretimed controllers. The intersection at Oak/SW 7th Street was controlled by actuated controller. All intersections were equipped with pedestrian controls.

In order to evaluate the system performance, the "before" TLS traffic conditions were monitored and various field data were collected. 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 the "after" conditions. A single timing plan was developed for the entire day because the vehicular travel patterns and directional distributions were similar throughout the day. A coupling analysis was conducted to estimate potential benefits of coordinating each intersection. The intersection at Oak/7th Street was fully actuated and was not coordinated with the system. For all other intersections, the cycle length used for the "after" conditions was 65 seconds long. The implementation of the signal timings required fine tuning in the field. These timings were found to operate well.

Based on TRANSYT-7F simulation, the project resulted in an estimated $209,000 savings per year on total operating cost, a direct benefit to motorists using these routes. This operating cost savings included a total savings of 1,623,000 stops (a 11.7 percent reduction), a total annual fuel savings of 19,458 gallons (a 7.2 percent reduction), and a delay annual savings of 16,698 veh-hrs (a 18.3 percent reduction). Travel times were reduced in the range of 6.81 to 19.3 percent. Progression was increased for both the northbound and southbound traffic along Oak Avenue. The results of coupling analysis showed a probability of benefits in coordinating the signals. Coordination was achieved between all the intersections except Oak at 7th, where coordination was not warranted. The total cost of the project was $35,383 and the resultant benefit to cost ratio was 6 to 1.

		STOPS		TOTAL SYSTEM DELAY (veh-hrs)		FUEL (gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	NOON	4141	3651	27.45	22.52	80.57	74.75
	OFF	3785	3353	24.19	19.64	72.42	67.19
	PM	4444	3844	34.23	29	90.14	83.4
DIFFERENCES	NOON		490		4.93		5.82
	OFF		432		4.55		5.23
	PM		600		5.23		6.74
HRS/DAY	NOON		1		1		1
	OFF		10		10		10
	PM		1		1		1
DAILY	NOON		490		4.93		5.82
	OFF		4320		45.5		52.3
	PM		600		5.23		6.74
	TOTAL		5410		55.66		64.86
UNIT VALUES			$0.014		$10.00		$1.00
ANNUAL SAVINGS			$22,722		$166,980		$19,458

PROJECT COST:	$35,383	TOTAL ANNUAL SAVINGS:	$209,160
BENIFIT/COST RATIO:	5.91		


3rd Ave. NW
2nd Ave. NW
1st Ave. NW
Oak Ave. (US 281)
1st Ave. NE
2nd Ave. NE
3rd Ave. NE
4th Ave. NE
5th Ave. NE
6th Ave. NE
7th Ave. NE
2nd St. NW
1st St. NW
620'
One-Way
Hubbard St. (US 180 WB)
2
284'
5
1412'
7
274'
1st St. SW
3
284'
6
1412'
8
One-Way
2nd St. SW
3rd St. SW
1548'
5th St. SW
5th St. SE
6th St. SW
6th St. SE
7th St. SW
4
7th St. SE
3rd Ave. SW
2nd Ave. SW
1st Ave. SW
Oak Ave. (US 281)
1st Ave. SE
2nd Ave. SE
3rd Ave. SE
4th Ave. SE
5th Ave. SE
6th Ave. SE

INTEF

Green Avenue (BU 90Y)

The District 20 Traffic Office of TxDOT worked on the following project. BU 90Y is an east-west business route in the central east section of the city. The characteristics affecting the traffic flow along the arterial are museums, historical churches, Lamar University etc. The attached map displays the project network system, cross streets, and link distances.

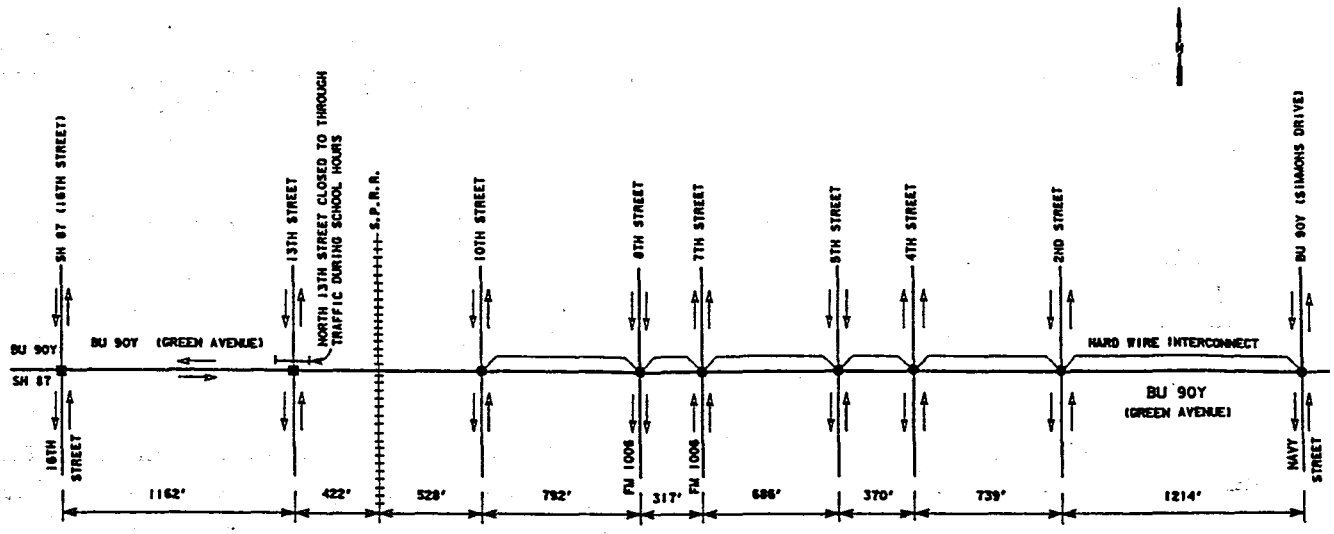
The old traffic signal system along BU 90Y consisted of seven interconnected and two isolated signalized intersections. A hardwire interconnect tied the seven electromechanical three dial controllers. However, only one dial was being used to operate the seven intersections. All the intersections were operating in a pretimed mode. Between two and five phases were being used. None of the intersections except the intersection at 13th street had pedestrian controls. All the intersections except one had Kentron-KST controllers. The isolated intersection at 16th street was being operated by a Naztek 900 controller. The modifications to the signal system involved eliminating signals at four intersections. Hence, four intersections with synchronized signals and one isolated intersection were being operated. Naztek 900 controllers were installed at all the intersections.

In order to evaluate the system performance, traffic conditions were monitored and various data were collected before implementation of any changes. This data was in the form of traffic volumes, saturation flow rates, travel times, and delays. While 15 minute volumes were collected for peak periods, hourly volumes were collected for the off-peak periods. Saturation flows were estimated in the field by using the method suggested in the TLS PASSER II training manuals. The volumes indicated that the volumes in the PM peak were far larger than the volumes during the rest of the day. Test car method was used to collect data about link travel times, average number of stops, and the stop locations.

PASSER II-87 simulation model was employed to optimize the phase splits and estimate delays. Implementing the new signal timings resulted in a total annual savings of about 1.5 million dollars to the motorists using this route. The number of stops decreased by about 3.65 million (a decrease of about 28.5 percent), there were about 138,720 fewer hours of delay (a reduction of 80 percent), and there was a fuel savings of about 121,107 gallons (a reduction of about 47 percent) in an year. It is observed that there is a very large improvement in the traffic conditions during the PM peak. This has occurred because the volumes in the PM peak were significantly higher than the other times of the day. The elimination of signals at four intersections also contributed significantly to the improvement in the travel conditions. There was a significant reduction in the travel times. While the travel times in the east bound direction decreased by about 33 to 68 percent, the travel times in the west bound directions decreased by 20 to 45 percent. The total cost of the project was $31,000 and the benefit to cost ratio was 50 to 1.

		STOPS		TOTAL SYSTEM DELAY (veh-hrs)		FUEL (gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	AM	2067	1930	11.1	7.4	34.57	31.06
	OFF	4584	2942	71.5	10.7	96.72	43.33
	PM	3233	3030	26.7	12	53.97	42.5
DIFFERENCES	AM		137		3.7		3.51
	OFF		1642		60.8		53.39
	PM		203		14.7		11.47
HRS/DAY	AM		2		2		2
	OFF		7		7		7
	PM		2		2		2
DAILY	AM		274		7.4		7.02
	OFF		11494		425.6		373.73
	PM		406		29.4		22.94
	TOTAL		12174		462.4		403.69
UNIT VALUES			$0.014		$10.00		$1.00
ANNUAL SAVINGS			$51,131		$1,387,200		$121,107

PROJECT COST:	$31,147	TOTAL ANNUAL SAVINGS:	$1,559,438
BENIFIT/COST RATIO:	50.07		



LEGEND

■ ISOLATED SIGNAL

● SIGNAL SYSTEM (Hard Wire Interconnect)

BU 90Y (GREEN AVENUE) IN ORANGE

FIG. 1 - ARTERIAL CONFIGURATION

SCALE = 1"=500'

RM 620

The Traffic Engineering personnel of the City of Round Rock worked with the District 14 Traffic Office of TxDOT on the RM 620 project. Five intersections including a diamond interchange with IH 35 were included in this project. The attached map displays the project network system, cross streets, and link distances.

