COMMUNITY ASSISTANCE
PLANNING REPORT NO. 107

EAST MORELAND BOULEVARD SHORT-RANGE AND LONG-RANGE HIGHWAY IMPROVEMENT PLAN

CITY OF WAUKESHA
WAUKESHA COUNTY
WISCONSIN

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EAST MORELAND BOULEVARD
SHORT-RANGE AND LONG-RANGE HIGHWAY IMPROVEMENT PLAN
CITY OF WAUKESHA
WAUKESHA COUNTY, WISCONSIN

Prepared by the

Southeastern Wisconsin Regional Planning Commission
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April 1984

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SOUTHEASTERN WISCONSIN REGIONAL PLANNING COMMISSION

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April 18, 1984

The Honorable Paul J. Keenan, Mayor
and Members of the Common Council
of the City of Waukesha
City Hall
201 Delafield Street
Waukesha, Wisconsin 53186

Dear Mayor Keenan:

In August 1982, the Common Council of the City of Waukesha requested the Regional Planning Commission to prepare a management plan addressing existing and probable future traffic problems along that segment of E. Moreland Boulevard extending from Barker Road to Whiterock Avenue. A technical advisory committee was created--consisting of representatives of the Wisconsin Department of Transportation, the Waukesha County Highway and Transportation Committee, and the City of Waukesha Departments of Public Works and Planning--to work with the Commission staff in the development of the desired solutions to these problems, and thereby improve the operating efficiency and safety of vehicular travel on E. Moreland Boulevard and the arterial streets and highways that intersect E. Moreland Boulevard.

The Committee and Commission staff have now completed and are pleased to provide to you herewith this report setting forth a recommended traffic management plan for E. Moreland Boulevard. The plan is composed of a short-range element and a long-range element. The short-range element recommends relatively low-cost traffic engineering measures to resolve existing traffic conflict and accident problems. The long-range element recommends somewhat more costly roadway improvements to serve probable future traffic volumes efficiently and safely.

The findings and recommendations set forth in this report are the result of more than a year of intensive study by the Committee and Commission staff, which together unanimously recommend adoption and implementation of the plan presented in this report. Such adoption and implementation would, in the Committee and Commission staff opinions, abate existing traffic congestion, control vehicle conflicts between local and through traffic, reduce accident exposure, and generally provide a safer, more efficient facility in the E. Moreland Boulevard corridor.

This report and plan are respectfully submitted for your careful consideration and action. The Commission staff stands ready to meet with the Common Council, should the Council so desire, to discuss the findings and recommendations of the study, and, should the plan be adopted as recommended, to assist the City in its implementation of the plan over time.

Sincerely,

Kurt W. Bauer
Executive Director

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Chapter I

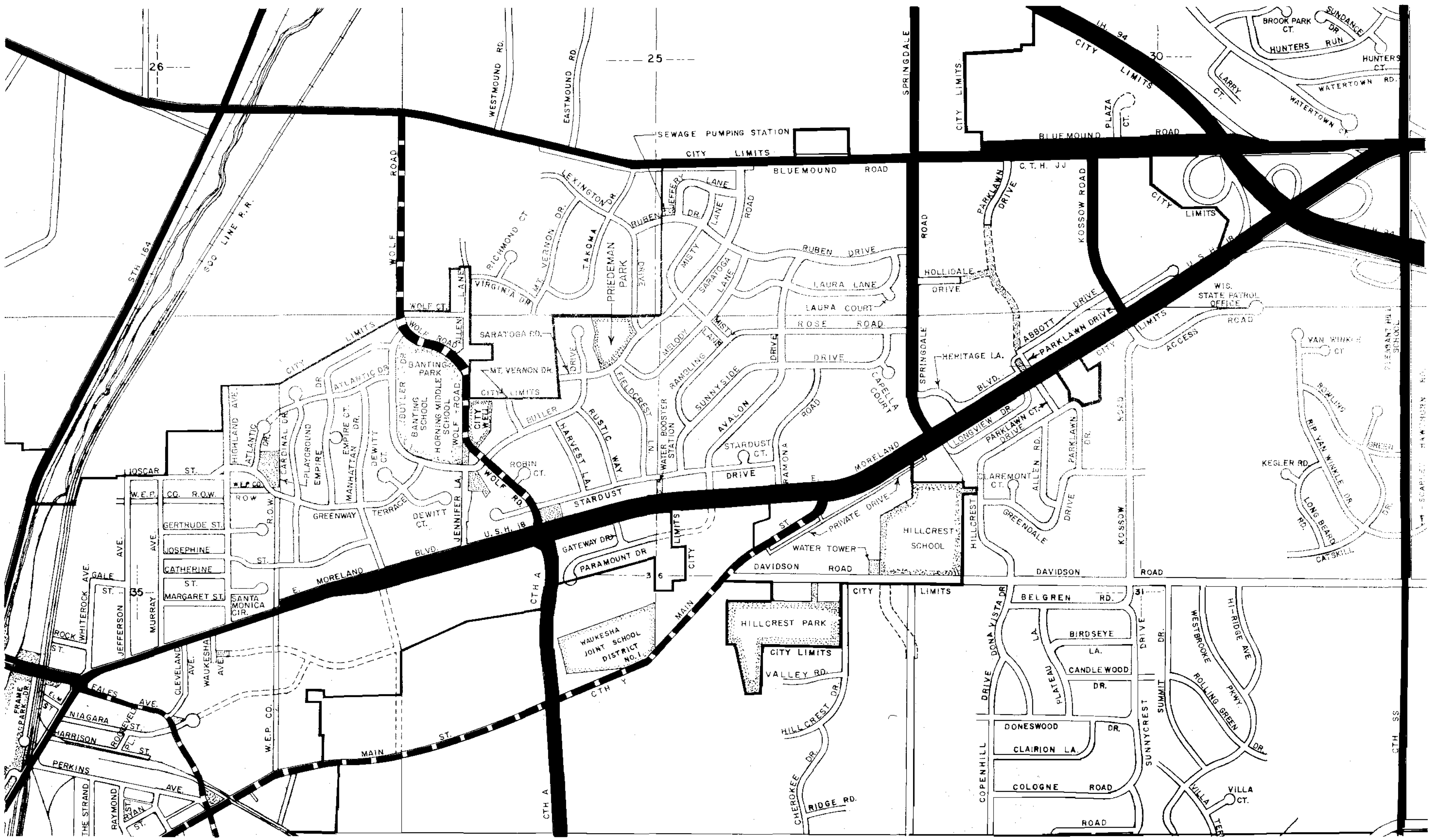
INTRODUCTION

East Moreland Boulevard is a principal east-west arterial route between the City of Waukesha on the west and the rest of the greater Milwaukee area to the east, and, as such, serves heavy volumes of through, as well as local, traffic. Commercial development has been attracted to this arterial facility, complicating traffic movements and increasing traffic volumes and conflicts. Over the past several years, local elected officials and residents of the City of Waukesha have become increasingly concerned with motor vehicle operating conditions and accident problems on, and land use development along, the segment of E. Moreland Boulevard (USH 18) extending from Barker Road to Whiterock Avenue, a distance of approximately 2.8 miles (see Map 1). In addition, proposals have been made in recent years to modify the access to E. Moreland Boulevard, including the southerly extension of Springdale Road from its existing intersection with E. Moreland Boulevard.

Based upon these perceived existing and anticipated traffic problems, the Common Council of the City of Waukesha on August 3, 1982, requested the Southeastern Wisconsin Regional Planning Commission to prepare a traffic management plan for this segment of E. Moreland Boulevard. The plan is comprised of a short-range element and a long-range element. The short-range plan element analyzes and recommends traffic engineering improvements to be implemented to resolve existing traffic conflict and accident problems, while the long-range plan analyzes and recommends roadway improvements to serve probable future traffic volumes efficiently and safely within reasonable cost.

Map 1

ARTERIAL STREET AND HIGHWAY SYSTEM IN THE VICINITY OF E. MORELAND BOULEVARD BETWEEN BARKER ROAD AND WHITEROCK AVENUE: 1983



LEGEND

- ARTERIAL
- COLLECTOR
- LAND ACCESS

GRAPHIC SCALE

0 1000 2000 FEET

Source: Wisconsin Department of Transportation.

Chapter II

EXISTING CONDITIONS

INTRODUCTION

Essential to the preparation of both the short-range and long-range plan elements is an understanding of the configuration and functional classification of E. Moreland Boulevard, as well as of the average weekday and peak-hour traffic volumes, vehicle operating speeds and intersection delay, and traffic accident frequency and rates identified for E. Moreland Boulevard. Information concerning the existing roadway segment is required for the identification of existing traffic problems; the design and evaluation of alternative short-range traffic management actions to solve or mitigate identified problems; and the evaluation of long-range arterial street and highway system improvements designed to accommodate future land use development and travel patterns.

STREET AND HIGHWAY SYSTEM

East Moreland Boulevard is classified as an arterial street and, as such, it is intended to expedite the movement of vehicular traffic. The segment of E. Moreland Boulevard to be considered in this study extends between the intersections of Barker Road and Whiterock Avenue, as shown on Map 1. From Barker Road to Manhattan Drive, a distance of 2.08 miles, the facility is a divided highway providing two lanes for traffic in each direction. This segment has a 24-foot-wide median and a pavement width of 24 feet, with 6-foot-wide paved shoulders. For the next 1,000 feet, or about 0.18 mile west of Manhattan Drive, the roadway narrows to provide two lanes for traffic on a 38-foot-wide pavement with curb and gutter; this narrower section extends to Whiterock Avenue, a distance of 0.58 mile. On-street parking is prohibited along the entire segment of E. Moreland Boulevard from Barker Road to Whiterock Avenue.

The segment of E. Moreland Boulevard between Barker Road and Whiterock Avenue is intersected by six arterial facilities: Barker Road, IH 94, Kossow Road, Springdale Road, CTH A, and Whiterock Avenue. East Moreland Boulevard is also intersected by three collector facilities: Main Street (CTH Y), Wolf Road, and Eales Avenue. Eleven land access streets also intersect this segment of E. Moreland Boulevard.

Traffic signals are located at the intersections of E. Moreland Boulevard with Barker Road, Kossow Road, Main Street (CTH Y), CTH A, and Whiterock Avenue. All of these signalized intersections are traffic-actuated. None of the signals are interconnected. Table 1 indicates the phasing, timing, and total cycle length for each of these signals.

Traffic Volume

Current and historic traffic volumes on the study segment of E. Moreland Boulevard and intersecting arterial streets and highways are summarized in Table 2. Vehicular traffic volumes on the study segment of E. Moreland Boulevard have been increasing since 1970 at an annual rate of about 3.5 percent.

Table 1

TRAFFIC SIGNAL OPERATION ON THE SEGMENT OF E. MORELAND BOULEVARD BETWEEN BARKER ROAD AND WHITEROCK AVENUE: 1983

Phase	Intersection (time in seconds)	
	E. Moreland Boulevard	Barker Road
Green	45.0	35.0
Yellow	4.5	4.5
Red	78.5	88.5
Leading Green Left-Turn Arrow	15.0	15.0
Yellow Left-Turn Arrow	3.0	3.0
Total Cycle	128.0	128.0

Phase	Intersection (time in seconds)		
	E. Moreland Boulevard		Kossow Road
	Westbound	Eastbound	
Green	30.0	49.5	30.0
Yellow	4.5	4.5	4.5
Red	52.0	32.5	52.0
Leading Green Left-Turn Arrow	--	15.0	--
Yellow Left-Turn Arrow	--	3.0	--
Total Cycle	86.5	86.5	86.5

Phase	Intersection (time in seconds)		
	E. Moreland Boulevard		Main Street
	Westbound	Eastbound	
Green	74.0	45.0	25.0
Yellow	4.5	4.5	3.5
Red	30.0	59.5	80.0
Leading Green Left-Turn Arrow	25.0	--	--
Yellow Left-Turn Arrow	3.5	--	--
Total Cycle	108.5	108.5	108.5

Phase	Intersection (time in seconds)		
	E. Moreland Boulevard		CTH A
	Westbound	Eastbound	
Green	68.5	45.0	30.0
Yellow	4.5	4.5	4.5
Red	36.5	60.0	75.0
Leading Green Left-Turn Arrow	20.0	--	--
Right-Turn Arrow	--	--	20.0
Yellow Left-Turn Arrow	3.0	--	3.0
Total Cycle	109.5	109.5	109.5

Phase	Intersection (time in seconds)				
	E. Moreland Boulevard			Eales Street	Whiterock Avenue
	Westbound	Eastbound	Southbound		
Green	48.0	20.7	22.0	7.0	35.0
Yellow	4.0	4.3	4.0	5.0	5.0
Red	28.0	55.0	54.0	68.0	40.0
Leading Green Left-Turn Arrow	--	--	--	--	8.0
Yellow Left-Turn Arrow	--	--	--	--	5.0
Total Cycle	80.0	80.0	80.0	80.0	80.0

NOTE: All traffic signals are traffic-actuated. Timing values represent maximum interval times expected to occur under peak-hour traffic conditions.

Source: City of Waukesha and Wisconsin Department of Transportation.