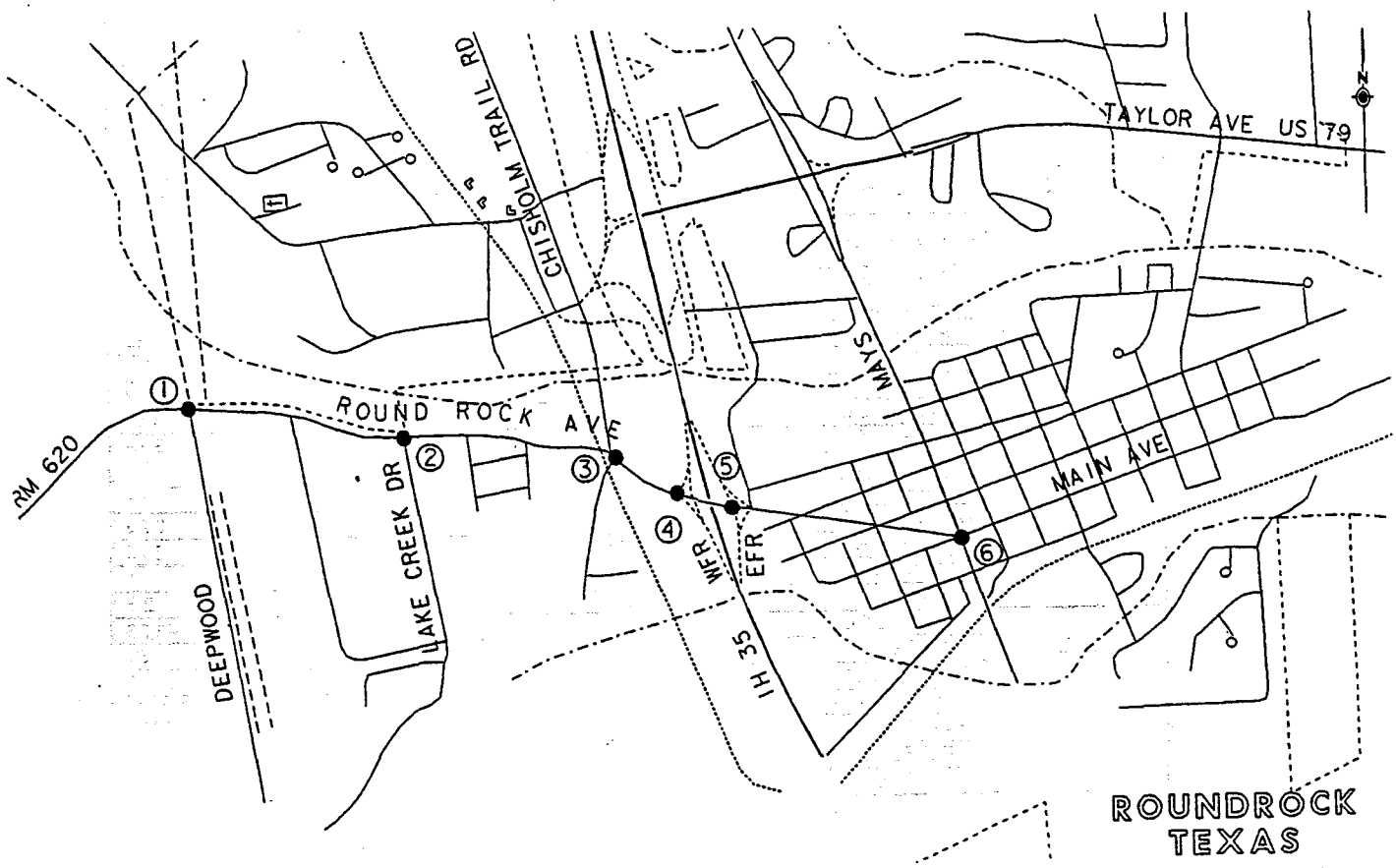
RM 620 is one of the major arterials running in the east-west direction in the town of Round Rock. RM 620 west of IH 35 has five lanes with a continuous two way left-turn lane and is located in a school zone. Flashing beacons are activated during the peak periods. Hence, there is a significant variation in speeds in the peak periods. The land use is predominantly residential. East of IH 35, RM 620 is a two lane two-way roadway and has a lot of commercial and office development. Hence, congestion is most pronounced in the peak hours. All five intersections in the project are completely actuated. They use between two and five phases. Only the intersection with LakeCreek Dr. has pedestrian controls. Controllers at two of the intersections do not have the capability to operate in a coordinated manner. Hence, they had to be replaced with newer controllers.

In order to evaluate the system performance, traffic conditions were monitored and various data were collected before the implementation of any changes. This data was in the form of traffic volumes, saturation flow rates, travel times, and delays. While 15 minute volumes were collected for peak periods, hourly volumes were collected for the off-peak periods. Saturation flows were estimated in the field by using the method suggested in the TLS PASSER II and PASSER III training manuals. The test car method was used to collect data about link travel times, average number of stops, and the stop locations.

PASSER III was initially used to obtain signal timings for the diamond interchange. The same timings were used in PASSER II-87 simulation model to optimize the phase splits, obtain offsets, and estimate delays for the arterial. However, these timings were found to impede progression as a large cycle length was required at the intersection with Chisholm Trail. Hence, PASSER II optimization process was used to obtain the optimum cycle lengths for the various time periods. Based on field observations, minor fine tuning of the timings were done. Implementing the new signal timings resulted in a total annual savings of about 1.3 million dollars to the motorists using this route. The delays decreased by about 110,000 hrs (a decrease of about 40 percent), there were about 7.8 million fewer number of stops (a reduction of 23.6 percent), and there was a fuel savings of about 144,000 gallons per year (a reduction of about 15.6 percent). There were significant reductions in the travel times in a few links. The links between Mays and IH 35 and IH 35 and Chisholm Trial showed reductions in the travel times of about 53 seconds and 45 seconds, respectively. The total cost of the project was $12,151 and the benefit to cost ratio was 110 to 1.

		STOPS		TOTAL SYSTEM DELAY (veh-hrs)		FUEL (gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	AM-SCHOOL	7640	6162	43.6	31.1	198.36	176.73
	AM PEAK	7640	6483	43.6	31.7	207.6	187.6
	OFF-SCHOOL	8410	5646	93.4	31.5	231.54	162.74
	OFF PEAK	8410	5613	93.4	34.5	242.11	168.92
	PM-SCHOOL	9883	8026	66.9	65.8	264.86	248.29
	PM PEAK	9883	8034	66.9	65.8	278.46	272.78
DIFFERENCES	AM-SCHOOL		1478		12.5		21.63
	AM PEAK		1157		11.9		20
	OFF-SCHOOL		2764		61.9		68.8
	OFF PEAK		2797		58.9		73.19
	PM-SCHOOL		1857		1.1		16.57
	PM PEAK		1849		1.1		5.68
HRS/DAY	AM-SCHOOL		2		2		2
	AM PEAK		2.5		2.5		2.5
	OFF-SCHOOL		2.25		2.25		2.25
	OFF PEAK		2.75		2.75		2.75
	PM-SCHOOL		1		1		1
	PM PEAK		2.5		2.5		2.5
DAILY	AM-SCHOOL		2956		25		43.26
	AM PEAK		2893		29.75		50
	OFF-SCHOOL		6219		139.28		154.8
	OFF PEAK		7692		161.98		201.27
	PM-SCHOOL		1857		1.1		16.57
	PM PEAK		4623		2.75		14.2
	TOTAL		26239		360		480
UNIT VALUES			$0.014		$10.00		$1.00
ANNUAL SAVING			$110,203		$1,079,550		$144,031

PROJECT COST:	$12,151	TOTAL ANNUAL SAVINGS:	$1,333,784
BENIFIT/COST RATIO:	109.77		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CHISHOLM TRAIL RD
MAYS
ROUND ROCK AVE
RM 620
LAKE CREEK DR
DEEPWOOD
WFR
EFR
IH 35
MAIN AVE
ROUNDROCK
TEXAS
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Central Business District

The City's Traffic Signals Unit were assisted by the Texas Department of Transportation to work on the following project. The project is located in the central business district of the City of San Marcos. The network consisted of 26 intersections on a number of arterials running across the city. The attached map displays the project network system and cross streets.

While most of the major streets in the network are four-lane undivided, the minor streets are mostly two-lane undivided roadways. Congestion is most pronounced in the morning peak and the evening peak due to the presence of the several businesses, manufacturing plants, and educational institutions. However, the flow is also significant in the off-peak period due to the location of Southwest Texas State University in the center of the city.

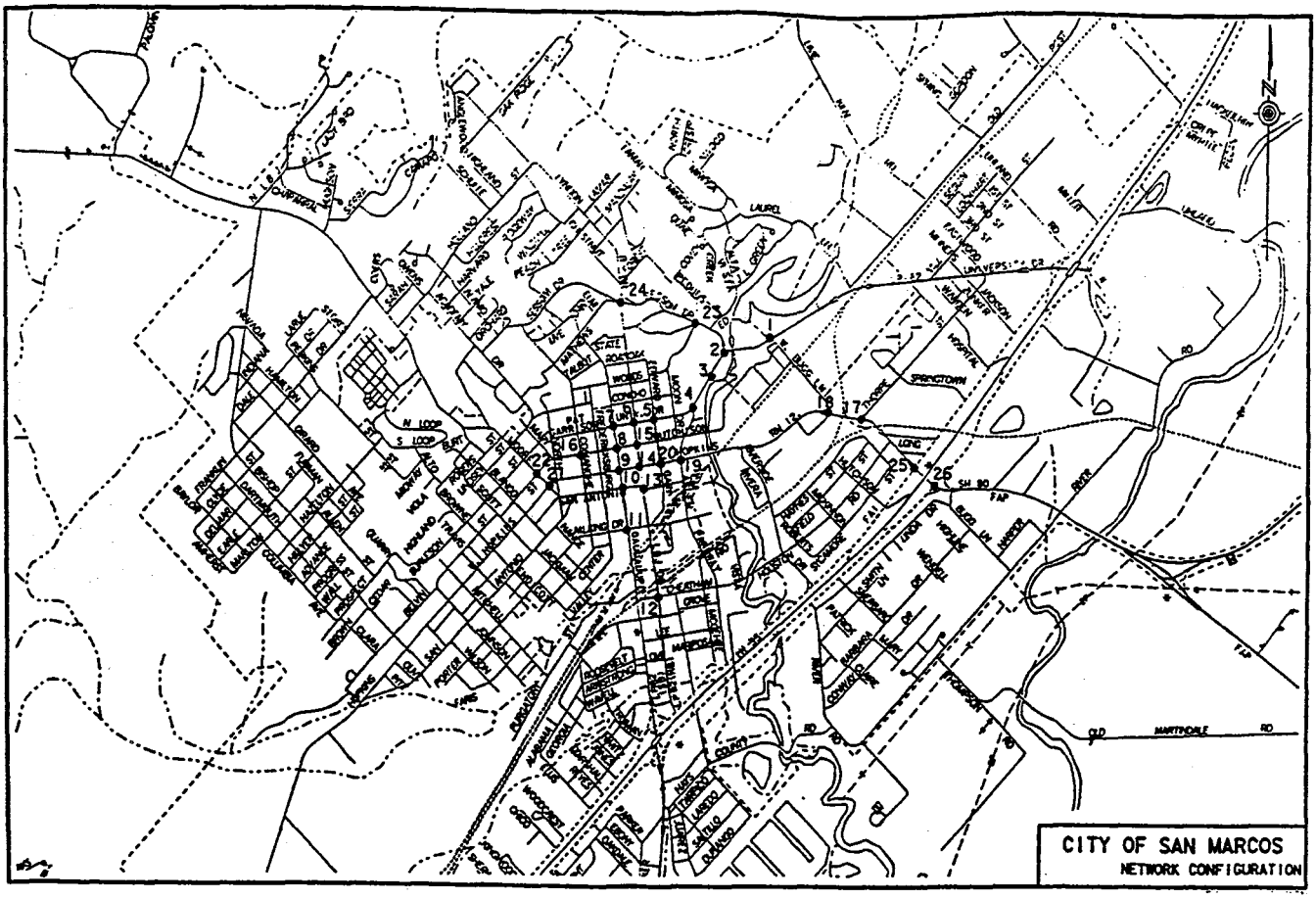
The system consisted of 25 signalized intersections and an intersection with a four-way stop control. Eleven of the controllers located in the heart of the city were connected to the master controller. Eight of the controllers were not TBC compatible and had to be replaced. While five of the intersections were under actuated control, the remaining were under pretimed control. The controllers were using between two and four phases. Fourteen intersections were equipped with pedestrian controls.

In order to evaluate the system performance, traffic conditions were monitored and various data were collected before implementation of any changes. This data was in the form of traffic volumes, saturation flow rates, travel times, and delays. The assistant key was used in PASSER II-90 to estimate the saturation flow rates, lost times, and the effective green. The test car method was used to collect link travel times, average number of stops, and the stop locations.

PASSER II-90 simulation model was employed to obtain the phase splits and offsets for two arterials. An optimum cycle length of 75 seconds for the AM and the off-peak periods and 85 seconds for the PM peak was obtained from PASSER II. These timings were then coded into TRANSYT- 7F program to obtain the optimum timings for the network. Minor fine tuning of the splits and offsets was done to improve the progression. Implementing the new signal timings resulted in a total annual savings of about 10.8 million dollars to the motorists using the CBD network. The number of stops decreased by about 8.57 million (a decrease of about 9.36 percent), there were about 1.05 million fewer hours of delay (a reduction of 42 percent), and there was a fuel savings of about 324,000 gallons (a reduction of 12 percent) in an year. The average travel times decreased significantly on most of the links. There were very few links which indicated an increase in the travel time. The total cost of the project was $41,687 with a benefit to cost ratio of 261 to 1.

		STOPS		TOTAL SYSTEM DELAY (veh-hrs)		FUEL (gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	AM	18581	18439	333	175	415	413
	OFF	30359	26851	868	467	918	764
	PM	27693	25832	789	608	843	844
DIFFERENCES	AM	142		158		2	
	OFF	3508		401		154	
	PM	1861		181		-1	
HRS/DAY	AM	2		2		2	
	OFF	7		7		7	
	PM	2		2		2	
DAILY	AM	284		316		4	
	OFF	24556		2807		1078	
	PM	3722		362		-2	
	TOTAL	28562		3485		1080	
UNIT VALUES		$0.014		$10.00		$1.00	
ANNUAL SAVINGS		$119,960		$10,455,000		$324,000	

PROJECT COST:	$41,687	TOTAL ANNUAL SAVINGS:	$10,898,960
BENIFIT/COST RATIO:	261.45		


CITY OF SAN MARCOS
NETWORK CONFIGURATION

SH 95 System

The District 14 Traffic Office of TxDOT worked on improving traffic signal timing on SH 95 and Business 79 (2nd and 4th Streets). The City of Taylor's 1990 population rose eight percent from its 1980 census. SH 95 and Business 79 are the major arterials that run through this steadily growing city. Therefore, there is a need for traffic to flow in the most safe and efficient manner possible.

The predominant land use along US 79 and SH 95 is commercial and office development. Therefore, congestion is most pronounced during the morning and evening peak periods. The flow in the off-peak period is also significant due to the location of various restaurants in the area.

The traffic signal network covered in this project includes seven intersections along SH 95 and two on Business 79, which are to be coordinated with SH 95. US 79 and SH 95 are four-lane, undivided, two-way roadways; however, the intersection of SH 95 at Lake Drive has a continuous left turn bay. The attached map displays the project arterial and cross streets.

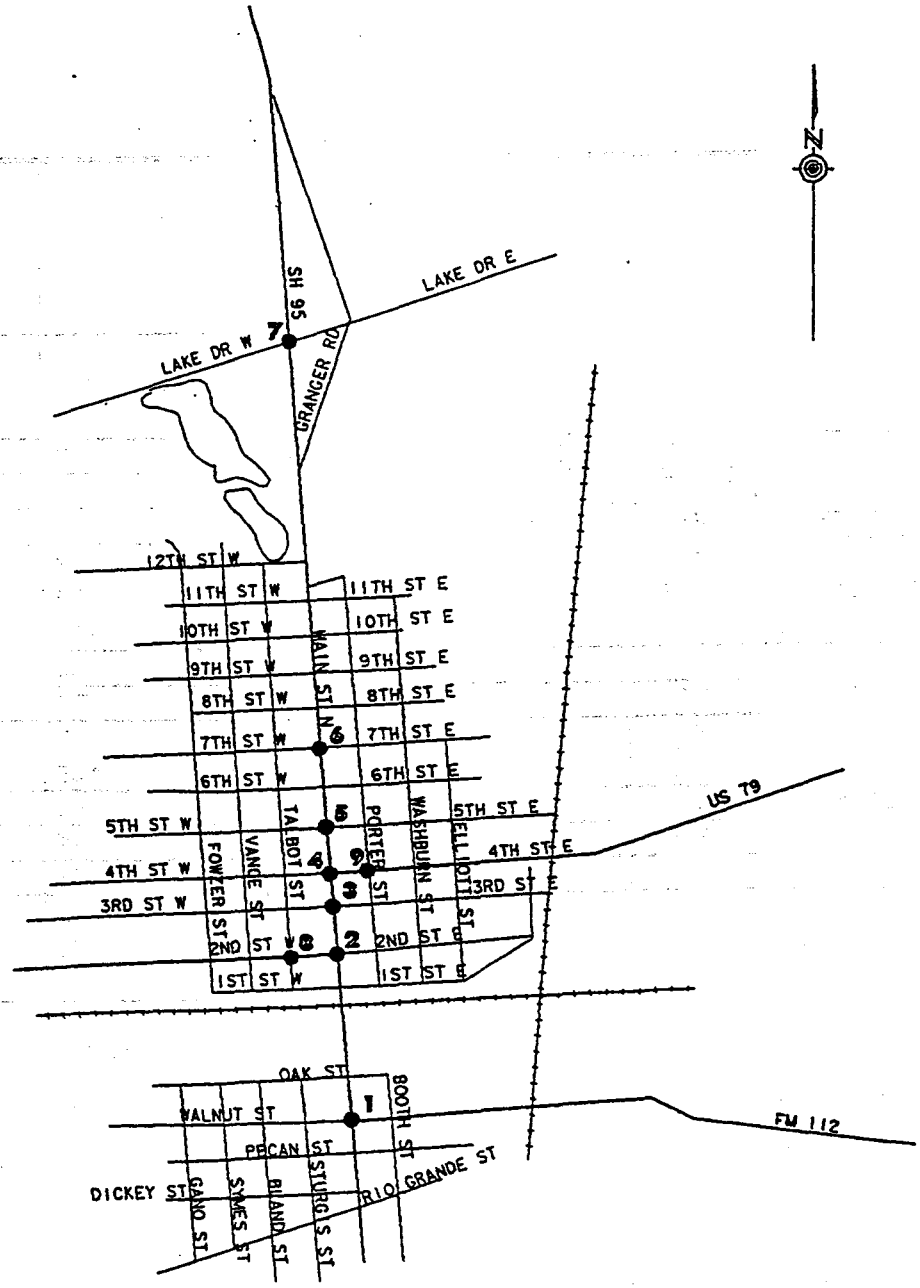
The electromechanical controllers at each intersection were replaced with those that are time base coordinated. All the controllers are pretimed with two phases, except for the SH 95/Lake Dr. intersection which is three phased. None of the intersections had pedestrian controls. The outdated eight inch signal heads were upgraded to 12 inch.

"Before" and "after" conditions of the study were monitored in order to evaluate the system's performance of the TLS program. Basic traffic and intersection data (travel times and travel delays at each node), signal phasing, vehicle turning movements, and saturation flow rates were required at each intersection. The vehicle turning movement counts and intersection data were taken by collecting data during actual field studies. The remaining information was obtained from data files.

Based on the PASSER II-90 simulation, the project had an estimated total annual cost savings of $86,066. This operating cost savings included a total annual savings of 3,284,071 stops (a 11.4 percent reduction), a total annual fuel savings of 25,539 gallons (a 5.8 percent reduction), and a total annual delay savings of 1,455 veh-hrs (a 1.2 percent reduction). Visual observation indicates improved traffic flow and reduced congestion. Travel time decreased on an average of 3.5 minutes and the delay decreased by about 20 percent. The total cost of the project was $61,188 and the resultant benefit to cost ratio was 1 to 1.

		STOPS		TOTAL SYSTEM DELAY (veh-hrs)		FUEL (gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	AM	6997	6156	31.6	28.7	105.63	97.25
	OFF	8861	7840	37.9	37.7	134.66	126.9
	PM	9344	8330	41	41.5	143.48	136.3
DIFFERENCES	AM	841		2.9		8.38	
	OFF	1021		0.2		7.76	
	PM	1014		-0.5		7.18	
HRS/DAY	AM	1.5		1.5		1.5	
	OFF	7.5		7.5		7.5	
	PM	2		2		2	
DAILY	AM	1262		4.35		12.57	
	OFF	7658		1.5		58.2	
	PM	2028		-1		14.36	
	TOTAL	10947		4.85		85.13	
UNIT VALUES		$0.014		$10.00		$1.00	
ANNUAL SAVINGS		$45,977		$14,550		$25,539	

PROJECT COST:	$61,188	TOTAL ANNUAL SAVINGS:	$86,066
BENIFIT/COST RATIO:	1.41		



TAYLOR
TEXAS

1st/3rd

The City of Temple Department of Public Works and Transportation worked on the following project. A total of eleven (11) intersections were included in this traffic signal network at spacing that varied between 370 feet and 4,215 feet. The attached figure shows the project network system, cross streets, and link distances.

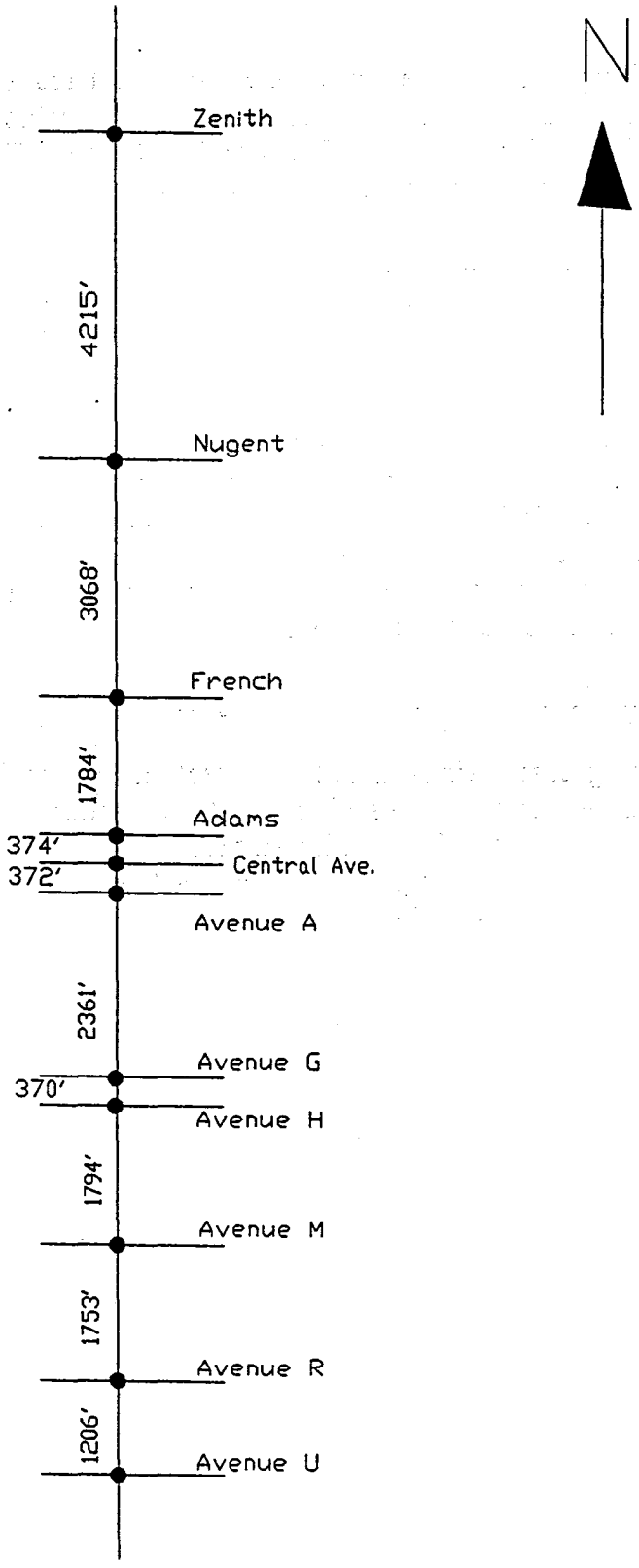
All controllers were modified to achieve time based coordination (TBC) capabilities. The existing master controllers were modified to become secondaries to operate on TBC mode. The intersections had between two and eight signal phases.