Table 2

AVERAGE ANNUAL WEEKDAY TRAFFIC VOLUMES ON E. MORELAND BOULEVARD AND SELECTED INTERSECTING ARTERIAL STREETS AND HIGHWAYS: 1970 THROUGH 1983

Location	Year					Average Growth Rate (percent)
	1970	1973	1976	1979	1983	
E. Moreland Boulevard						
West of Whiterock Avenue	11,460	13,150	15,110	15,230	16,000	2.6
West of CTH A	13,270	14,600	16,380	17,490	20,300	3.4
West of CTH Y	22,000	21,410	23,200	30,360	26,700	1.5
West of IH 94	13,710	14,440	21,090	26,430	30,700	6.4
East of Barker Road	12,480	13,880	16,980	20,810	21,310	3.4
Subtotal	74,320	80,580	94,440	110,320	115,010	3.5
Arterial Streets and Highways Intersecting E. Moreland Boulevard						
CTH A South of E. Moreland Boulevard	8,000	10,000	12,630	14,630	14,000	4.4
CTH Y South of E. Moreland Boulevard	5,970	3,780	8,880	12,820	12,600	6.5
Springdale Road North of E. Moreland Boulevard	--[a]	--[a]	4,660	8,370	8,000	--
IH 94 North of E. Moreland Boulevard	30,240	36,510	44,860	49,000	60,850	6.0
Barker Road North of E. Moreland Boulevard	2,780	2,650	3,770	5,030	6,350	7.1
Subtotal	46,990	52,940	74,800	89,850	101,800	6.2
Total	121,310	133,520	169,240	200,170	216,810	4.5

[a]Count data not available.

Source: Wisconsin Department of Transportation and SEWRPC.

Traffic volume growth rates on the north-south arterial streets intersecting the study segment of E. Moreland Boulevard have averaged 6.7 percent since 1970, somewhat higher than the traffic growth rate on E. Moreland Boulevard.

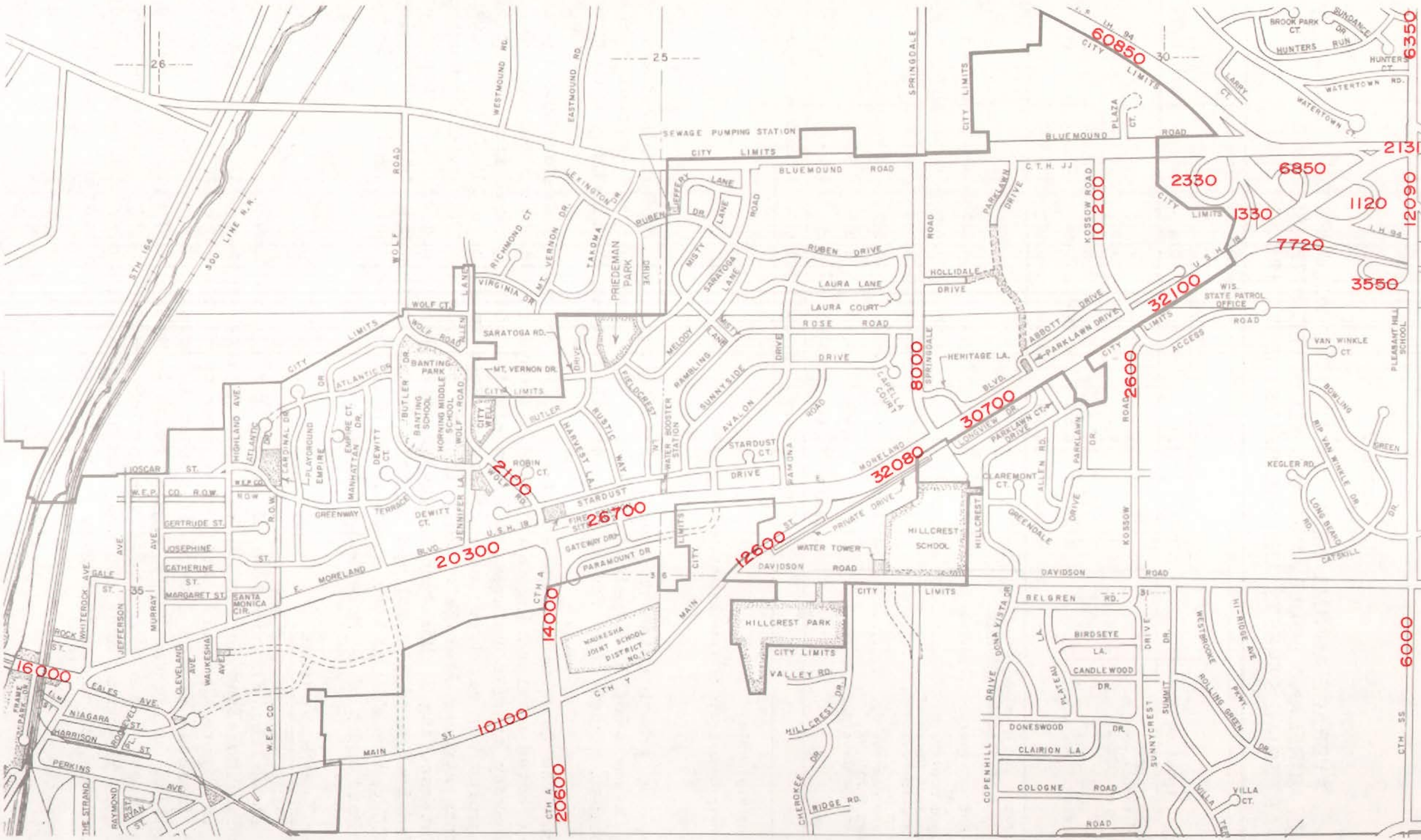
Map 2 shows the 24-hour average weekday traffic volumes on E. Moreland Boulevard and selected intersecting streets and highways in 1983. As shown on Map 2, average weekday traffic volumes on E. Moreland Boulevard range from a high of 32,100 vehicles per day (vpd) east of Kossow Road to a low of 16,000 vpd west of Whiterock Avenue. Average weekday traffic volumes in 1982 on the selected streets intersecting E. Moreland Boulevard were: 14,000 vpd on CTH A south of E. Moreland Boulevard; 12,600 vpd on Main Street south of E. Moreland Boulevard; 8,000 vpd on Kossow Road north of E. Moreland Boulevard; and 12,090 vpd on Barker Road south of E. Moreland Boulevard.

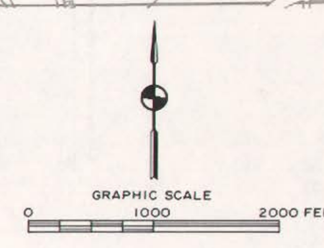
Peak-Hour Traffic Volumes

Figure 1 shows the distribution of hourly traffic volumes during an average weekday on E. Moreland Boulevard west of its intersection with Main Street. As shown in Figure 1, hourly traffic volumes on E. Moreland Boulevard exhibit a general increase from a low of less than 1 percent of the average weekday 24-hour volume during the early morning hours between 12:00 a.m. and 6:00 a.m. to a high of about 8.5 percent of the average weekday 24-hour volume between 4:00 p.m. and 5:00 p.m. and 5:00 p.m. and 6:00 p.m. This distribution of hourly traffic volumes, as shown in Figure 1, is typical of the traffic flow pattern

Map 2

AVERAGE WEEKDAY TRAFFIC VOLUME ON E. MORELAND BOULEVARD
AND SELECTED INTERSECTING STREETS AND HIGHWAYS: 1983





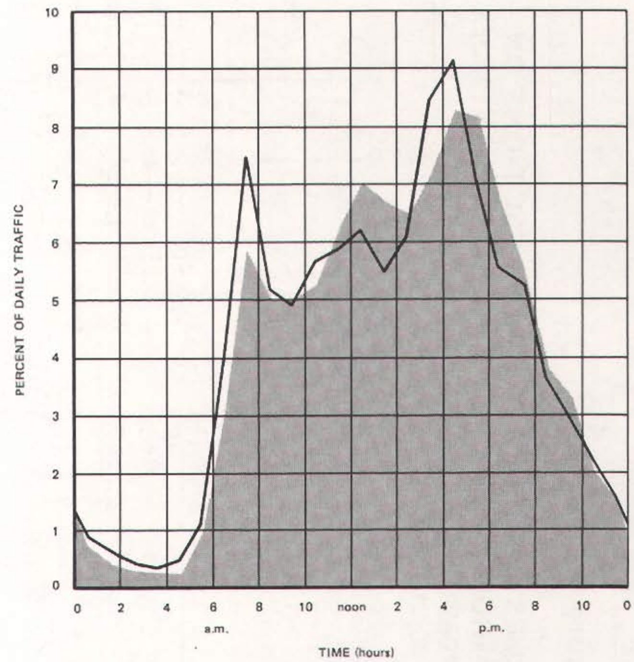
Source: Wisconsin Department of Transportation and SEWRPC.

on other arterial streets and highways in the Southeastern Wisconsin Region except for the lack of a noticeable peak in morning traffic volumes from 7:00 a.m. to 8:00 a.m., and the larger traffic volume on E. Moreland Boulevard from noon to 3:00 p.m. This difference in hourly traffic distribution may be attributed to the traffic generated principally between 10:00 a.m. and 7:00 p.m. by the extensive commercial and retail land development adjacent to the study segment of E. Moreland Boulevard. Therefore, the mid-day and evening peak periods are of primary concern, since it is at these times of the day that traffic demand may approach the operating capacity of an arterial facility such as E. Moreland Boulevard.

Hourly traffic volumes for the morning 7:00 a.m. to 8:00 a.m., the mid-day 12:00 p.m. to 1:00 p.m., and the evening 4:00 p.m. to 5:00 p.m. time periods are shown in Figures 2 through 4. As indicated on the traffic flow profiles shown in these figures, total hourly traffic volumes exhibit similar flow patterns during the morning, mid-day, and evening time periods. Total hourly traffic gradually increases on E. Moreland Boulevard, starting at a low of between 1,000 and 1,500 vehicles per hour (vph) east of its intersection with Whiterock Avenue, and reaching a high of between 1,800 and 2,700 vph on the segment of E. Moreland Boulevard between Main Street (CTH Y) and Barker Road. Mid-day hourly traffic volumes are about 50 percent greater than the morning peak-hour volumes, and the evening peak-hour volume is slightly greater than the mid-day hourly volumes.

Figure 1

HOURLY VARIATION IN DAILY TRAFFIC ON E. MORELAND BOULEVARD WEST OF MAIN STREET OCTOBER 1981



LEGEND

AVERAGE HOURLY WEEKDAY TRAFFIC VOLUME ON E. MORELAND BOULEVARD

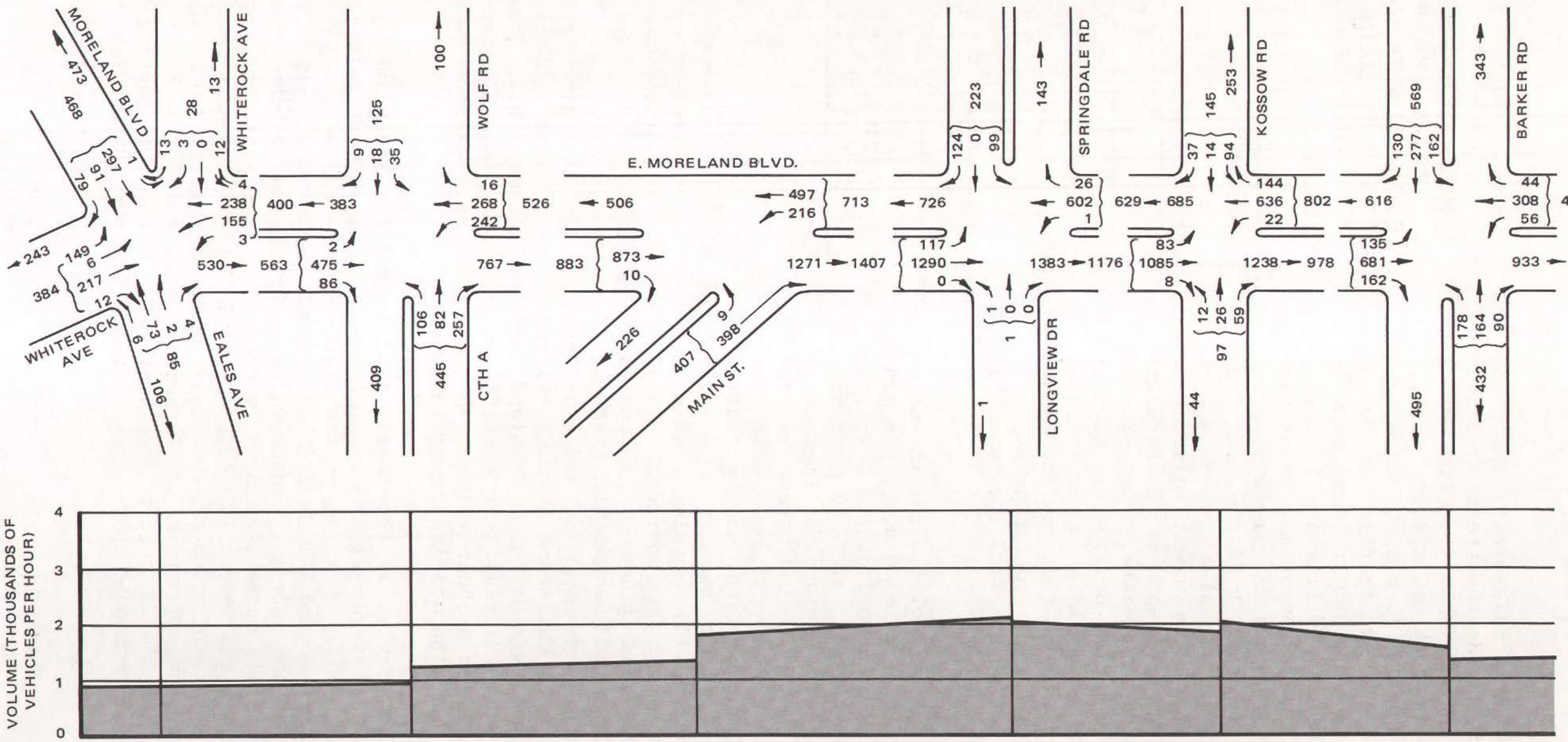
AVERAGE HOURLY WEEKDAY TRAFFIC VOLUME IN SOUTHEASTERN WISCONSIN REGION

Source: Wisconsin Department of Transportation and SEWRPC.