In order to evaluate the system performance, the "before" TLS traffic conditions were monitored and various field data were collected. 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-87 for the "after" conditions for each of the morning, evening, and off-peak periods. The optimum cycle lengths for the intersections were 60 and 65 seconds long, respectively. These timing plans were found to achieve better progression.

Based on PASSER II-87 simulation, the project resulted in an estimated $557,329 savings per year on total operating cost, a direct benefit to motorists using these routes. This operating cost savings included a total savings of 11,912,100 stops (a 21.7 percent reduction), a total annual fuel savings of 24,109 gallons (a 1.4 percent reduction), and a delay annual savings of 36,645 veh-hrs (a 12.7 percent reduction). The City intends to run new programs to tie all projects together and achieve better progression. The total cost of the project was $12,123 and the resultant benefit to cost ratio was 46 to 1.

		STOPS		TOTAL SYSTEM DELAY (veh-hrs)		FUEL (gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	AM	13357	10297	91.3	57.8	396.99	390
	OFF	9279	7163	45.3	41.9	288.53	284.43
	PM	13012	11466	80.4	67.6	395.64	391.42
DIFFERENCES	AM	3060		33.5		6.99	
	OFF	2116		3.4		4.1	
	PM	1546		12.8		4.22	
HRS/DAY	AM	1.5		1.5		1.5	
	OFF	15.5		15.5		15.5	
	PM	1.5		1.5		1.5	
DAILY	AM	4590		50.25		10.49	
	OFF	32798		52.7		63.55	
	PM	2319		19.2		6.33	
	TOTAL	39707		122.15		80.36	
UNIT VALUES		$0.014		$10.00		$1.00	
ANNUAL SAVINGS		$166,769		$366,450		$24,109	

PROJECT COST:	$12,123	TOTAL ANNUAL SAVINGS:	$557,329
BENIFIT/COST RATIO:	45.97		


N
Zenith
4215'
Nugent
3068'
French
1784'
Adams
374'
Central Ave.
372'
Avenue A
2361'
Avenue G
370'
Avenue H
1794'
Avenue M
1753'
Avenue R
1206'
Avenue U

31st Street

The City of Temple Department of Public Works and Transportation worked on the following project. A total of nine (9) intersections were included in this traffic signal network at spacing that varied between 387 feet and 3,840 feet. The attached figure shows the project network system, cross streets, and link distances.

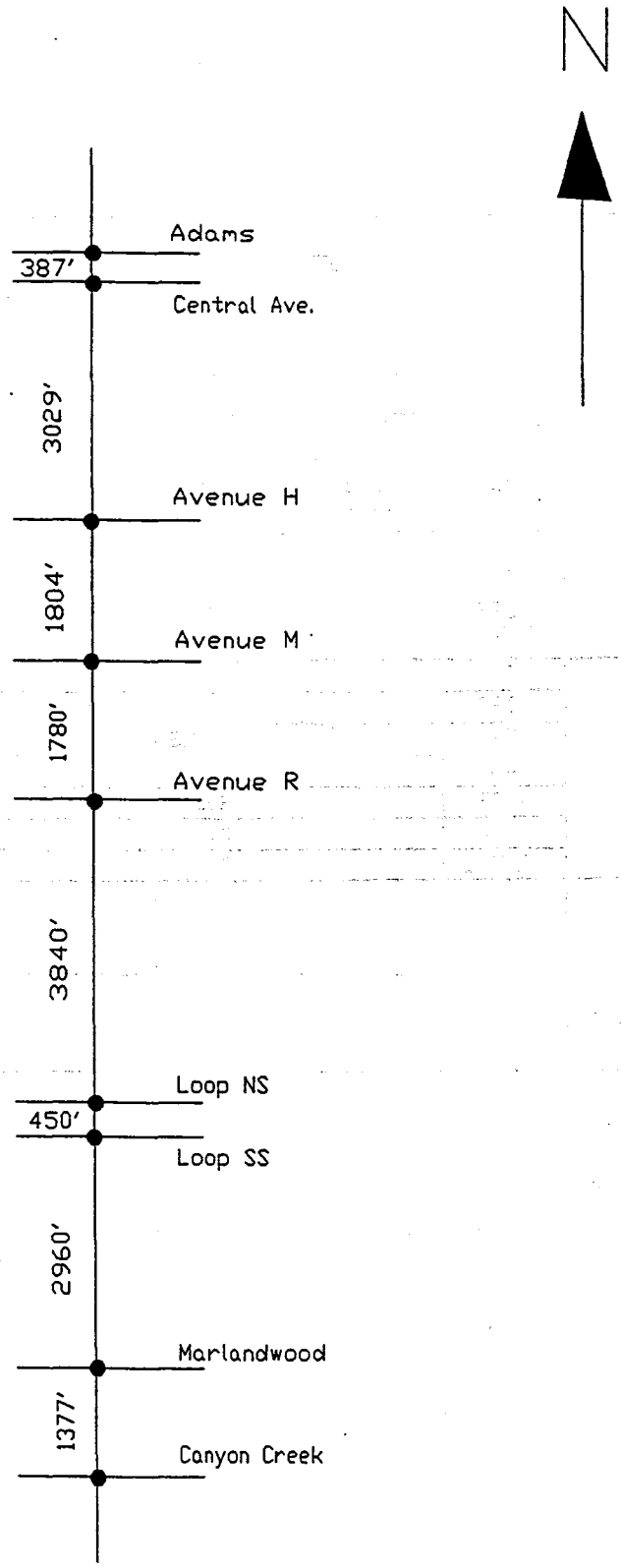
All controllers were modified to achieve time based coordination (TBC) capabilities. The existing master controllers were modified to become secondaries to operate on TBC mode. The intersections had between two and eight signal phases.

In order to evaluate the system performance, the "before" TLS traffic conditions were monitored and various field data were collected. 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-87 for the "after" conditions for each of the morning, evening, and off-peak periods. The optimum cycle lengths for the intersections were 60 and 65 seconds long, respectively. These timing plans were found to achieve better progression.

Based on PASSER II-87 simulation, the project resulted in an estimated 6.18 million dollar savings per year on total operating cost, a direct benefit to motorists using these routes. This operating cost savings included a total savings of 28,598,100 stops (a 29.2 percent reduction), a total annual fuel savings of 142,660 gallons (a 6.5 percent reduction), and a delay annual savings of 563,925 veh-hrs (a 53.0 percent reduction). The City intends to run new programs to tie all projects together and achieve better progression. The total cost of the project was $2,324 and the resultant benefit to cost ratio was 2660 to 1.

		STOPS		TOTAL SYSTEM DELAY (veh-hrs)		FUEL (gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	AM	20753	17926	181.5	139.2	463.45	454.19
	OFF	15860	11374	151.2	78.1	370.74	348.98
	PM	32827	18458	620.3	164.8	559.91	477
DIFFERENCES	AM		2827		42.3		9.26
	OFF		4486		73.1		21.76
	PM		14369		455.5		82.91
HRS/DAY	AM		1.5		1.5		1.5
	OFF		15.5		15.5		15.5
	PM		1.5		1.5		1.5
DAILY	AM		4241		63.45		13.89
	OFF		69533		1133.05		337.28
	PM		21554		683.25		124.36
	TOTAL		95327		1879.75		475.53
UNIT VALUES			$0.014		$10.00		$1.00
ANNUAL SAVINGS			$400,373		$5,639,250		$142,660

PROJECT COST:	$2,324	TOTAL ANNUAL SAVINGS:	$6,182,284
BENIFIT/COST RATIO:	2660.19		


N
Adams
387'
Central Ave.
3029'
Avenue H
1804'
Avenue M
1780'
Avenue R
3840'
Loop NS
450'
Loop SS
2960'
Marlandwood
1377'
Canyon Creek

57th Street

The City of Temple Department of Public Works and Transportation worked on the following project. A total of five (5) intersections were included in this traffic signal network at spacing that varied between 355 feet and 3,570 feet. The attached figure shows the project network system, cross streets, and link distances.

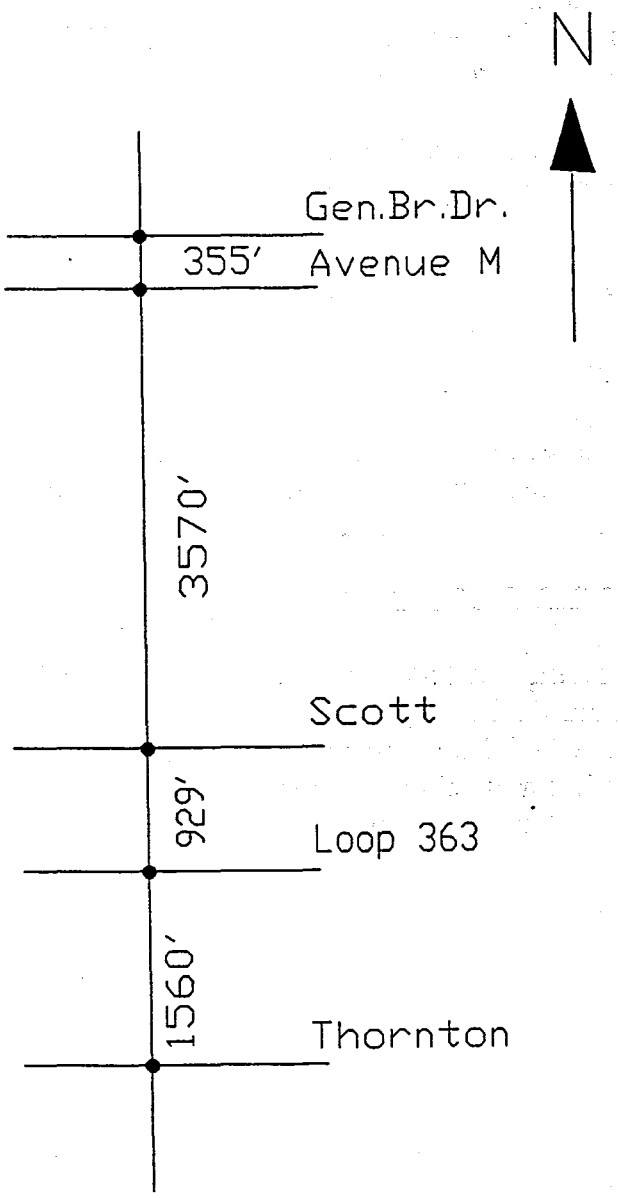
All controllers were modified to achieve time based coordination (TBC) capabilities. The existing master controllers were modified to become secondaries to operate on TBC mode. The intersections had between two and eight signal phases.