A detailed review of the hourly traffic volumes shown in Figures 2 through 4 indicates that during the morning peak hour, a high volume of left turns, exceeding 150 vph, occurs on the westbound approaches of E. Moreland Boulevard at Main Street and CTH A--216 and 242 vph, or about 30 and 46 percent, respectively, of the hourly approach volumes. During the mid-day time period, a high volume of left turns continues to occur on these westbound approaches--287 at Main Street and 344 at CTH A, or about 27 and 36 percent, respectively, of the hourly approach volumes--with high volumes of left turns also occurring on the eastbound approaches at Springdale Road and Kossow Road--170 and 199 vph, or about 15 and 17 percent, respectively. During the evening peak hour, high volumes of westbound left turns continue to occur at the Main Street and CTH A

Figure 2

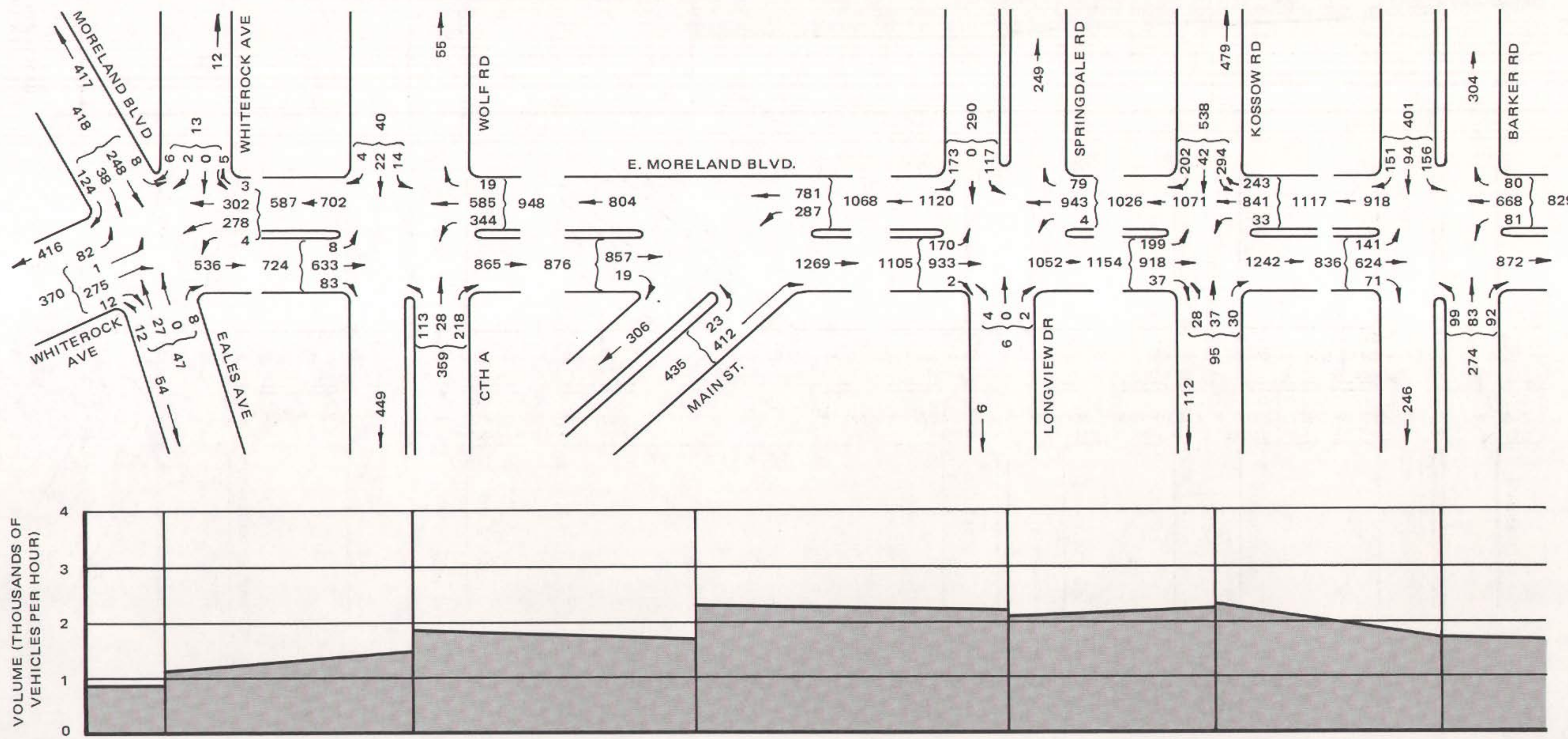
MORNING PEAK-HOUR TRAFFIC VOLUMES AT SELECTED INTERSECTIONS ON E. MORELAND BOULEVARD FROM BARKER ROAD TO WHITEROCK AVENUE: 1983



Source: SEWRPC.

Figure 3

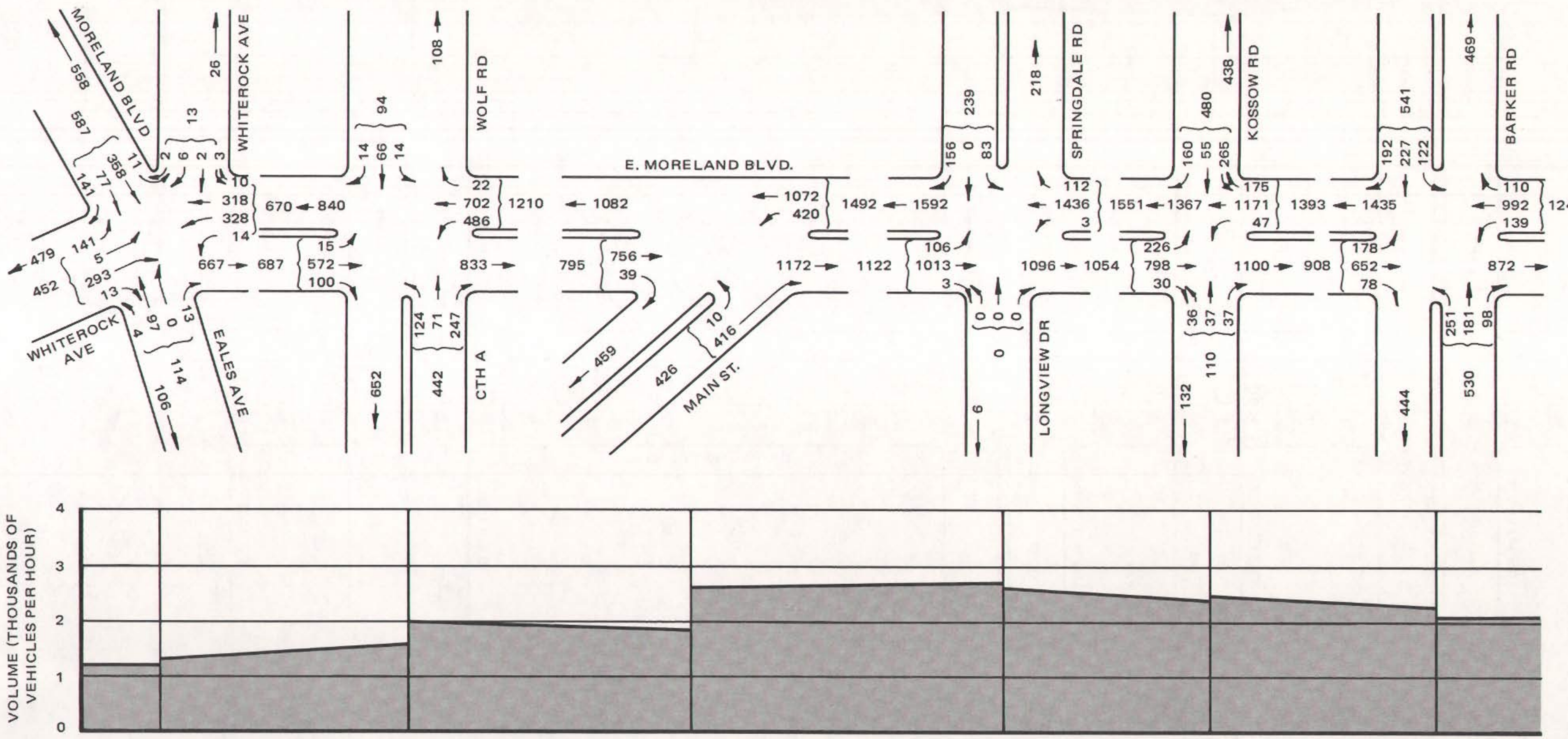
MID-DAY TRAFFIC VOLUMES AT SELECTED INTERSECTIONS ON E. MORELAND BOULEVARD FROM BARKER ROAD TO WHITEROCK AVENUE: 1983 (12:00 p.m. to 1:00 p.m.)



Source: SEWRPC.

Figure 4

EVENING PEAK-HOUR TRAFFIC VOLUMES AT SELECTED INTERSECTIONS
ON E. MORELAND BOULEVARD FROM BARKER ROAD TO WHITEROCK AVENUE:
1983 (4:00 p.m. to 5:00 p.m. or 5:00 p.m. to 6:00 p.m.)



Source: SEWRPC.

intersections--420 and 486 vph, or about 28 and 40 percent, respectively--and on the eastbound approach at Kossow Road--226, or about 21 percent of the hourly approach volume. A high eastbound evening peak-hour left-turn volume also occurs at the Barker Road intersection, with 178 vph, or about 20 percent of the eastbound hourly approach volume.

A high volume of left turns, exceeding 150 vph, also occurs on several of the streets that intersect E. Moreland Boulevard. During the morning peak hour a high volume of left turns occurs on the north- and southbound approaches of Barker Road--178 and 162 vph, or about 41 and 28 percent, respectively. During the mid-day time period, a high volume of left turns occurs on the southbound approaches of Barker Road and Kossow Road--156 and 294 vph, or about 39 and 55 percent, respectively, of the hourly approach volumes. During the evening peak hour, the southbound approach of Kossow Road continues to exhibit high left-turn volumes of 265 vph, or about 55 percent of the hourly approach volume, with the northbound approach of Barker Road exhibiting a high left-turn volume of 251 vph, or about 47 percent of the hourly approach volume.

Only the eastbound approach of E. Moreland Boulevard at Barker Road exhibits a high right-turn volume during the morning peak hour, with 162 vph, or about 16 percent of the hourly approach volume. During the mid-day and evening peak-hour time periods, only the westbound approach of E. Moreland Boulevard at Kossow Road exhibits a high volume of right turns, with 243 and 175 vph, or about 22 and 12 percent, respectively, of the hourly approach volumes.

A high volume of right turns, exceeding 150 vph, also occurs on several of the streets that intersect E. Moreland Boulevard. During the morning peak hour, a high volume of right turns occurs on the northbound approaches of Main Street and CTH A--398 and 257 vph, or about 98 and 58 percent, respectively, of the hourly approach volumes. The northbound approaches of both Main Street and CTH A continue to exhibit high volumes of right-turn movements during the mid-day time period, with 412 and 218 vph, or about 95 and 61 percent, respectively, of the hourly approach volumes, while the southbound approaches of Barker Road, Kossow Road, and Springdale Road exhibit high mid-day turning volumes of 151, 202, and 173 vph, or about 38, 38, and 60 percent, respectively, of the hourly approach volumes. During the evening peak hour, these five intersection approaches continue to exhibit high right-turn volumes, with the northbound approaches on Main Street and CTH A having right-turn volumes of 416 and 247 vph, or about 98 and 56 percent, respectively, of the hourly approach volumes; and with Barker Road, Kossow Road, and Springdale Road having right-turn volumes of 192, 160, and 156 vph, or about 35, 33, and 65 percent, respectively, of the hourly approach volumes.

INTERSECTION DELAYS

Intersection delay indicates the presence of traffic congestion and is measured as the amount of time vehicular traffic must stop and wait prior to proceeding through a signalized or stop sign-controlled intersection. The percentage of vehicles stopped at an intersection at any given time is another useful indicator of needed changes in traffic signal timing and consideration at an intersection. Intersection delay information was obtained by Commission staff for the three signalized intersections between Barker Road and Whiterock Avenue and for the Springdale Road intersection with E. Moreland Boulevard for the

4:00 p.m. to 6:00 p.m. time period. The 4:00 p.m. to 5:00 p.m. peak hour exhibited the highest average hourly intersection delay and percent of vehicles stopped during the 4:00 p.m. to 6:00 p.m. time period. The 4:00 p.m. to 5:00 p.m. values are provided in Table 3.

The average peak-hour delay per vehicle observed at the signalized intersection of Kossow Road and E. Moreland Boulevard ranged from a low of 5.9 seconds for the westbound through movement of 1,171 vehicles to a high of 25.8 seconds for the combined southbound left-turn and through movement of 320 vehicles. Total average peak-hour delay for the 2,242 vehicles on E. Moreland Boulevard averaged 6.8 seconds and for the 590 vehicles on Kossow Road averaged 20.0 seconds, resulting in a total average intersection delay of 9.6 seconds per vehicle. Approximately 43 percent of the vehicles on E. Moreland Boulevard and 67 percent of the vehicles on Kossow Road were required to stop before proceeding through the intersection during the evening peak hour because of vehicle conflicts or traffic signal operation.

Average peak-hour delay per vehicle observed at the intersection of Springdale Road and E. Moreland Boulevard, which is stop sign-controlled on the Springdale Road approach to the intersection, ranged from a low of 19.6 seconds for the eastbound left-turn movement of 106 vehicles to a high of 37.2 seconds for the southbound right-turn movement of 156 vehicles. The westbound left-, through, and right-turn movements and eastbound through and right-turn movements were observed to exhibit no delays attributable to vehicular conflict or stop sign controls. The total peak-hour delay for the 2,673 vehicles on E. Moreland Boulevard averaged 0.8 second and for the 239 vehicles on Springdale Road averaged 34.3 seconds, resulting in a total average intersection delay of 3.6 seconds per vehicle. In total, approximately 4 percent of the vehicles on E. Moreland Boulevard were required to stop. This 4 percent is composed entirely of eastbound vehicles making left turns, of which 89 percent were required to stop. One hundred percent of the vehicles on Springdale Road were required to stop before proceeding through the intersection during the evening peak-hour because of the stop signs on Springdale Road.

Average peak-hour delay per vehicle observed at the signalized intersection of Main Street (CTH Y) and E. Moreland Boulevard ranged from a low of 1.4 seconds for the westbound through movement of 1,072 vehicles to a high of 32.1 seconds for the northbound left-turn movement of 10 vehicles. Total peak-hour delay for the 2,248 vehicles on E. Moreland Boulevard averaged 4.2 seconds and for the 426 vehicles on Main Street averaged 8.9 seconds, resulting in a total average intersection delay of 5.0 seconds per vehicle. Approximately 31 percent of the vehicles on E. Moreland Boulevard and 55 percent of the vehicles on Main Street were required to stop before proceeding through the intersection during the evening peak-hour because of vehicle conflicts or traffic signal operation.

Average peak-hour delay per vehicle observed at the signalized intersection of CTH A/Wolf Road and E. Moreland Boulevard ranged from a low of 3.9 seconds for the westbound through movement of 702 vehicles to a high of 31.1 seconds for the combined northbound left-turn and through movement of 195 vehicles. Total peak-hour delay for the 1,775 vehicles on E. Moreland Boulevard averaged 9.2 seconds and for the 536 vehicles on CTH A/Wolf Road averaged 16.1 seconds, resulting in a total average intersection delay of 10.9 seconds per vehicle.

Table 3

VEHICLE DELAY AT SELECTED STREET INTERSECTIONS WITH THE SEGMENT OF E. MORELAND BOULEVARD BETWEEN BARKER ROAD AND WHITEROCK AVENUE: 4:00 P.M. TO 5:00 P.M.

Intersection	Approach	Movement	Volume (vehicles per hour)	Average Delay (seconds) Per Stopped Vehicle	Average Delay (seconds) Per Vehicle	Percent of Vehicles Stopped
E. Moreland Boulevard and Kossow Road	Westbound	Left Turn.........	47	37.5	18.8	50
		Through...........	1,171	15.0	5.9	39
	Eastbound	Left Turn.........	226	15.0	14.3	95
		Through...........	798	14.7	5.3	36
		Subtotal/ Average	2,242	15.7	6.8	43
	Northbound	Left and Through..........	73	30.0	15.0	50
		Right Turn........	37	24.0	20.0	83
	Southbound	Left and Through..........	320	37.9	25.8	68
		Right Turn........	160	15.5	10.7	69
		Subtotal/ Average	590	29.8	20.0	67
	Total/Average		2,832	18.4	9.6	49
E. Moreland Boulevard and Springdale Road	Westbound	Left, Through, and Right........	1,551	--	--	--
	Eastbound	Left Turn.........	106	22.0	19.6	89
		Through and Right Turn	1,016	--	--	--
		Subtotal/ Average	2,673	22.0	0.8	4
	Southbound	Left Turn.........	83	28.8	28.8	100
		Right Turn........	156	37.2	37.2	100
		Subtotal/ Average	239	34.3	34.3	100
	Total/Average		2,912	31.6	3.6	11
E. Moreland Boulevard and Main Street (CTH Y)	Westbound	Left Turn.........	420	15.0	8.3	55
		Through...........	1,072	9.5	1.4	14
	Eastbound	Through...........	756	14.3	5.9	41
		Subtotal/ Average	2,248	13.5	4.2	31
	Northbound	Left Turn.........	10	32.1	32.1	100
		Right Turn........	416	15.5	8.4	54
		Subtotal/ Average	426	16.2	8.9	55
	Total/Average		2,674	12.7	5.0	35
E. Moreland Boulevard and CTH A/Wolf Road	Westbound	Left Turn.........	486	14.5	11.0	76
		Through...........	702	16.7	3.9	24
	Eastbound	Left and Through..........	587	25.6	14.2	56
		Subtotal/ Average	1,775	19.1	9.2	49
	Northbound	Left and Through..........	195	27.9	21.2	76
		Right Turn........	247	15.0	10.4	70
	Southbound	Left, Through, and Right........	94	30.0	20.4	68
		Subtotal/ Average	536	22.4	16.1	72
	Total/Average		2,311	20.2	10.9	54

Source: SEWRPC.

Table 4

INTERSECTION LEVELS OF SERVICE AND CORRESPONDING VEHICULAR DELAY RANGES

	Level of Service	Average Delay (seconds per vehicle)
A	Free Flow.............................	0.0 - 10
B	Stable Flow, Slight Delay...............	10.1 - 20
C	Design Capacity, Acceptable Delay.......	20.1 - 30
D	Approaching Unstable Flow, Tolerable Delay.....................	30.1 - 40
E	Unstable Flow, Intolerable Delay........	40.1 - 60
F	Forced Flow............................	60

Source: <u>NCHRP Signalized Intersection Capacity Method</u>, Transportation Research Board, May 1982.

Approximately 49 percent of the vehicles on E. Moreland Boulevard and 72 percent of the vehicles on CTH A/Wolf Road were required to stop before proceeding through the intersection during the evening peak-hour because of vehicle conflicts or traffic signal operation.

A comparison of the measured average peak-hour delay with the level-of-service delay values shown in Table 4 indicates that when the intersection approaches to each intersection are considered in total, all of the intersections examined are operating above design capacity--level-of-service C. In addition, the majority of each separate traffic movement at each intersection is operating at or better than design capacity during the evening peak hour. However, the combined left-turn and through traffic movement on the southbound approach of Kossow Road, the left-turn traffic movement on the southbound approach of Springdale Road, the combined left-turn and through traffic movement on the northbound approach of CTH A, and the left-turn, through, and right-turn traffic movements on the southbound approach of Wolf Road are all operating at design capacity. The right-turn traffic movement on the southbound approach of Springdale Road and the left-turn traffic movement on the northbound approach of Main Street are operating below, or worse than, design capacity during the evening peak-hour.

Average Vehicle Operating Speeds

Average vehicle operating speeds were measured on E. Moreland Boulevard during both the mid-day and peak periods of traffic demand. These speeds were determined by the "floating car" method, which utilizes a test car that is driven at the average speed of the other vehicles in the traffic stream over measured segments of the roadway. In conducting the average vehicle operating speed study, E. Moreland Boulevard was divided into six segments, as listed in Table 5 and shown in Figure 5. A total of seven travel time runs were made in each direction of travel on E. Moreland Boulevard during the 11:00 a.m. to 3:00 p.m. mid-day period and 11 runs were made in each direction of travel during the evening peak period of 4:00 p.m. to 6:00 p.m. These operating speed runs were made by Commission staff on Tuesday and Thursday, July 12 and 14, 1983. Table 5 and Figure 5 indicate the mid-day and peak-period average operating speeds on each of the roadway segments surveyed and the average vehicle delay encountered at each signalized intersection along E. Moreland Boulevard.

As indicated in Table 5 and Figure 5, the average travel time on the westbound study segment of E. Moreland Boulevard is approximately 4.3 minutes during the mid-day time period and 4.5 minutes during the evening peak period, which results in an average mid-day operating speed of about 40 miles per hour (mph) and a reduced peak-period operating speed of 38 mph. A comparison of the posted speed limit to the average operating speed for each roadway segment indicates that traffic traveling on the westbound, 45 mph-posted segments of E. Moreland Boulevard between Barker Road and CTH A/Wolf Road is either at or about 3 mph below the posted speed limit during the mid-day time period and about 2 to 7 mph below the posted speed limit during the evening peak period. However, vehicular operating speed on the westbound, 35 mph-posted segment of E. Moreland Boulevard between CTH A/Wolf Road and the driveway to the Bakers Square restaurant is about 1 mph and 3 mph above the posted speed limit during the mid-day period and peak-period, respectively. Speeds increase to about 5 mph and 6 mph above the posted speed limit during the mid-day period and peak-period, respectively, on the 25 mph-posted segment of westbound E. Moreland Boulevard between the Bakers Square restaurant and Whiterock Avenue.

The average peak-hour vehicle delays experienced by westbound through movements at the intersections of E. Moreland Boulevard with Kossow Road, Main Street, and CTH A/Wolf Road agree very closely with the signalized intersection delay values presented in Table 3. Signalized intersection delay is not presented in Table 3 for the westbound approach of E. Moreland Boulevard at Whiterock Avenue, and was observed in the travel time/operating speed survey to be 31.9 seconds during both the mid-day and evening peak-hour time periods. This indicates that the left-turn and through movements on the westbound approach of E. Moreland Boulevard at Whiterock Avenue are operating below design capacity levels.

Table 5 and Figure 5 indicate that the average travel time on the eastbound study segment of E. Moreland Boulevard is approximately 4.4 minutes during the mid-day period and 4.6 minutes during the evening peak hours, which results in an average mid-day operating speed of about 38 mph and a peak-period operating speed of 37 mph. A comparison of the posted speed limit to the average operating speed for each roadway segment indicates that vehicles are exceeding the 25-mph posted speed limit on the eastbound segment of E. Moreland Boulevard between Whiterock Avenue and the Bakers Square restaurant driveway by about 8 and 4 mph during the mid-day and peak-hour time periods, respectively. Eastbound vehicles on the 35 mph-posted segment of E. Moreland Boulevard between the Bakers Square restaurant driveway and CTH A/Wolf Road were found to be exceeding the speed limit by about 3 and 1 mph during the mid-day and peak-hour time periods, respectively. However, vehicular operating speeds on the remaining eastbound segments of E. Moreland Boulevard from CTH A/Wolf Road to Barker Road, posted for 45 mph, are about 2 to 6 mph and 1 to 8 mph below the speed limit during the mid-day and peak-hour time periods, respectively.

The average peak-hour vehicle delays experienced by eastbound through movements at the intersections of E. Moreland Boulevard with CTH A/Wolf Road, Main Street, and Kossow Road also agree very closely with the signalized intersection delay values presented in Table 3. Signalized intersection delay is not summarized in Table 3 for eastbound traffic at Barker Road, and was

Table 5

AVERAGE MID-DAY AND PEAK-HOUR WEEKDAY TRAVEL TIMES, OPERATING SPEEDS, AND DELAYS ON E. MORELAND BOULEVARD BETWEEN BARKER ROAD AND WHITEROCK AVENUE: 1983

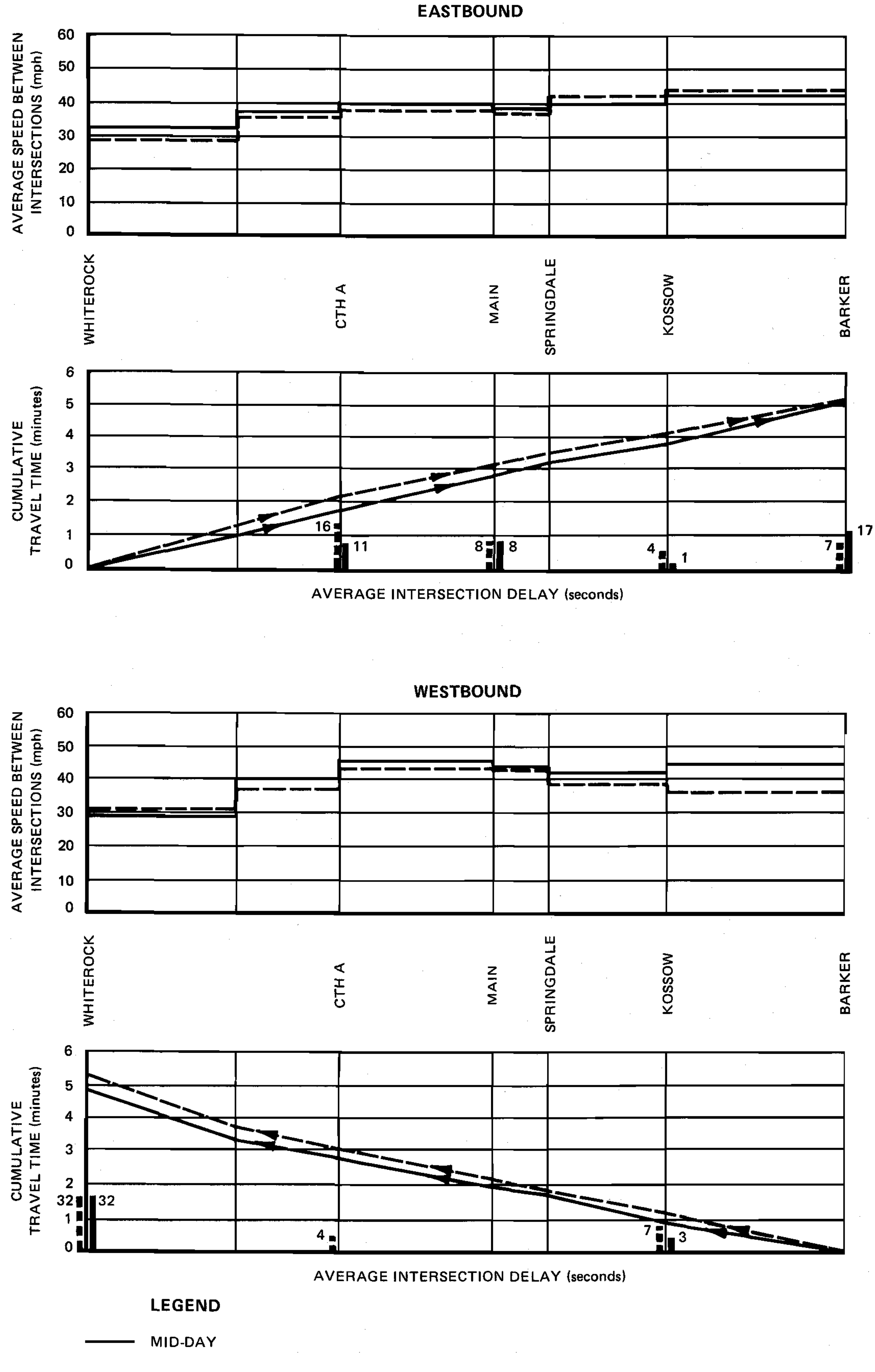
Roadway Segment	Length (miles)	Posted Speed Limit (mph)	Average Travel Time, Speed, and Delay[a]					
			Mid-Day			Peak Hour		
			Travel Time (seconds)	Speed (mph)	Delay (seconds)	Travel Time (seconds)	Speed (mph)	Delay (seconds)
Westbound								
Barker Road to Kossow Road.........	0.65	45	53.0	44.2	3.4	62.2	37.6	7.3
Kossow Road to Springdale Road.....	0.45	45	38.8	41.7	--	41.4	39.1	--
Springdale Road to Main Street.....	0.20	45	16.7	43.1	--	16.8	42.8	--
Main Street to CTH A/Wolf Road.....	0.57	45	45.0	45.6	--	47.9	42.8	3.9
CTH A/Wolf Road to Bakers Square Driveway...........	0.40	35	36.0	40.0	--	38.1	37.8	--
Bakers Square Driveway to Whiterock Avenue	0.57	25	69.1	29.7	--	65.6	31.3	31.9
Total/Average	2.84	--	259.0	39.5	35.5	272.0	37.6	43.1
Eastbound								
Whiterock Avenue to Bakers Square Driveway..........	0.57	25	62.7	32.7	--	70.7	39.0	--
Bakers Square Driveway to Whiterock Avenue............	0.40	35	38.1	37.8	11.0	40.0	36.0	16.4
CTH A/Wolf Road to Main Street.....	0.57	45	52.0	39.5	8.3	53.2	38.6	8.5
Main Street to Springdale Road.....	0.20	45	18.7	38.5	--	19.3	37.3	--
Springdale Road to Kossow Road.....	0.45	45	40.8	39.7	0.9	38.3	42.3	3.5
Kossow Road to Barker Road........	0.65	45	54.7	42.8	16.7	53.6	43.6	7.3
Total/Average	2.84	--	267.0	38.3	36.9	275.1	37.2	35.7