In order to evaluate the system performance, the "before" TLS traffic conditions were monitored and various field data were collected. 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 the "after" conditions for each of the morning, evening, and off-peak periods. Due to volume on 57th Street and construction of intersections, good results were not obtained by PASSER II. Improvements were obtained when TRANSYT-7F was used for the AM period. TRANSYT-7F was easier to use even though each phase has to be an input. Changing of phases for different runs gave better results than PASSER II. The optimum cycle lengths for the intersections were 60 and 65 seconds long, respectively.

Based on TRANSYT-7F simulation, the operating cost increased by $415,787. This operating cost included a total savings of 1,514,400 stops (a 7.4 percent reduction) and a total annual fuel savings of 14,379 gallons (a 2.4 percent reduction). However, the total system delay increased along 57th Street by 45,136 veh-hrs (a 53.9 percent increase). The increase in the systems delay can be attributed to the fact that construction of intersections and streets was being carried out at the time of collecting the data. The City intends to run new programs to tie all projects together and achieve better progression. The total cost of the project was $7,692 and the resultant benefit to cost ratio was -54 to 1.

		STOPS		TOTAL SYSTEM DELAY (veh-hrs)		FUEL (gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	AM	4932	3976	49.28	23.85	116	91.18
	OFF	3609	3231	11.3	21.6	102.27	102.05
	PM	3455	4952	20.2	39.5	141.71	136.85
DIFFERENCES	AM		956		25.43		24.82
	OFF		378		-10.3		0.22
	PM		-1497		-19.3		4.86
HRS/DAY	AM		1.5		1.5		1.5
	OFF		15.5		15.5		15.5
	PM		1.5		1.5		1.5
DAILY	AM		1434		38.15		37.23
	OFF		5859		-159.65		3.41
	PM		-2246		-28.95		7.29
	TOTAL		5048		-150.46		47.93
UNIT VALUES			$0.014		$10.00		$1.00
ANNUAL SAVINGS			$21,200		($451,365)		$14,379

PROJECT COST:	$7,692	TOTAL ANNUAL SAVINGS:	($415,787)
BENIFIT/COST RATIO:	-54.06		


N
Gen.Br.Dr.
355'
Avenue M
3570'
Scott
929'
Loop 363
1560'
Thornton

Avenue H

The City of Temple Department of Public Works and Transportation worked on the following project. A total of four (4) intersections were included in this traffic signal network at spacing that varied between 1,119 feet and 3,962 feet. The attached figure shows the project network system, cross streets, and link distances.

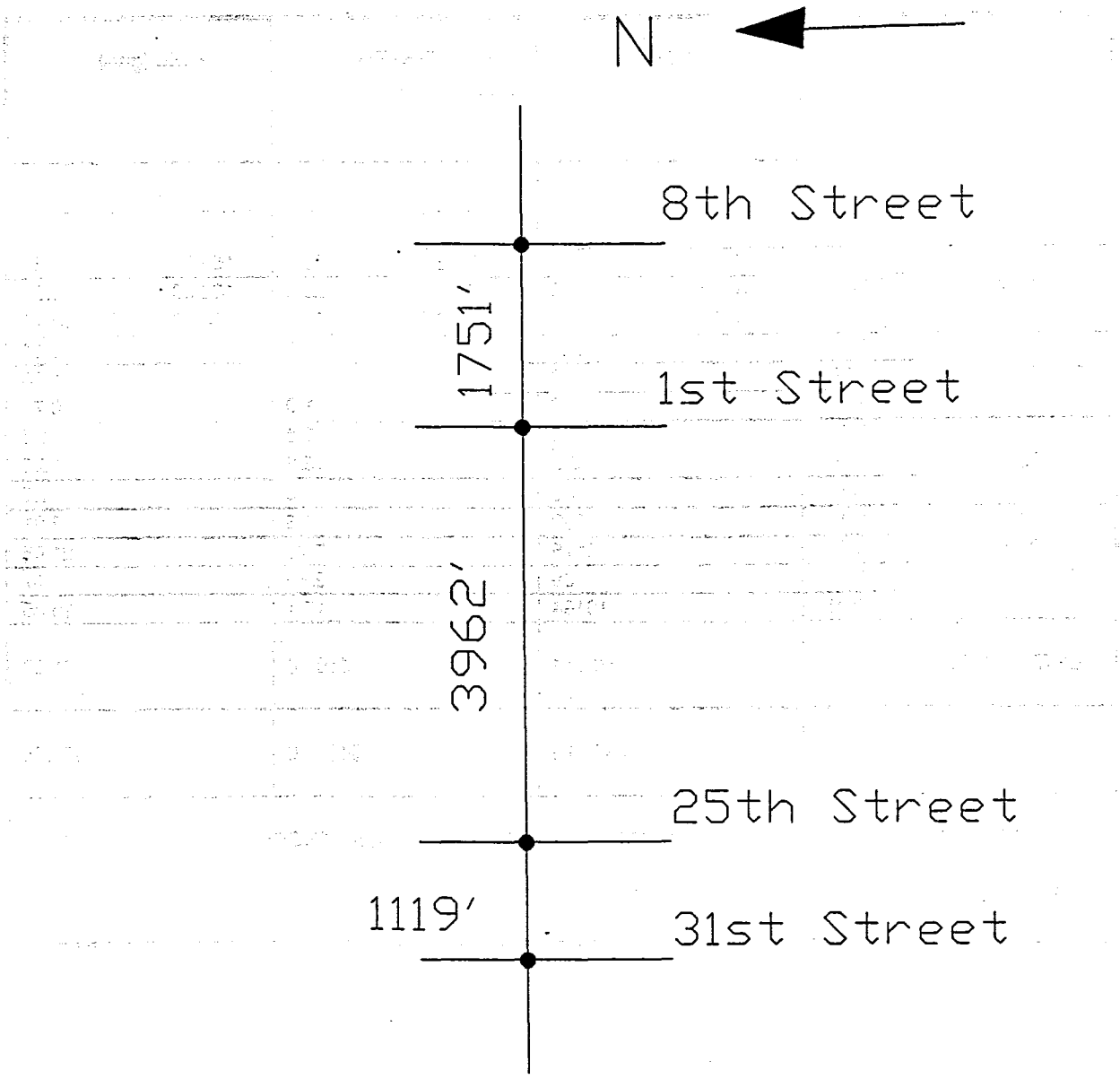
All controllers were modified to achieve time based coordination (TBC) capabilities. The existing master controllers were modified to become secondaries to operate on TBC mode. The intersections had between two and eight signal phases.

In order to evaluate the system performance, the "before" TLS traffic conditions were monitored and various field data were collected. 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-87 for the "after" conditions for each of the morning, evening, and off-peak periods. The optimum cycle lengths for the intersections were 60 and 65 seconds long, respectively. These timing plans were found to achieve better progression.

Based on PASSER II-87 simulation, the project resulted in an estimated $95,700 savings per year on total operating cost, a direct benefit to motorists using these routes. This operating cost savings included a total savings of 3,055,200 stops (a 12.7 percent reduction), a total annual fuel savings of 7,606 (a 1.0 percent reduction), and a delay annual savings of 4,530 veh-hrs (a 3.3 percent reduction). The City intends to run new programs to tie all projects together and achieve better progression. The total cost of the project was $5,520 and the resultant benefit to cost ratio was 17.33 to 1.

		STOPS		TOTAL SYSTEM DELAY (veh-hrs)		FUEL (gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	AM	5439	4813	31.8	28.8	169.83	167.69
	OFF	4190	3598	23.1	22.6	132.63	131.27
	PM	4661	4615	33.5	31.6	164.19	163.48
DIFFERENCES	AM	626		3		2.14	
	OFF	592		0.5		1.36	
	PM	46		1.9		0.71	
HRS/DAY	AM	1.5		1.5		1.5	
	OFF	15.5		15.5		15.5	
	PM	1.5		1.5		1.5	
DAILY	AM	939		4.5		3.21	
	OFF	9176		7.75		21.08	
	PM	69		2.85		1.07	
	TOTAL	10184		15.1		25.35	
UNIT VALUES		$0.014		$10.00		$1.00	
ANNUAL SAVINGS		$42,773		$45,300		$7,606	

PROJECT COST:	$5,520	TOTAL ANNUAL SAVINGS:	$95,679
BENIFIT/COST RATIO:	17.33		


N
8th Street
1751'
1st Street
3962'
25th Street
1119'
31st Street

Avenue M

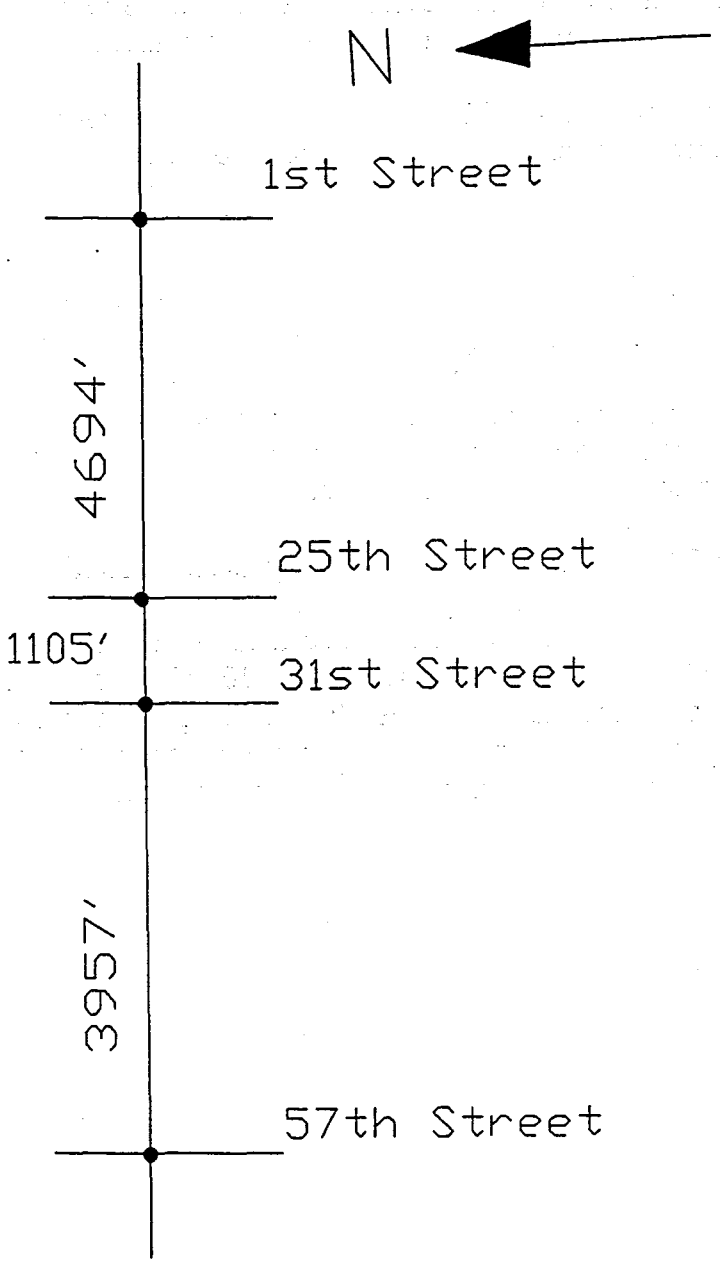
The City of Temple Department of Public Works and Transportation worked on the following project. A total of four (4) intersections were included in this traffic signal network at spacing that varied between 1,105 feet and 4,694 feet. The attached figure shows the project network system, cross streets, and link distances.

All controllers were modified to achieve time based coordination (TBC) capabilities. The existing master controllers were modified to become secondaries to operate on TBC mode. The intersections had between two and eight signal phases.

In order to evaluate the system performance, the "before" TLS traffic conditions were monitored and various field data were collected. 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-87 for the "after" conditions for each of the morning, evening, and off-peak periods. The optimum cycle lengths for the intersections were 60 and 65 seconds long, respectively. These timing plans were found to achieve better progression.

Based on PASSER II-87 simulation, the project resulted in an estimated 1.01 million dollar savings per year on total operating cost, a direct benefit to motorists using these routes. This operating cost savings included a total savings of 10,159,500 stops (a 35.5 percent reduction), a total annual fuel savings of 48,177 (a 3.9 percent reduction), and a delay annual savings of 81,945 veh-hrs (a 40.2 percent reduction). The City intends to run new programs to tie all projects together and achieve better progression. The total cost of the project was $5,076 and the resultant benefit to cost ratio was 199 to 1.

		STOPS		TOTAL SYSTEM DELAY (veh-hrs)		FUEL (gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTEP
HOURLY VALUES	AM	5700	3697	37.1	23.9	257.19	
	OFF	4917	3206	32.4	21	216.63	
	PM	7065	4172	80.7	29.6	268.96	
DIFFERENCES	AM		2003		13.2		
	OFF		1711		11.4		
	PM		2893		51.1		
HRS/DAY	AM		1.5		1.5		
	OFF		15.5		15.5		
	PM		1.5		1		
DAILY	AM		3005				
	OFF		26521				
	PM		4340				
	TOTAL		33865				
UNIT VALUES			$0.014				
ANNUAL SAVINGS			$142,231				
PROJECT COST:			$5,076	TOT			
BENIFIT/COST RATIO:			198.95				


N
1st Street
4694'
25th Street
1105'
31st Street
3957'
57th Street

Central/Adams

The City of Temple Department of Public Works and Transportation worked on the following project. A total of seven (7) intersections were included in this traffic signal network at spacing that varied between 315 feet and 2,668 feet. The attached figure shows the project network system, cross streets, and link distances.

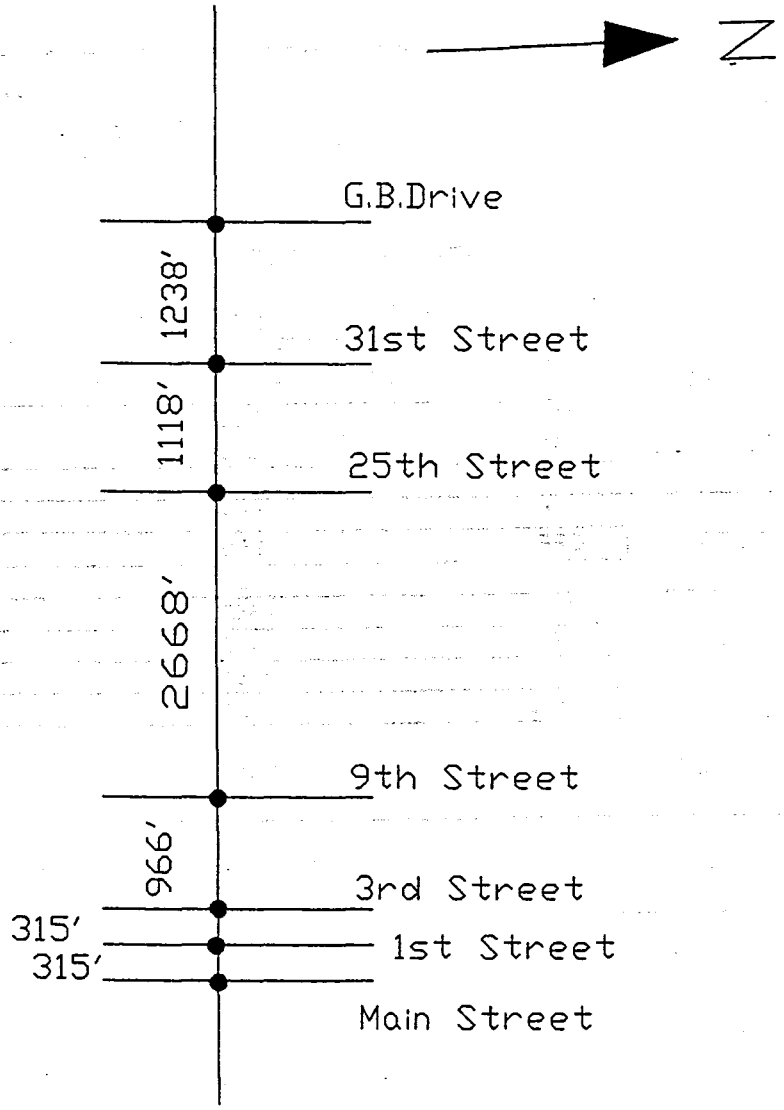
All controllers were modified to achieve time based coordination (TBC) capabilities. The existing master controllers were modified to become secondaries to operate on TBC mode. The intersections had between two and eight signal phases.

In order to evaluate the system performance, the "before" TLS traffic conditions were monitored and various field data were collected. 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-87 for the "after" conditions for each of the morning, evening, and off-peak periods. The optimum cycle lengths for the intersections were 60 and 65 seconds long, respectively. These timing plans were found to achieve better progression.

Based on PASSER II-87 simulation, the project resulted in an estimated 3.26 million dollar savings per year on total operating cost, a direct benefit to motorists using these routes. This operating cost savings included a total savings of 13,576,200 stops (an 18.7 percent reduction), a total annual fuel savings of 310,467 gallons (an 18.7 percent reduction), and a delay annual savings of 276,400 veh-hrs (a 42.7 percent reduction). The City intends to run new programs to tie all projects together and achieve better progression. The total cost of the project was $10,374 and the resultant benefit to cost ratio was 315 to 1.

		STOPS		TOTAL SYSTEM DELAY (veh-hrs)		FUEL (gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	AM	17275	13553	329.86	93.47	522.36	318.37
	OFF	12866	10581	94.28	63.84	279.25	238.77
	PM	17141	12994	226.77	103.55	442.83	320.86
DIFFERENCES	AM	3722		236.39		203.99	
	OFF	2285		30.44		40.48	
	PM	4147		123.22		121.97	
HRS/DAY	AM	1.25		1.25		1.25	
	OFF	15.5		15.5		15.5	
	PM	1.25		1.25		1.25	
DAILY	AM	4653		295.49		254.99	
	OFF	35418		471.82		627.44	
	PM	5184		154.03		152.46	
	TOTAL	45254		921.33		1034.89	
UNIT VALUES		$0.014		$10.00		$1.00	
ANNUAL SAVINGS		$190,066		$2,763,998		$310,467	

PROJECT COST:	$10,374	TOTAL ANNUAL SAVINGS:	$3,264,530
BENIFIT/COST RATIO:	314.68		


N
G.B.Drive
1238'
31st Street
1118'
25th Street
2668'
9th Street
966'
3rd Street
315'
1st Street
315'
Main Street

Highway US 82

The City of Texarkana Engineering Department worked on improving traffic signal timing on Highway US 82. US 82 is one of the main arterials in Texarkana and it brings people into and out of the city from several communities and towns west of Texarkana. The section of the arterial that was studied has ten intersections. The major streets intersecting this arterial are five-lane including left-turn lanes. The minor streets are two-lane undivided roadways. Traffic is usually heaviest eastbound in the mornings and westbound in the evenings. The noon-hour traffic is equally distributed in both directions as is the off-peak. The ten cross streets are 14th, 16th, Texas, Spruce, Summerhill, Read./Crock, Milam, Smelser, Robison, and West./Bay. The controllers at each intersection are pretimed, with no pedestrian controls and various numbers of phases. The attached map displays the project arterial, cross streets, and link distances.

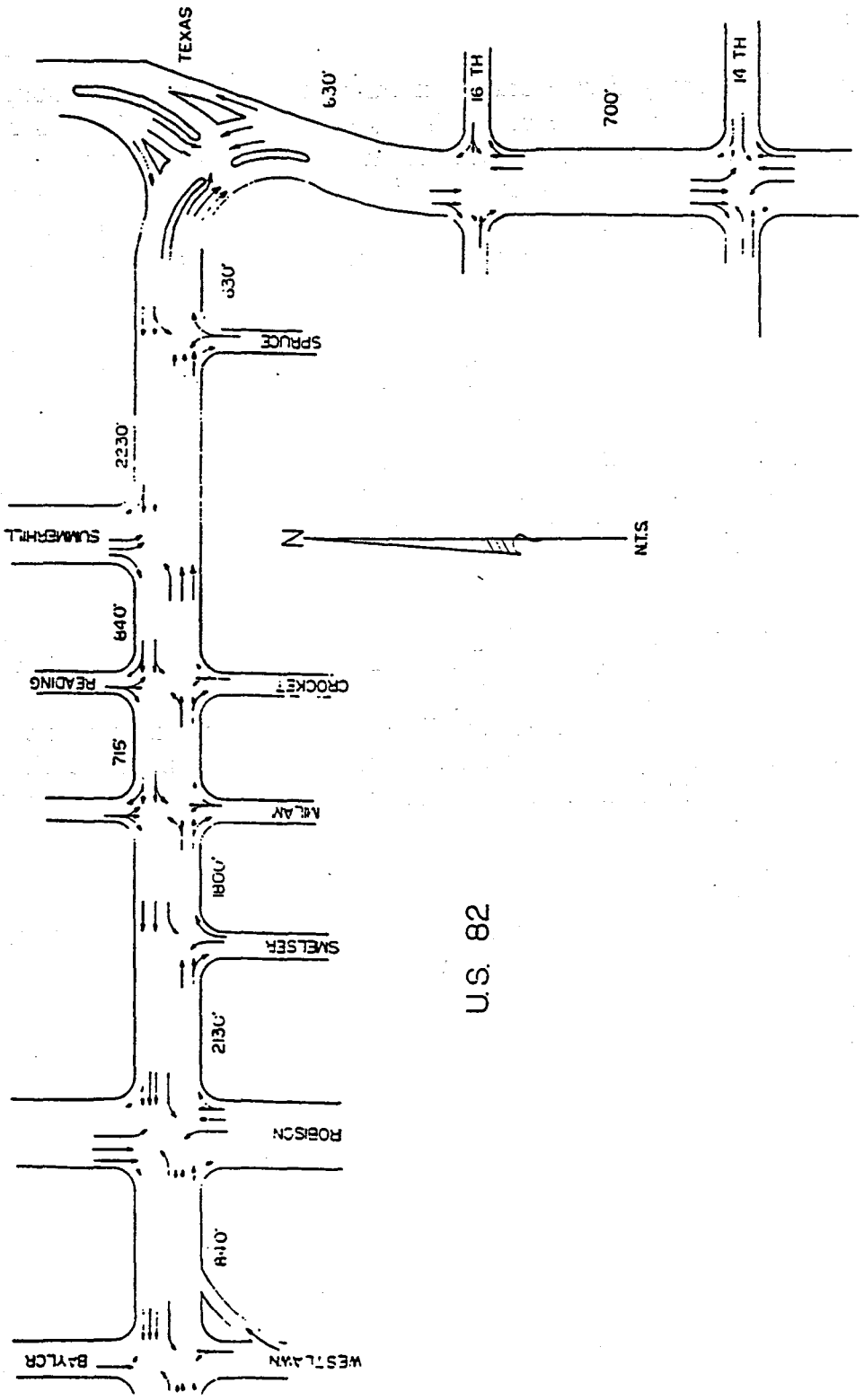
"Before" and "after" conditions of the study were monitored in order to evaluate the system's performance of the TLS program. Basic traffic and intersection data (travel times and travel delays at each node), signal phasing, vehicle turning movements, and saturation flow rates were required at each intersection. The vehicle turning movement counts and intersection data were taken by collecting data during actual field studies for twelve hours each day. The remaining information was obtained from data files.