[a]Mid-day travel time, operating speeds, and delay were surveyed between the hours of 11:00 a.m. and 3:00 p.m., and peak-hour travel times, operating speeds, and delay were surveyed between the hours of 4:00 p.m. and 6:00 p.m.

Source: SEWRPC.

Figure 5

TRAVEL TIME-SPEED AND DELAY PROFILE FOR E. MORELAND BOULEVARD FROM WHITEROCK AVENUE TO BARKER ROAD: 1983



Source: SEWRPC.

observed in the travel time/operating speed survey to be about 16.7 seconds and 7.3 seconds during the mid-day and peak-hour time periods, respectively. This indicates that the eastbound through and right-turn movements at Barker Road are operating above design capacity levels.

TRAFFIC ACCIDENTS

The incidence of traffic accidents provides another measure of the operating conditions and vehicle conflict areas on E. Moreland Boulevard. Where the number or severity of accidents on E. Moreland Boulevard appears relatively high in comparison to the accident experience at other locations, a detailed investigation is warranted to determine traffic management actions that can be taken to correct or ameliorate the accident problems. The motor vehicle on-street accidents which occurred during the years 1980 through 1982 were reviewed for the entire study segment of E. Moreland Boulevard. For analysis purposes the motor vehicle accidents were separated into two basic categories: intersection-related accidents and nonintersection or roadway segment-related accidents. As shown in Tables 6 and 7, during the three-year period from 1980 through 1982, 379 motor vehicle accidents were reported on the study segment of E. Moreland Boulevard, of which 333 accidents, or 88 percent, occurred at street and highway intersections. The annual incidence of total motor vehicle accidents on E. Moreland Boulevard exhibits a decreasing trend, with 146 accidents in 1980 of which 127, or 87 percent, were intersection related; 121 accidents in 1981 of which 105, or 87 percent, were intersection related; and 112 accidents in 1982 of which 101, or 90 percent, were intersection related. Approximately 71 percent, or 237, of the total intersection accidents, and 70 percent, or 32, of the roadway segment-related accidents resulted in property damage only. There was one fatal accident, related to a roadway segment, reported in 1980, with no fatal accidents reported in 1981 and 1982.

Those locations on E. Moreland Boulevard with a three-year average or a 1982 total of four or more accidents are identified in this study as locations with potential accident patterns which may be correctable with traffic management actions. As shown on Map 2 in Chapter II, there are seven separate locations--six intersections and one roadway segment location--where the three-year average or the 1982 total number of accidents exceeds four. The location in the study area with the highest accident frequency is the intersection of E. Moreland Boulevard and CTH A/Wolf Road, with 83 accidents reported between 1980 and 1982. This is followed by the E. Moreland Boulevard intersections with Main Street (65 accidents), Kossow Road (54 accidents), Springdale Road (44 accidents), Manhattan Drive (18 accidents), and Parklawn Drive (10 accidents). The only roadway segment to experience a three-year average of four or more accidents was that between Springdale Road and Main Street, with a total of 12 accidents reported between 1980 and 1982.

Based upon these initial inventory findings, a more detailed investigation was conducted of the circumstances surrounding each accident at these seven locations. Using the information provided on the motor vehicle accident reports, a series of collision diagrams was prepared indicating the type and severity of each accident, as well as the date, day of week, and time of day of the accident, and the roadway and weather conditions at the time of the accident.

These collision diagrams are presented in Appendix A of this report. This detailed investigation provided the information necessary to determine whether these accident locations had any predominant pattern of collision circumstances.

Intersection of E. Moreland Boulevard and CTH A/Wolf Road

This signalized intersection experienced a three-year total of 83 accidents: 34 in 1980, 25 in 1981, and 24 in 1982, for an annual accident rate of 3.14, 2.41, and 2.32 accidents per million vehicles entering the intersection, respectively. Of the total accidents, 49 involved vehicles making left turns, 20 involved rear-end collisions, six involved right-angle collisions, five involved vehicles sideswiping another vehicle, and three involved vehicles losing control and strucking a fixed object. Twenty-six of the accidents, or 31 percent, occurred after dark. Fifty-eight of the accidents, or 70 percent, occurred during clear weather conditions and 54, or 65 percent, occurred with dry pavement conditions. None of the accidents involved a fatality. Personal injuries occurred in 32 of the accidents--27 involving left-turning vehicles, three involving rear-end collisions, and two involving right-angle collisions. These accidents were distributed throughout the year and the days of the week.

Intersection of E. Moreland Boulevard and Main Street

This signalized intersection experienced a three-year total of 65 accidents--27 in 1980, 18 in 1981, and 20 in 1982, for an annual accident rate of 2.11, 1.49, and 1.71 accidents per million vehicles entering the intersection, respectively. Of the total accidents, 29 involved rear-end collisions, 23 involved vehicles making left turns, six involved right-angle collisions, four involved vehicles losing control, and three involved vehicles sideswiping another vehicle. Nineteen of the accidents, or 29 percent, occurred after dark. Forty-five of the accidents, or 69 percent, occurred during clear weather conditions and 32, or 49 percent, occurred with dry pavement conditions. None of the accidents involved a fatality. Personal injuries occurred in 15 of the accidents--five involving rear-end collisions, seven involving left-turning vehicles, and one each involving a right-angle collision, a sideswiped vehicle, and a vehicle that went out of control. These accidents were generally distributed throughout the year and days of the week; however, 27 accidents occurred during the winter months of December through February, and 20 of the accidents occurred on Fridays.

Intersection of E. Moreland Boulevard and Kossow Road

This signalized intersection experienced a three-year total of 54 accidents--18 in 1980, 17 in 1981, and 19 in 1982, for an annual accident rate of 1.62, 1.47, and 1.53 accidents per million vehicles entering the intersection, respectively. Of the total accidents, 24 involved rear-end collisions, 15 involved vehicles making left turns, 10 involved right-angle collisions, four involved vehicles sideswiping another vehicle, and one involved a vehicle backing into a vehicle exiting a driveway. Eighteen of the accidents, or 33 percent, occurred after dark. Thirty-five of the accidents, or 65 percent, occurred during clear weather conditions, and 30, or 56 percent, occurred with dry pavement conditions. None of the accidents involved a fatality. Personal injuries occurred in 17 of the accidents--eight involving rear-end collisions, seven involving left-turning vehicles, and two involving right-angle collisions. These accidents were distributed throughout the year and days of the week.

Table 6

TRAFFIC ACCIDENTS REPORTED AT STREET AND HIGHWAY INTERSECTIONS WITH E. MORELAND BOULEVARD BETWEEN BARKER ROAD AND WHITEROCK AVENUE: 1980 THROUGH 1982

E. Moreland Boulevard Intersection With:	1980				1981				1982				Total			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Kossow Road...........	13	5	--	18	10	7	--	17	14	5	--	19	37	17	--	54
Parklawn Drive.........	1	1	--	2	2	2	--	4	3	1	--	4	6	4	--	10
Springdale Road.......	20	1	--	21	9	3	--	12	9	2	--	11	38	6	--	44
Main Street...........	20	7	--	27	14	4	--	18	16	4	--	20	50	15	--	65
Ramona Road...........	1	--	--	1	5	2	--	7	1	--	--	1	7	2	--	9
Avalon Drive..........	--	--	--	--	2	--	--	2	2	--	--	2	4	--	--	4
CTH A/Wolf Road.......	22	12	--	34	15	10	--	25	14	10	--	24	51	32	--	83
Jennifer Lane.........	2	3	--	5	3	--	--	3	2	--	--	2	7	3	--	10
Manhattan Drive.......	1	1	--	2	4	1	--	5	9	2	--	11	14	4	--	18
Highland Avenue.......	4	1	--	5	1	2	--	3	--	--	--	--	5	3	--	8
Waukesha Avenue.......	1	--	--	1	1	1	--	2	2	--	--	2	4	1	--	5
Cleveland Avenue......	3	3	--	6	--	--	--	--	3	--	--	3	6	3	--	9
Murray Avenue.........	1	--	--	1	1	--	--	1	--	1	--	1	2	1	--	3
Jefferson Avenue......	1	3	--	4	4	2	--	6	1	--	--	1	6	5	--	11
Total	99	37	--	127	71	34	--	105	76	25	--	101	237	96	--	333

NOTE: (1) - Property Damage
(2) - Personal Injury
(3) - Fatality
(4) - Total

Source: City of Waukesha and SEWRPC.

Table 7

TRAFFIC ACCIDENTS REPORTED ON E. MORELAND BOULEVARD BETWEEN BARKER ROAD AND WHITEROCK AVENUE: 1980 THROUGH 1982

Roadway Segment	1980				1981				1982				Total			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
IH 94 to Kossow Road..	2	--	--	2	--	--	--	--	--	1	--	1	2	1	--	3
Kossow Road to Parklawn Drive......	--	1	--	1	4	1	--	5	--	--	--	--	4	2	--	6
Parklawn Drive to Springdale Road.....	3	--	--	3	--	1	--	1	1	--	--	1	4	1	--	5
Springdale Road to Main Street.........	3	2	--	5	1	3	--	4	3	--	--	3	7	5	--	12
Main Street to Ramona Road.........	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Ramona Road to Avalon Drive........	--	--	--	--	--	1	--	1	1	--	--	1	1	1	--	2
Avalon Drive to CTH A/Wolf Road.....	1	1	--	2	--	--	--	--	3	--	--	3	4	1	--	5
CTH A/Wolf Road to Jennifer Lane.......	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Jennifer Lane to Manhattan Drive.....	2	--	--	2	1	--	--	1	--	--	--	--	3	--	--	3
Manhattan Drive to Highland Avenue.....	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Highland Avenue to Waukesha Avenue.....	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Waukesha Avenue to Cleveland Avenue....	--	--	1	1	1	--	--	1	1	--	--	1	2	--	1	3
Cleveland Avenue to Murray Avenue.......	2	--	--	2	--	--	--	--	--	--	--	--	2	--	--	2
Murray Avenue to Jefferson Avenue ...	1	--	--	1	2	1	--	3	--	1	--	1	3	2	--	5
Jefferson Avenue to Whiterock Avenue ...	3	1	--	4	--	1	--	1	2	--	--	2	5	2	--	7
Total	17	5	1	23	9	8	--	17	11	2	--	13	37	15	1	53

NOTE: (1) - Property Damage
(2) - Personal Injury
(3) - Fatality
(4) - Total

Source: City of Waukesha and SEWRPC.

Intersection of E. Moreland Boulevard and Springdale Road

This two-way stop sign-controlled intersection experienced a three-year total of 44 accidents--21 in 1980, 12 in 1981, and 11 in 1982, for an annual rate of 1.89, 1.06, and 0.96 accidents per million vehicles entering the intersection, respectively. Of the total accidents, 27 involved rear-end collisions, eight involved right-angle collisions, four involved vehicles making left turns, three involved vehicles sideswiping another vehicle, and two involved vehicles losing control. Twelve of the accidents, or 27 percent, occurred after dark. Thirty-one of the accidents, or 70 percent, occurred during clear weather conditions and 27, or 61 percent, occurred with dry pavement conditions. None of the accidents involved a fatality. Personal injuries occurred in six of the accidents--two involving vehicles that went out of control, two involving vehicles that were sideswiped, one involving a rear-end collision, and one involving a left-turning vehicle. These accidents were generally distributed throughout the year and days of the week; however, 18 accidents occurred during the summer months of June, July, and August, and 14 of the accidents occurred on Fridays.

Intersection of E. Moreland Boulevard and Manhattan Drive

This two-way stop sign-controlled intersection experienced a three-year total of 18 accidents--two in 1980, five in 1981, and 11 in 1983, for an annual accident rate of 0.32, 0.76, and 1.56 accidents per million vehicles entering the intersection, respectively. Of the total accidents, seven involved right-angle collisions, six involved vehicles striking fixed objects, two involved vehicles sideswiping another vehicle, two involved vehicles making left turns, and one involved a rear-end collision. Eleven of the accidents, or 61 percent, occurred after dark. Another 11 of the accidents, or 61 percent, occurred during clear weather conditions and seven, or 39 percent, occurred with dry pavement conditions. None of the accidents involved a fatality. Personal injuries occurred in four of the accidents, two involving vehicles striking fixed objects and one each involving a right-angle collision and a vehicle making a left turn. These accidents were generally distributed throughout the year and days of the week; however, seven accidents occurred during the winter months of December, January, and February.

Intersection of E. Moreland Boulevard and Parklawn Drive

This two-way stop sign-controlled intersection experienced a three-year total of 10 accidents--two in 1980 and four each in 1981 and 1982, for an annual accident rate of 0.21, 0.39, and 0.42 accident per million vehicles entering the intersection, respectively. Of the total accidents, five involved right-angle collisions, two involved rear-end collisions, one involved a vehicle losing control and strucking another vehicle, one involved a vehicle making a U-turn, and one involved a vehicle backing across the roadway median. Four of the accidents, or 40 percent, occurred after dark. Six of the accidents, or 60 percent, occurred during clear weather and dry pavement conditions. None of the accidents involved a fatality. Personal injuries occurred in four of the accidents--all involving right-angle collisions. These accidents were distributed throughout the year. Five of the accidents occurred on a Friday.

E. Moreland Boulevard Between Springdale Road and Main Street

A three-year total of 12 traffic accidents, five in 1980, four in 1981, and three in 1982, occurred on the 0.20-mile-long segment of E. Moreland Boulevard between Springdale Road and Main Street, resulting in an annual accident rate for the roadway segment of 224, 184, and 142 accidents per hundred million vehicle miles, respectively. Of the total accidents, five involved right-angle collisions with vehicles crossing the median or exiting or entering driveways on E. Moreland Boulevard, three involved rear-end collisions, two involved vehicles sideswiping another vehicle, and two involved right-turning vehicles colliding with another vehicle. Seven of the accidents, or 58 percent, occurred after dark. Eleven of the accidents, or 92 percent, occurred during clear weather conditions, and seven accidents, or 58 percent, occurred with dry pavement conditions. None of the accidents involved a fatality. Personal injuries occurred in five of the accidents--three involving a right-angle collision and one each involving a vehicle that was sideswiped and a vehicle that was making a right turn. These accidents were randomly distributed throughout the year; however, six of the accidents occurred on Fridays.

SUMMARY--EXISTING CONDITIONS

The average weekday traffic volumes on E. Moreland Boulevard range between a low of 16,000 vehicles per day west of Whiterock Avenue to a high of 32,100 vehicles per day east of Kossow Road. Since 1970 these traffic volumes have been growing at an annual rate of about 3.5 percent. The morning peak hour from 7:00 a.m. to 8:00 a.m. accounts for about 6 percent of the average weekday traffic volume on E. Moreland Boulevard; the mid-day noon to 1:00 p.m. period for about 7 percent; and the hours of the evening peak period of 4:00 p.m. to 5:00 p.m. and 5:00 p.m. to 6:00 p.m. for about 8.5 percent. Heavy-duty trucks comprise approximately 3 to 5 percent of the hourly traffic volumes on E. Moreland Boulevard.

There are high left-turn volumes on the eastbound approaches of E. Moreland Boulevard at its intersections with Springdale Road, Kossow Road, and Barker Road; on the westbound approaches of E. Moreland Boulevard at its intersections with CTH A and Main Street; on the northbound approach of Barker Road; and on the southbound approaches of Kossow Road and Barker Road. There are high right-turn volumes on the eastbound approach of E. Moreland Boulevard at Barker Road; on the westbound approach of E. Moreland Boulevard at Kossow Road; on the southbound approaches of Springdale Road, Kossow Road, and Barker Road; and on the northbound approaches of CTH A and Main Street.

Based upon intersection delay measurements, the following traffic movements are operating below design capacity levels: the right-turn traffic movement on the southbound approach of Springdale Road, the left-turn traffic movement on the northbound approach of Main Street, and the left-turn and through traffic movements on the westbound approach of E. Moreland Boulevard to Whiterock Avenue. In addition, the following traffic movements are operating at design capacity: the combined left-turn and through traffic movement on the southbound approach of Kossow Road, the left-turn traffic movement on the southbound approach of Springdale Road, the combined left-turn and through traffic movement on the northbound approach of CTH A, and the left-turn, through, and right-turn traffic movements on the southbound approach of Wolf Road.

Based upon vehicular operating speed measurements, traffic on the roadway segments of E. Moreland Boulevard between Barker Road and CTH A/Wolf Road is operating within a range of 1 to 5 mph below the 45-mph posted speed limit during the mid-day time period and 1 to 8 mph below the speed limit during the evening peak hours. Mid-day and evening peak-hour operating speeds are 1 to 5 mph, respectively, above the 35-mph posted speed limit on the segment of E. Moreland Boulevard between CTH A/Wolf Road and the driveway to the Bakers Square restaurant, and 4 to 8 mph, respectively, above the 25-mph posted speed limit on the segment of E. Moreland Boulevard between the Bakers Square restaurant driveway and Whiterock Avenue.

Through detailed analysis of the 379 accidents which occurred on E. Moreland Boulevard from 1980 through 1982, seven high accident locations were identified--locations where at least four motor vehicle accidents occurred in 1982 or where an average of at least four accidents occurred during the three-year period of 1980 through 1982. These seven locations--the E. Moreland Boulevard intersections with Kossow Road, Parklawn Drive, Springdale Road, Main Street, CTH A/Wolf Road, and Manhattan Drive and the roadway segment between Springdale Road and Main Street--accounted for 286 accidents, or about 75 percent of the total accidents on E. Moreland Boulevard.

Chapter III

SHORT-RANGE HIGHWAY IMPROVEMENT PLAN

INTRODUCTION

Under the short-range plan element for E. Moreland Boulevard, alternative traffic management actions were considered which would ameliorate the existing traffic congestion and accident problems identified on the study segment of E. Moreland Boulevard. These actions consist primarily of low-cost, short-range traffic engineering improvement measures such as traffic control device modifications, traffic regulations, and isolated roadway improvements. The evaluation of these alternative traffic management actions addressed the cost of each action and the advantages and disadvantages of each action. The following analysis addresses the identified traffic problems along E. Moreland Boulevard in an east-to-west direction.

ANALYSIS OF TRAFFIC PROBLEMS ON E. MORELAND BOULEVARD

Kossow Road and E. Moreland Boulevard Intersection

A total of 54 accidents occurred at this intersection in calendar years 1980 through 1982. The average annual accident rate was 1.54 accidents per million vehicles entering the intersection. This intersection exhibited the third highest accident frequency and rate of the six problem intersections identified along E. Moreland Boulevard. The predominant collision pattern experienced at this intersection involved vehicles colliding into the rear of another vehicle--24 accidents--and vehicles making left turns which were struck by vehicles in the opposing traffic stream--15 accidents. Together these collision patterns accounted for 72 percent of the 54 total accidents and 82 percent of the 17 accidents involving injuries reported at this intersection. None of the traffic movements at this intersection were found to be operating below or worse than, design capacity levels, with only the southbound combined left-turn and through traffic movement operating at design capacity during the evening peak hour, with an average vehicle delay of 25.8 seconds. This combined traffic movement accounts for 320, or about 11 percent, of the total 2,832 vehicles entering the intersection during the evening peak hour of 4:00 p.m. to 5:00 p.m.

Rear-End Accident Problem: The alternative traffic management actions considered to have potential to ameliorate the rear-end accident problem at this intersection include: retiming the signal sequence, signal sequence modification; signal coordination, and reducing the posted speed limit.

The first alternative, retiming the signal sequence, involves changing the green time allocated to each traffic movement to reduce the number of vehicles required to stop on each roadway approach to the intersection. There is no capital cost involved in retiming traffic signals. Traffic signal plans are designed to proportionally match vehicle traffic demand to the phases on the signal sequence. The advantage of retiming traffic signals is that as traffic patterns change, traffic signal phase times are changed to more efficiently accommodate the new traffic volumes. This serves to reduce the number of stopped vehicles and minimizes delay experienced by drivers, thereby decreasing overall vehicle travel times. As previously noted, the signals at this intersection are fully traffic-actuated, with minimum and maximum phase times designed to match changing traffic demands. Since 17, or 71 percent, of the 24 rear-end collision accidents involved vehicles traveling in an east-west direction on E. Moreland Boulevard, it would be desirable to reduce the number of vehicles stopping on the east- and westbound approaches to this intersection. However, as shown in Table 3, only 39 percent of the westbound through traffic and 36 percent of the eastbound through traffic during the evening peak hour are required to stop at this intersection. Together these two traffic movements account for 1,969 vehicles, or about 70 percent of the traffic entering the intersection during the evening peak hour. In order to provide additional green time for the east- and westbound traffic movements, green time would have to be taken away from either the north- and southbound green phase, or the eastbound exclusive left-turn phase. As already noted, the southbound combined through and left-turn movements are currently operating at design capacity, with an average peak-hour vehicle delay of 25.8 seconds. Any reduction in the green time available for this traffic movement would result in increased congestion and vehicle delays for southbound traffic entering the intersection. Another way to provide additional green time for the east- and westbound traffic movements is to reduce the amount of time allocated to, or eliminate, the eastbound exclusive left-turn phase. Table 3 indicates that about 95 percent of the 226 peak-hour eastbound left turns at the intersection are required to stop, which is inordinately high for a 15-second-maximum protected left-turn green phase time. Field observations by Commission staff indicate that traffic demand for the exclusive turn phase is fairly uniform, with vehicles arriving throughout the signal cycle. Under uniform flow conditions, the protected left-turn phase is normally terminated by the signal control equipment prior to reaching the maximum 15-second time interval. Although uniform flow conditions exist for this traffic movement, average vehicle delay is only 14.3 seconds during the evening peak hour, as shown in Table 3. Reducing the amount of time allocated to the left-turn phase would not significantly improve operating conditions on E. Moreland Boulevard, and elimination of the left-turn phase would only serve to increase the potential for left-turn accidents, which have also been identified as an accident problem at this intersection. Therefore, implementation of this alternative is not recommended.

Another signal retiming alternative involves changing the yellow clearance interval time in the signal cycle to provide increased warning to vehicle traffic that the east- and westbound through green phase is about to be terminated. The existing yellow clearance intervals, as shown in Table 1, are 4.5 seconds long on all approaches to the intersection, with a 3.0-second yellow clearance interval following the protected eastbound left-turn green interval. Comparison of these clearance interval times with those recommended by the Institute of Transportation Engineers indicates that the clearance intervals are properly designed to accommodate existing signal phasing, roadway geometrics, and vehicular operating speeds. Therefore, implementation of this alternative is not recommended.

The second alternative, signal sequence modification, involves eliminating the protected eastbound leading left-turn arrow or changing it to a lagging left-turn arrow. This modification involves no capital cost. The advantages of a lagging left-turn arrow are: The green phases for both directions start simultaneously; it allows for greater total approach capacity because left turns may enter and cross the intersection during the regular green phase, thereby reducing the exclusive arrow time required to accommodate the remaining left-turn vehicles; and the left turns do not preempt right-of-way from the opposing through traffic. The disadvantages of this alternative are that it requires two yellow clearance intervals because the green phases are terminated at different times for the two opposing directions of travel, and it creates vehicular conflict problems for left turns not controlled by the exclusive turn phase, as drivers normally expect both through movements to stop at the same time. Therefore, the small amount of additional green phase time for east- and westbound through traffic gained from modification of the signal sequence would increase the accident potential of left-turning vehicles. Implementation of this alternative is not recommended.

The third alternative, signal coordination, involves interconnecting the traffic signals at this intersection with the existing traffic signals at the E. Moreland Boulevard intersections with Barker Road and Main Street. The capital cost of this alternative is about $12,000. This alternative has the potential advantage of reducing the number of vehicles required to stop at this intersection by encouraging the formation of vehicle platoons which would be controlled to arrive at the start of the Kossow Road east/westbound green phase. The disadvantage of this alternative is that the signal spacing between both Kossow Road and Barker Road and Kossow Road and Main Street would be about 0.65 mile, which exceeds the recommended maximum 0.50-mile spacing normally required to assure platoon continuity through a coordinated signal system. This disadvantage is exacerbated by the existing vertical roadway alignment which prohibits drivers' vision of upstream signals and by the heavy turning volumes onto and off the segments of E. Moreland Boulevard east and west of Kossow Road which, based upon Commission staff field observations, produce a uniform flow of vehicle traffic between the existing signalized intersections. Implementation of this alternative is not recommended.