The input data was coded into PASSER II and four input files were established. Approximately 92 runs were made to determine the best overall timing plans for the four periods of the day, AM, NOON, OFF, and PM. Five new cabinets and controllers with the existing times were installed so as not to disturb the normal traffic patterns. Offset changes were the only alterations from the original timing plans . Five offsets were changed in the Am Peak plan to facilitate traffic coming into the system on Summerhill Road, a major arterial. Only one offset was changed on the NOON Peak program, two on the PM Peak program and three on the OFF Peak program. All these changes were made to help traffic entering the system at Summerhill Road.

Based on the PASSER II simulation, the project had an estimated total annual cost savings of $341,991. This operating cost savings included a total annual savings of 3,881,143 stops (a 7.2 percent reduction), a total annual fuel savings of 18,479 gallons (a 1.6 percent reduction), and a total annual delay savings of 26,918 veh-hrs (a 6.3 percent reduction). The travel time reduced approximately 30 percent. Visual observation indicates improved traffic flow and reduced congestion. The total cost of the project was $38,326 and the resultant benefit to cost ratio was 9 to 1.

		STOPS		TOTAL SYSTEM DELAY (veh-hrs)		FUEL (gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	AM	10287	9370	82.8	73.7	222.15	218.64
	OFF	10712	10059	86.2	81.1	234.15	229.99
	NOON	11908	10806	92.3	86.2	259.29	255.87
	PM	13815	12710	106.3	101.7	284.06	280.86
DIFFERENCES	AM	917		9.1		3.51	
	OFF	653		5.1		4.16	
	NOON	1102		6.1		3.42	
	PM	1105		4.6		3.2	
HRS/DAY	AM	1.75		1.75		1.75	
	OFF	9.75		9.75		9.75	
	NOON	2.25		2.25		2.25	
	PM	2.25		2.25		2.25	
DAILY TOTALS	AM	1605		15.92		6.14	
	OFF	6367		49.73		40.56	
	NOON	2480		13.72		7.70	
	PM	2486		10.35		7.2	
	TOTAL	12937		89.73		61.60	
UNIT VALUES		$0.014		$10.00		$1.00	
ANNUAL SAVINGS		$54,336		$269,175		$18,479	

PROJECT COST:	$38,326	TOTAL ANNUAL SAVINGS:	$341,991
BENIFIT/COST RATIO:	8.92		


TEXAS
630'
16 TH
700'
14 TH
630'
SPRUCE
2230'
SUMMERHILL
N
N.T.S.
640'
READING
CROCKETT
715'
MAIN
1801'
SWELSER
2130'
ROBISON
810'
BAYLOR
WESTLAWN
U.S. 82

Hillcrest Road System

The City of University Park worked on improving traffic signal timing on two thoroughfares in University Park, one of which was Hillcrest Road. The Hillcrest Road System consists of eight intersections on Hillcrest Road and two intersections on Lovers Lane. Hillcrest Road is a north-south arterial which generally has a four-lane undivided cross section. Southern Methodist University abuts the east side of Hillcrest Road from Daniel Avenue to the south end of the project. The attached map displays the project arterial and cross streets.

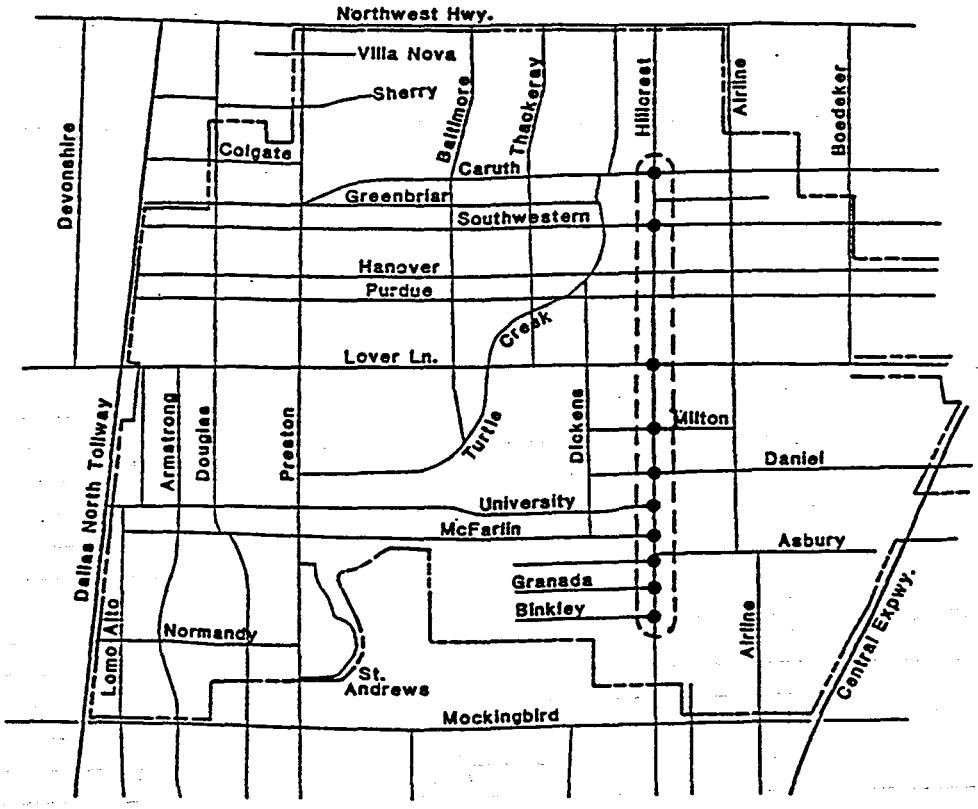
New Eagle closed-loop controllers and cabinets were purchased for all project intersections. Since installation of interconnect cable was not included in the TLS grant budget, initial coordination is being achieved by means of the internal time-based coordination. As soon as funds are available, the City intends to install twisted-pair cable to link the individual intersections with a field master. Each field master will be linked by means of dial-up commercial telephone line to the microcomputer, thereby achieving full, closed-loop system capability.

"Before" and "after" conditions of the study were monitored in order to evaluate the system's performance of the TLS program. Basic traffic and intersection data (travel times and travel delays at each node), signal phasing, vehicle turning movements, and saturation flow rates were required at each intersection. The vehicle turning movement counts and intersection data were taken by collecting data during actual field studies during an AM Peak, an AM offpeak, a PM peak, and a PM offpeak. The remaining information was obtained from data files.

Based on the PASSER II-90 simulation, the project had an estimated total annual cost savings of $390,311. This operating cost savings included a total annual savings of 9,922,214 stops (a 17.9 percent reduction), a total annual fuel savings of 65,400 gallons (an 8.4 percent reduction), and a total annual delay increase of 18,600 veh-hrs (a 6.3 percent increase). The travel time decreased three minutes and the delay was reduced by 73 percent. Visual observation indicates improved traffic flow and reduced congestion. The total cost of the project was $42,347 and the resultant benefit to cost ratio was 9 to 1.

		STOPS		TOTAL SYSTEM DELAY (veh-hrs)		FUEL (gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	AM	16130	12477	62	56	219	197
	OFF	15370	13226	69	69	207	195
	PM	22577	17197	191	166	358	313
DIFFERENCES	AM		3653		6		22
	OFF		2144		0		12
	PM		5380		25		45
HRS/DAY	AM		2		2		2
	OFF		7		7		7
	PM		2		2		2
DAILY	AM		7306		12		44
	OFF		15008		0		84
	PM		10760		50		90
	TOTAL		33074		62		218
UNIT VALUES			$0.014		$10.00		$1.00
ANNUAL SAVINGS			$138,911		$186,000		$65,400

PROJECT COST:	$42,347	TOTAL ANNUAL SAVINGS:	$390,311
BENIFIT/COST RATIO:	9.22		



SOURCE: TLS GRANT APPLICATION

N.T.S.

LEGEND

- PROJECT INTERSECTION
- PROJECT LIMITS

PROJECT AREA
HILLCREST ROAD TLS PROJECT
CITY OF UNIVERSITY PARK

Preston Road System

The City of University Park worked on improving traffic signal timing on two thoroughfares in University Park, one of which was Preston Road. The Preston Road System consists of eight intersections on Preston Road and two intersections on Lovers Lane. Preston Road is a north-south arterial, the cross section of which varies from four to six lanes, undivided. Minor intersections typically do not have left-turn bays, and the cross section is transitioned from six lanes to four by marking the right-most lanes "RIGHT TURN ONLY" in advance of signalized intersections. Lovers Lane is an east-west arterial which usually has just one lane per direction. The attached map displays the project arterial and cross streets.