The final alternative action, reducing the existing speed limit, involves lowering the posted speed limit from 45 to 35 miles per hour (mph) on E. Moreland Boulevard. The capital cost of this alternative, which consists of regulatory signing changes, is about $1,000. As in all regulatory signing changes, the limits imposed upon highway speeds should be reasonable and appropriate. An important basis for establishing the proper speed limit for any street or highway is the nationally recognized "85th percentile speed"--that is, the speed at or below which 85 percent of the observed traffic is moving. Based upon field measurements, the existing mid-day 85th percentile speed on the segment of E. Moreland Boulevard between Kossow Road and Springdale Road is 50.5 mph in the eastbound direction and 43.5 mph in the westbound direction of travel. Another measure of travel speed characteristics is the "10-mph pace"--that is, the 10-mph speed increment within which the majority of vehicles are traveling. It is advisable to set posted speed limits within the minimum and maximum limits of the 10-mph pace to reduce the variation in speeds between vehicles, which serves to minimize the potential for mid-block motor vehicle accidents. The limits of the 10-mph pace for eastbound traffic were 42 mph and 52 mph, accounting for about 62 percent of the vehicles in the traffic stream, and for westbound traffic were 37 mph and 47 mph, accounting for about 58 percent of the vehicles in the traffic stream.

Factors used to supplement the 85th percentile and 10 mph-pace speed data are accident experience, adjacent land development, and traffic volumes. The predominant type of accidents experienced on E. Moreland Boulevard, as previously noted, were rear-end and turning movement collisions, which indicates that vehicular travel speed is not the principal cause of accidents. Instead, these accidents may be more directly related to the increasing intensity of land development adjacent to the study segment of E. Moreland Boulevard, and the vehicle conflicts associated with traffic volumes attracted to those developments. Current City of Waukesha development practices are directed at controlling those vehicle conflicts through the use of frontage roads and driveway access controls. The existing 45-mph speed limit appears to be observed by the majority of drivers on E. Moreland Boulevard, based upon the aforenoted 85th percentile and 10 mph pace speed data and the average mid-day and evening peak-hour travel time data presented in Table 5, which indicates an average travel speed of between 37 and 44 mph on the segment of E. Moreland Boulevard between Barker Road and Main Street. The existing 45-mph speed limit is satisfactory for the geometric design and suburban character of land development adjacent to E. Moreland Boulevard. Implementation of this alternative is not recommended. However, should traffic volumes, land development intensity, and motor vehicle accidents continue to increase in the area, it is recommended that the posted speed limit on E. Moreland Boulevard be reduced to 35 mph to control the accident frequency and severity that may result.

Left-Turn Accident Problem: The alternative traffic management actions considered to have potential to ameliorate the left-turn accident problem at this intersection include: signal sequence modification, signal coordination, reducing the posted speed limit, and turn prohibitions.

The first alternative, signal sequence modification, involves changing the existing eastbound protected/permissive left-turn arrow to a protected-only left-turn arrow. The capital cost of this alternative, which involves adding an eastbound red left-turn signal indication to the signal sequence, is estimated at $1,000. The advantage of this alternative is that eastbound left-turn maneuvers would be permitted only during the separate left-turn phase portion of the signal cycle, prohibiting eastbound left turns from conflicting with opposing westbound traffic. Of the 15 left-turn accidents involved in this collision pattern, six accidents, or 40 percent, involved eastbound left-turning vehicles, with four of those accidents occurring in 1982. As previously noted, the eastbound left turns at this intersection arrive on a fairly uniform basis, which would increase intersection delay under a protected-phase operation. Implementation of this alternative is not recommended.

As stated in the rear-end accident analysis for this intersection, interconnecting traffic signals for progressive traffic movement and reducing the posted speed limit would not improve safety or vehicle operating conditions at this intersection, and these actions are not recommended for implementation.

The final alternative action considered to ameliorate the left-turn accident problem at this intersection is the prohibition of left turns. The capital cost of this alternative, which consists of regulatory signing, would be about $400 per approach. This alternative would eliminate the possibility of left-turn collisions and increase intersection capacity for through and right-turning traffic movements. The disadvantage of this alternative is that it would increase turning movements at other intersections along E. Moreland

Boulevard as drivers alter travel patterns to reach their destinations. This may be expected to result in increased accidents, trip lengths, travel times, and fuel consumption. Since there are no convenient alternative arterial routes serving the commercial land development adjacent to E. Moreland Boulevard, implementation of this alternative is not recommended.

Concluding Remarks: In conclusion, no traffic management actions are recommended for either the rear-end or left-turn accident problems identified at this intersection. It is noted that the annual accident rates at this intersection for the years 1980, 1981, and 1982 were 1.62, 1.47, and 1.53 accidents, respectively, per million vehicles entering the intersection. These are very low accident rates which are reflective of an efficient and safer-than-normal intersection operation. Should the accident patterns identified at this intersection increase in frequency and/or rate in the future, the actions considered in the analysis should be reevaluated for implementation.

It is noted that a new major traffic generator, the Westown movie theater, has recently been constructed immediately adjacent to the northeast corner of this intersection. A traffic congestion and accident problem may occur at this intersection because of the proximity of the theater access road, about 65 feet, to the northeast corner of the intersection. Even though vehicle trips attracted to the theater normally do not coincide with periods of peak traffic volume on either Kossow Road or E. Moreland Boulevard, the addition of the new vehicle conflicts is anticipated to result in excessive vehicle queues exiting the theater parking lot and in motor vehicle accidents as drivers maneuver to exit and enter the traffic stream on Kossow Road. It is therefore recommended that the existing access road to and from the theater parking lot be vacated or closed and that a new roadway be constructed between the existing Marine Bank and Target Department Store developments to connect the theater parking lot with Kossow Road. As a temporary solution, pending the timeliness of implementing the recommended solution, it is recommended that the existing frontage road providing access to the theater be designated as a one-way entrance road and that an agreement be reached between the Target Department Store development and the theater owners to provide egress from the theater through the department store parking lot.

Parklawn Drive and E. Moreland Boulevard Intersection

A total of 10 accidents occurred at this intersection in calendar years 1980 through 1982. The average annual accident rate was 0.34 accident per million vehicles entering the intersection. This intersection exhibited the lowest accident frequency and rate of the six problem intersections identified along E. Moreland Boulevard. The predominant collision pattern experienced at this intersection involved vehicles colliding with another vehicle at right angles--five accidents. This collision type accounted for 50 percent of the 10 accidents, and for all of the four accidents involving injuries reported at this intersection. This accident problem is expected to worsen upon the construction of the planned Parklawn Drive extension between E. Moreland Boulevard and CTH JJ, which will serve to increase vehicular traffic demand at the intersection of Parklawn Drive with E. Moreland Boulevard.

Right-Angle Accident Problem: The alternative traffic management actions considered to have potential to ameliorate the right-angle accident problem at this intersection include: installing traffic signals, signal timing revision, designating a one-way street, prohibiting traffic movements, and reducing the posted speed limit.

The first alternative, installation of traffic signals, involves installing, at an estimated cost of $30,000, semi-actuated traffic signals designed to permit traffic on the Parklawn Drive intersection approaches to actuate the traffic control equipment, and thereby safely enter the intersection and reduce the frequency of right-angle accidents. This alternative has the disadvantage of increasing vehicle delay by stopping vehicles using E. Moreland Boulevard. According to the Manual on Uniform Traffic Control Devices, a publication of the U. S. Department of Transportation, Federal Highway Administration, a traffic signal would not be warranted at this intersection. Therefore, implementation of this alternative is not recommended.

The second alternative--signal timing revisions--involves increasing the amount of red time provided to westbound traffic at the intersection of Kossow Road and E. Moreland Boulevard. This alternative has no capital cost. This alternative has the advantage of increasing the size of gaps in the westbound traffic stream on E. Moreland Boulevard, thereby providing additional time for traffic on Parklawn Drive to enter the intersection safely. This alternative has the disadvantage of potentially increasing the rear-end accident problem at the intersection of Kossow Road and E. Moreland Boulevard and of causing a traffic congestion problem at Kossow Road. Implementation of this alternative is not recommended.

The designation of Parklawn Drive as a one-way street northbound north of, and/or southbound south of, E. Moreland Boulevard is another alternative with potential to eliminate the right-angle accident problem at this intersection. The capital cost of this alternative, which involves the placement of regulatory sign controls, is estimated at $500 per approach. The designation of Parklawn Drive as a one-way northbound roadway between E. Moreland Boulevard and Abbott Drive would not severely restrict accessibility to the commercial development located along E. Moreland Boulevard, nor would it significantly impact vehicle operating conditions at the intersections of Abbott Drive with Kossow Road or Heritage Lane with Springdale Road. This alternative should also serve to control traffic from the planned extension of Parklawn Drive between E. Moreland Boulevard and CTH JJ, which would potentially exacerbate the right-angle accident problem at this intersection. The disadvantage of this alternative is that it would increase the volume of traffic using the intersections of E. Moreland Boulevard with Kossow Road and Springdale Road, which have been identified as more severe accident problem locations. Implementation of this alternative is not recommended.

Another alternative considered to abate the right-angle accident problem at this intersection involves restricting access from the segment of Parklawn Drive between E. Moreland Boulevard and Abbott Drive by prohibiting left-turning and through vehicles from exiting Parklawn Drive onto E. Moreland Boulevard. The cost of this alternative, which involves the placement of regulatory sign controls and the channelization of Parklawn Drive to prohibit southbound left and through traffic movements, is $8,000. This alternative has the same basic advantage and disadvantages as the one-way street alternative, except that it permits southbound right-turn movements to continue to be made from Parklawn Drive. Implementation of this alternative is not recommended.

The designation of Parklawn Drive as a one-way southbound roadway between E. Moreland Boulevard and Hillcrest Drive, although eliminating the right-angle accident problem at this intersection, would severely restrict accessibility to the residential development south of E. Moreland Boulevard. This alternative would also increase the volume of traffic using the intersection of E. Moreland Boulevard and Kossow Road which, as previously noted, has a more severe accident problem. Implementation of this alternative is not recommended.

The final alternative with potential to abate the right-angle accident problem at this intersection involves reducing the posted speed limit on E. Moreland Boulevard. For reasons provided the Kossow Road-E. Moreland Boulevard intersection accident problem analysis, reducing the posted speed limit from 45 to 35 mph is not recommended on the study segment of E. Moreland Boulevard.

Concluding Remarks: In conclusion, no traffic management actions are recommended for the right-angle accident problem at this intersection. The annual accident rates at this intersection for the years 1980, 1981, and 1982 were 0.20, 0.40, and 0.42 accident, respectively, per million vehicles entering the intersection. These are the lowest accident rates of the intersections analyzed in this study. Should the accident patterns identified at this intersection increase in frequency and/or rate in the future, the actions considered in the analysis should be reevaluated for implementation. This is particularly important with respect to the increase in traffic volume that may be expected at the intersection of E. Moreland Boulevard with the proposed extension of Parklawn Drive between Abbott Drive and CTH JJ.

Springdale Road and E. Moreland Boulevard Intersection

A total of 44 accidents occurred at this intersection in calendar years 1980 through 1982. The average annual accident rate was 1.30 accidents per million vehicles entering the intersection. This intersection exhibited the fourth highest accident frequency and rate of the six problem intersections identified along E. Moreland Boulevard. However, for the last two years, the accident rate at this intersection is one-half of what it was in 1980, dropping from a high of 21 accidents in 1980 to 12 and 11 accidents in 1981 and 1982, respectively. The predominant collision pattern experienced at this intersection involved vehicles colliding into the rear of other vehicles--27 accidents. This collision type accounted for 61 percent of the total 44 accidents, and one of the seven accidents involving injuries reported at this intersection. The southbound right-turn movement at the intersection is currently operating at level-of-service D, with an average evening peak-hour delay of about 37 seconds per vehicle with the complementary southbound left-turn movement operating at level-of-service C, with an average delay of about 29 seconds per vehicle. This combined left- and right-turn traffic movement accounts for 239, or about 8 percent, of the total 2,912 vehicles entering the intersection during the evening peak period from 4:00 p.m. to 5:00 p.m.

Rear-End Accident Problem: The alternative traffic management actions considered to have potential to ameliorate the rear-end accident problem at this intersection include: left-turn pavement marking guidelines, left-turn channelization, acceleration lane construction, traffic signal installation, and turning movement prohibition.

The first alternative involves the placement of southbound-to-eastbound left-turn pavement marking guidelines at an estimated annual cost of $100. This alternative would serve to control the conflict between eastbound and southbound left-turning vehicles entering the intersection by providing the ready identification of traffic lanes. This is particularly important at uncontrolled intersections, where vehicles are in constant conflict with opposing traffic movements. The disadvantages of turning guidelines at an intersection are that they are subject to wear under heavy traffic conditions, are not clearly visible during periods of darkness or when wet, and can be obliterated by snow. It is recommended that this alternative be implemented.

Traffic islands or channelized turning lanes provide benefits similar to those of pavement markings, but in a more positive manner by physically separating traffic movements at an intersection. The capital cost of constructing a channelized turn lane is about $10,000. This alternative would serve to control the eastbound left-turn movement by providing an offset, channelized turn lane separated by an island from eastbound through traffic. The advantages of this alternative are that it would more positively identify the eastbound left-turn lane at the intersection; it would discourage the occurrence of concurrent eastbound left turns by two or three vehicles abreast, which presently occurs at the intersection median opening, blocking access to the median area for southbound left-turning vehicles; and it would improve driver vision of oncoming traffic for both eastbound and southbound left-turning vehicles. There are no significant disadvantages to this alternative. Implementation of this alternative is, therefore, recommended.