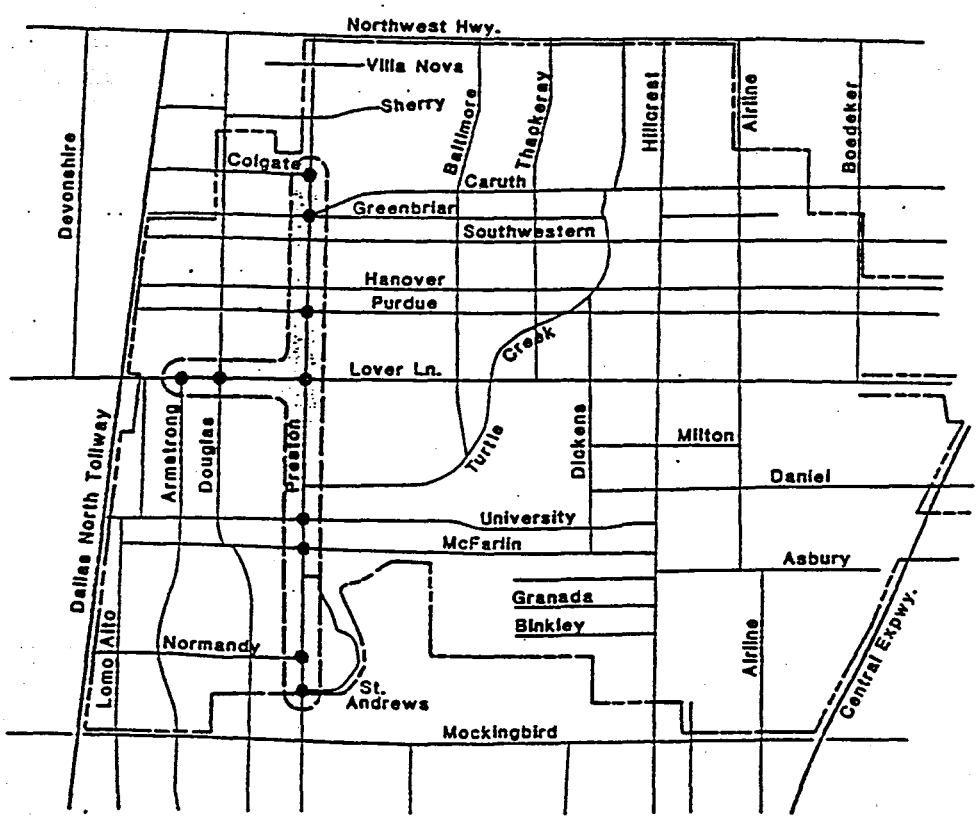
Prior to the TLS project, intersections were operating either free actuated on non-interconnected pretimed and were coordinated by means of a single 70-second dial. New Eagle closed-loop controllers and cabinets were purchased for all project intersections. Since installation of interconnect cable was not included in the TLS grant budget, initial coordination is being achieved by means of internal time-based coordination. As soon as funds are available, the City intends to install twisted-pair cable to link the individual intersections with a field master. Each field master will be linked by means of dial-up commercial telephone line to the microcomputer, thereby achieving full, closed-loop system capability.

"Before" and "after" conditions of the study were monitored in order to evaluate the system's performance of the TLS program. Basic traffic and intersection data (travel times and travel delays at each node), signal phasing, vehicle turning movements, and saturation flow rates were required at each intersection. The vehicle turning movement counts and intersection data were taken by collecting data during actual field studies during an AM Peak, an AM offpeak, a PM peak, and a PM offpeak. The remaining information was obtained from data files.

Based on the PASSER II-90 simulation, the project had an estimated total annual cost savings of $26,033. This operating cost savings included a total annual savings of 5,395,214 stops (a 2.8 percent reduction), a total annual fuel savings of 25,500 gallons (a 0.5 percent reduction), and a total annual delay increase of 7,500 veh-hrs (a 0.1 percent increase). However, field studies conducted by the City showed an improvement in the travel times and delay. This was due to the fact that, while the intersections were actually operating at different cycle lengths, a single cycle length was used during the simulation in PASSER II-90. The travel times decreased by 3 minutes and the delay reduced by 37.6 percent. Visual observation indicated improved traffic flow and reduced congestion. The total cost of the project was $42,347 and the resultant benefit to cost ratio was 0.61 to 1.

		STOPS		TOTAL SYSTEM DELAY (veh-hrs)		FUEL (gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	AM	75822	73603	2781	2768	2629	2606
	OFF	55395	54307	1347	1354	1465	1464
	PM	48290	45325	992	993	1202	1186
DIFFERENCES	AM		2219		13		23
	OFF		1088		-7		1
	PM		2965		-1		16
HRS/DAY	AM		2		2		2
	OFF		7		7		7
	PM		2		2		2
DAILY	AM		4438		26		46
	OFF		7616		-49		7
	PM		5930		-2		32
	TOTAL		17984		-25		85
UNIT VALUES			$0.014		$10.00		$1.00
ANNUAL SAVINGS			$75,533		($75,000)		$25,500

PROJECT COST:	$42,347	TOTAL ANNUAL SAVINGS:	$26,033
BENIFIT/COST RATIO:	0.61		



SOURCE: TLS GRANT APPLICATION

LEGEND

● PROJECT INTERSECTION

PROJECT LIMITS

PROJECT AREA
PRESTON ROAD TLS PROJECT
CITY OF UNIVERSITY PARK

RM 2244

The District 14 Traffic Office of TxDOT worked on the following project. West Lake Hills is a small town with an estimated population of 3,800. RM 2244 is the only major arterial running east-west through the town. Due to recent population growth, it has become necessary to improve traffic flow on RM 2244. Rollingwood and Walsh Tarlton are controlled by pretimed, electromechanical controllers. Westwood Terrace, Westbank Drive, Westlake Drive, and Campcraft are controlled by pretimed, solid state controllers. These two groups of controllers ran on a three period "time of day" strategy. The master controllers of the two groups are located at Walsh Tarlton and Westbank.

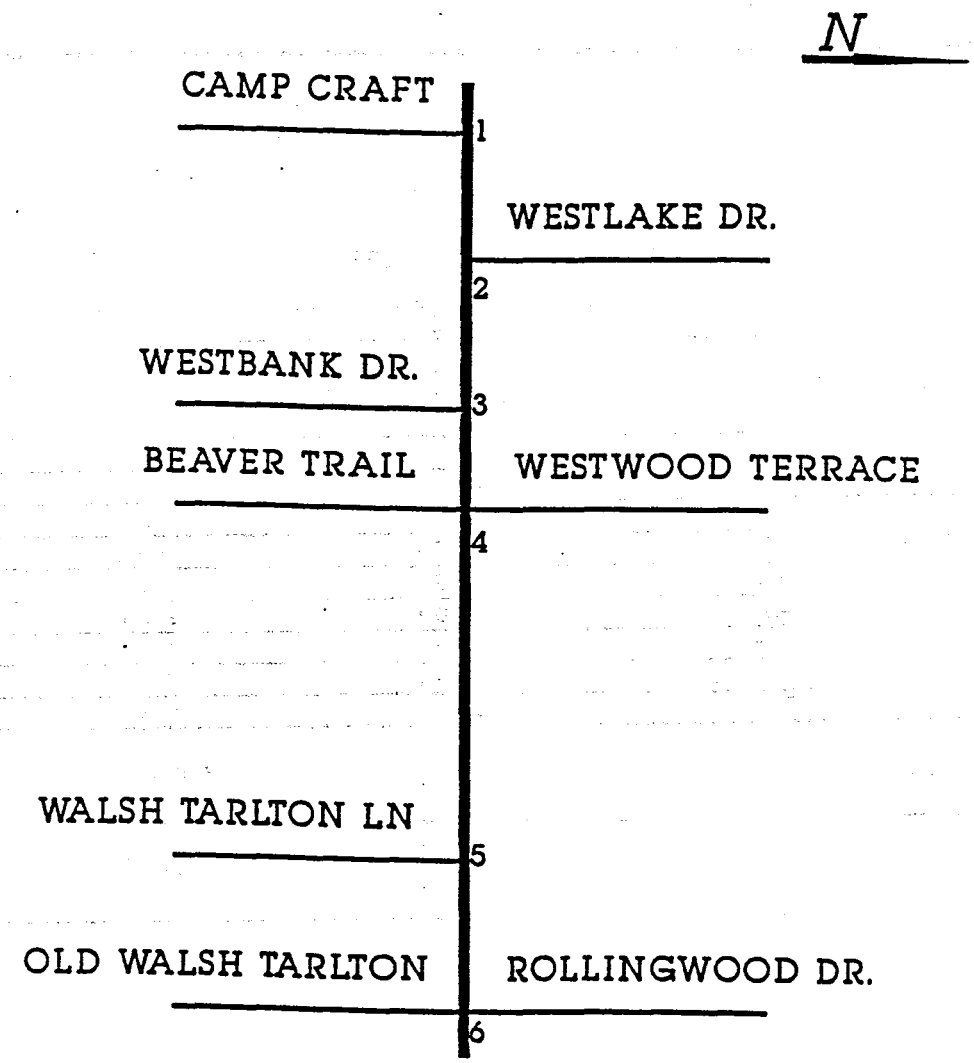
A total of six intersections were included in the RM 2244 Project. The attached map displays the project arterial and cross streets. RM 2244 has five lanes with a continuous left turn lane from Walsh Tarlton to east of Rollingwood and four lanes from Walsh Tarlton to west of Campcraft. The minor cross streets are mostly three lane, undivided, two-way roadways. All intersections have between three and five phases. All of the signals are equipped with pedestrian controls. Phasing modification was performed for two intersections.

In order to evaluate the system's performance, the "before" traffic conditions were monitored and various field data were collected. The data included traffic volumes, saturation flow rates, travel times, and travel delays. A left turn bay was added to the eastbound direction of RM 2244 at Walsh Tarlton. Phasing changes were made at the intersections of Walsh Tarlton and Rollingwood in order to improve the progression. The cycle lengths were increased due to high traffic volumes. The cycle lengths used for all three time of day periods were extended to 140 seconds. This length was obtained from the Optimal Signal Cycle Length Manual. Using the same cycle length alleviated the congestion that would occur while the signals were trying to synchronize during the switch. Changes in phase timing were implemented at two intersections. Fine tuning was necessary at Westbank and Walsh Tarlton in order to alleviate delay.

Based on the TRANSYT-7F simulation, the project had an estimated total annual cost savings of $3,515,365. This operating cost savings included a total annual savings of 13,165,350 stops (a 52.6 percent reduction), a total annual fuel savings of 277,050 gallons (a 39.9 percent reduction), and a delay annual savings of 305,400 veh-hrs (a 62.2 percent reduction). For RM 2244, the maximum reduction in travel time was 131 seconds for the PM peak (a 54.1 percent reduction). The total cost of the project was $110,563 and the resultant benefit to cost ratio was 32 to 1.

		STOPS		TOTAL SYSTEM DELAY (veh-hrs)		FUEL (gals)	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HOURLY VALUES	AM	7396	5232	243	63	278	158
	OFF	6248	2431	77	29	141	82
	PM	9647	5550	309	139	350	229
DIFFERENCES	AM	2164		180		120	
	OFF	3817		48		59	
	PM	4097		170		121	
HRS/DAY	AM	1.5		1.5		1.5	
	OFF	8.5		8.5		8.5	
	PM	2		2		2	
DAILY	AM	3246		270		180	
	OFF	32445		408		501.5	
	PM	8194		340		242	
	TOTAL	43885		1018		923.5	
UNIT VALUES		$0.014		$10.00		$1.00	
ANNUAL SAVINGS		$184,315		$3,054,000		$277,050	

PROJECT COST:	$110,563	TOTAL ANNUAL SAVINGS:	$3,515,365
BENIFIT/COST RATIO:	31.80		



CITY OF WEST LAKE HILLS
RM 2244