Channelization of the south-to-eastbound left-turn movement through the median opening on E. Moreland Boulevard may be expected to complement and reinforce the recommended left-turn-lane pavement marking guideline at this intersection. Such channelization would also have the advantage of eliminating north- and southbound traffic conflict problems at the intersection. The disadvantage of complete left-turn channelization at the median opening is the reduced accessibility provided to the land development adjacent to Longview Drive, which also meets E. Moreland Boulevard at this location. This accessibility problem could, however, be ameliorated through the construction of a new median opening at the eastern Longview Drive intersection with E. Moreland Boulevard west of the Parklawn Drive intersection. It is therefore recommended that the south-to-eastbound left-turn movement be channelized, and that a new median opening be constructed at the eastern intersection of Longview Drive with E. Moreland Boulevard.

Construction of an acceleration lane would involve providing a separate lane for southbound vehicles to enter the eastbound traffic stream at a speed approximating that of eastbound traffic. The capital cost of this alternative is about $5,000. The provision of an eastbound acceleration lane at this intersection would improve intersection operation by removing stopped vehicles from the median opening at the intersection, permitting other vehicles to enter the intersection without encountering a stopped vehicle. However, because this intersection is located near the crest of a hill, this alternative would also decrease the sight distance for left-turning southbound vehicles desiring to merge with the eastbound traffic stream. Implementation of this alternative is not recommended.

The installation of traffic signals, at an esimated cost of $30,000, would provide for the more orderly movement of traffic through the intersection by periodically stopping east- and westbound traffic to permit the conflict-free movement of southbound and eastbound left turns, thereby reducing the frequency of rear-end collisions involving left-turning vehicles in the intersection median. This alternative also has the advantage of providing gaps in the eastbound traffic stream, which would abate the right-angle accident problem at the intersection of Parklawn Drive and E. Moreland Boulevard. This alternative has the disadvantage of increasing total vehicle delay at the intersection by stopping vehicles using E. Moreland Boulevard which were previously uncontrolled. This total delay would, however, be minimized by reducing vehicle delay experienced by vehicles on Springdale Road attempting to enter the uncontrolled traffic on E. Moreland Boulevard. This alternative also has the disadvantage of requiring westbound traffic to stop on the approach to the crest of a long vertical grade, which would adversely impact vehicle acceleration time through the intersection, particularly for heavy-duty trucks. This disadvantage could be abated through coordination with the existing signals at the intersection of Kossow Road and E. Moreland Boulevard, or through major reconstruction of the east- and westbound approaches to the intersection to reduce the crest of the vertical curve in the vicinity of Springdale Road.

According to the Manual on Uniform Traffic Control Devices, the installation of a traffic signal at this intersection meets the warrant for the interruption of continuous traffic. However, it is normally accepted that vertical grades on arterial streets and highways should not exceed a maximum of about 5 percent, with grades through intersections reduced to below 5 percent whenever possible. The existing grade on the westbound approach to Springdale Road is 5.2 percent. Because of this steep grade on the westbound approach to the intersection, and the adverse impact that grade would have on vehicle operating conditions, particularly during wet or snowy roadway conditions, implementation of this alternative is not recommended.

The final alternative action considered to abate the rear-end accident problem at this intersection is the prohibition of southbound left turns from Springdale Road. The capital cost of implementing this alternative, which would consist of regulatory signing, would be about $200. This alternative would eliminate the occurrence of rear-end collisions involving southbound left-turn vehicles, and would reduce the number of vehicle conflicts at the intersection. The disadvantage of this alternative is that it would increase turning volumes at other intersections along E. Moreland Boulevard as drivers alter their trip patterns to reach their destinations. This may be expected to result in increased trip lengths, travel time, accidents, and fuel consumption. Because of the lack of continuous north-south routes intersecting with E. Moreland Boulevard, implementation of this alternative is not recommended.

Concluding Remarks: In conclusion, it is recommended that a south-to-eastbound left-turn pavement marking guideline be placed at this intersection and that the existing eastbound left-turn lane be reconstructed as an offset, channelized left-turn lane to reduce and control vehicle conflicts at this intersection.

E. Moreland Boulevard--Springdale Road to Main Street

This is the only roadway segment of E. Moreland Boulevard experiencing a vehicle accident problem. A total of 12 accidents occurred on this roadway segment in calendar years 1980 through 1982. The predominant collision pattern experienced on this segment of E. Moreland Boulevard involved vehicles colliding at right angles with another vehicle--five accidents. This collision type accounted for 42 percent of the total 12 accidents and three of the seven accidents involving injuries reported at this intersection. Eight of the 12 accidents, or 67 percent, occurred at the driveways and/or adjacent median opening located between the Russ Darrow Chrysler/Plymouth dealership and the Westbrook Shopping Center.

Right-Angle Accident Problem: The alternative traffic management actions considered to have potential to abate the right-angle accident problem on this roadway segment include: improved street lighting, turn prohibition, driveway closure and/or relocation, and reducing the posted speed limit.

The first alternative involves the installation of an additional street light on eastbound E. Moreland Boulevard between its intersection with Main Street and the driveway to the Russ Darrow Chrysler/Plymouth dealership. The capital cost of this alternative is estimated at $2,000. Of the 12 accidents that occurred along this roadway segment, seven, or 50 percent, occurred at night. This is an above average number of nighttime accidents. The advantage of improved street lighting along this roadway segment is that it would provide for the safer and more efficient flow of traffic. There are no significant disadvantages to this alternative. Therefore, it is recommended that the street lighting along this roadway segment be improved.

The prohibition of left turns exiting or entering the Russ Darrow Chrysler/Plymouth dealership and/or entering the Westbrook Shopping Center development would eliminate the potential for left-turn accidents at these locations. The capital cost of implementing this alternative, which includes regulatory signing, would be about $400. The disadvantage of this alternative is that it would increase turning volumes at the intersections of Springdale Road and Main Street with E. Moreland Boulevard as drivers alter their trip patterns to reach their destinations. Both of these intersections have been identified in this study as accident problem locations. Therefore, implementation of this alternative is not recommended.

The closure or relocation of the Russ Darrow Chrysler/Plymouth dealership and/or the Westbrook Shopping Center driveways should serve to eliminate about 67 percent of the 12 mid-block accidents on this roadway segment. The capital cost of this alternative is estimated at $2,500 to close a driveway and $15,000 to relocate a driveway. This alternative would reduce the number of vehicle conflicts on this roadway segment and provide for the more even distribution of vehicular speeds on the crest of the vertical roadway grade of 5.2 percent east of Springdale Road. Even though Russ Darrow Chrysler/Plymouth also has roadway access from a frontage road that intersects Main Street, that access is well removed from most vehicles traveling on E. Moreland Boulevard. The closure of the existing driveway on E. Moreland Boulevard may be expected to adversely impact accessibility to the Russ Darrow development. Relocation of the existing Russ Darrow driveway on E. Moreland Boulevard should not significantly change vehicular operating conditions on E. Moreland Boulevard. The Westbrook Shopping Center can be accessed from four other driveway openings, one of which is also located on E. Moreland Boulevard. Closure of the Westbrook driveway on E. Moreland Boulevard between Main Street and Springdale Road should not adversely impact the businesses located within the shopping center. However, such a driveway closure may be expected to adversely impact vehicular operating conditions and safety on E. Moreland Boulevard, particularly at its intersection with Springdale Road, as drivers alter their travel patterns to access the businesses located within the shopping center. The Westbrook driveway could be relocated westerly to the intersection of E. Moreland Boulevard and Main Street. This alternative would not only reduce vehicle conflicts on the crest of the vertical roadway grade on E. Moreland Boulevard, but would also relocate those conflicts to a signalized intersection, which would provide for safer and more controlled movement of vehicles through the intersection. This alternative would also allow two-way operation of the relocated driveway, which should reduce the number of vehicle conflicts at the intersections of Springdale Road and Ramona Road with E. Moreland Boulevard. The only disadvantage of the alternative is the increase in vehicle delay time it would cause at the intersection of Main Street and E. Moreland Boulevard. It is recommended that the Westbrook Shopping Center driveway on E. Moreland Boulevard between Springdale Road and Main Street be relocated to the Main Street intersection. It is also recommended that the Westbrook Shopping Center driveway on E. Moreland Boulevard between Main Street and Ramona Road be vacated to maximize utilization of the relocated driveway at Main Street and to further control vehicle conflicts along E. Moreland Boulevard.

The final alternative with potential to abate the right-angle accident problem on this roadway segment involves reducing the posted speed limit on E. Moreland Boulevard. For reasons provided in the Kossow Road/E. Moreland Boulevard intersection analysis, reducing the existing posted 45-mph speed limit is not recommended.

Concluding Remarks: In conclusion, it is recommended that an additional street light be installed on E. Moreland Boulevard between the driveway to the Russ Darrow Chrysler/Plymouth dealership and Main Street; that the Westbrook Shopping Center driveway on E. Moreland Boulevard between Springdale Road and Main Street be relocated to the Main Street intersection; and that the existing Westbrook Shopping Center driveway on E. Moreland Boulevard between Main Street and Ramona Road be vacated.

Main Street and E. Moreland Boulevard Intersection

A total of 65 accidents occurred at this intersection in calendar years 1980 through 1982. The average annual accident rate was 1.77 accidents per million vehicles entering the intersection. This intersection exhibited the second highest accident frequency and rate of the six problem intersections identified along E. Moreland Boulevard. The predominant collision patterns experienced at this intersection involved vehicles colliding into the rear of other vehicles--28 accidents--and left-turning vehicles being struck by oncoming traffic--23 accidents. Together these two collision patterns accounted for 78 percent of the 65 total accidents and 12, or 80 percent, of the 15 accidents involving injuries at the intersection. It is noted that the collision pattern at this intersection has changed from 16 rear-end and five left-turn-related accidents in calendar year 1980 to four rear-end and 13 left-turn-related accidents in calendar year 1982. This change is attributed to the installation of traffic signals at the intersection in June 1981. Therefore, the existing accident problem at this intersection involves left-turning vehicles colliding with oncoming vehicles, which accounted for 13, or 65 percent, of the 20 accidents that occurred in 1982.

Left-Turn Accident Problem: The alternative traffic management actions considered to have potential to abate the left-turn accident problem at this intersection include: signal sequence modification, signal coordination, reducing the posted speed limit, and turn prohibition.

The first alternative considered to abate this left-turn accident problem involves modification of the signal sequence from a westbound protected/permissive operation to a protected-only operation. The capital cost of this alternative, which would require the addition of a red left-turn signal control light in the existing traffic signal display, would be about $1,000. This alternative would reduce and control the conflict between westbound left-turn and eastbound traffic movements. This alternative may also be expected to increase average vehicle delay at the intersection, as westbound left turns would be permitted only during the exclusive left-turn indication. The exclusive left-turn indication would have to be of a longer duration than presently designed, requiring eastbound traffic to receive a shorter green indication. Implementation of this alternative is not recommended.

For reasons provided in the analysis of the Kossow Road/E. Moreland Boulevard intersection, the interconnection of traffic signals for progressive traffic movement and a reduction in the existing 45-mph speed limit are not recommended for implementation on the study segment of E. Moreland Boulevard.

The final alternative considered to abate the left-turn accident problem at this intersection consists of prohibiting westbound left turns. The capital cost of this alternative, which involves the placement of regulatory signing, is estimated at $200. This alternative would eliminate the potential for accidents involving westbound left-turning vehicles. The westbound left-turn movement at this intersection may be expected to be diverted westward to the intersection of CTH A and E. Moreland Boulevard. The intersection of CTH A and E. Moreland Boulevard, however, has been identified in this study as a high accident location with a left-turn accident problem. The diversion of left-turn vehicles would serve only to exacerbate the left-turn accident problem and potentially cause a traffic congestion problem at the CTH A intersection. There are no other routes available to readily accommodate this heavy left-turn movement. Therefore, implementation of this alternative is not recommended.

Concluding Remarks: In conclusion, no alternative traffic management actions are recommended to solve or abate the left-turn accident problem at this intersection. However, the previously recommended relocation to this intersection of the Westbrook Shopping Center driveway located between Springdale Road and Main Street may be expected to help reduce the number of left-turn accidents at this intersection by providing a more normal, four-legged intersection operation, with westbound left-turn vehicles receiving a separate phase of a redesigned three-phase, traffic-actuated signal design.

CTH A and E. Moreland Boulevard Intersection

A total of 83 accidents occurred at this intersection in calendar years 1980 through 1982. The average annual accident rate was 2.96 accidents per million vehicles entering the intersection. This intersection exhibited the highest accident rate and frequency of the six problem intersections identified along the study segment of E. Moreland Boulevard. The predominant collision patterns experienced at this intersection involved left-turn vehicles bring struck by oncoming traffic--50 accidents--and vehicles colliding into the rear of other vehicles--20 accidents. Together these two collision patterns accounted for 84 percent of the 83 total accidents and 30, or 94 percent, of the 32 accidents involving injuries at this intersection. None of the approaches to this intersection are operating below, or worse than, design capacity. Both the combined northbound through and left-turn movements and the combined southbound right-turn, through, and left-turn movements are, however, operating at design levels during the evening peak hour.

Left-Turn Accident Problem: The alternative traffic management actions considered to have potential to abate the left-turn accident problem at this intersection include: signal retiming, signal sequence modification, signal coordination, reducing the posted speed limit, and turn movement prohibition.

The first alternative involves retiming the traffic signal sequence to provide additional green time for the exclusive westbound left-turn arrow. There is no capital cost involved in retiming traffic signals. Traffic signal plans are designed to proportionally match traffic demand to the phases in the signal sequence. The advantage of retiming traffic signals is that as traffic patterns change, traffic signal phase times can be changed to more efficiently accommodate the new traffic volumes. This serves to reduce the number of stopped vehicles and minimizes delay experienced by drivers, thereby decreasing overall vehicle travel times. As previously noted, the signals at this intersection are fully traffic-actuated, with minimum and maximum phase times designed to match changing traffic demands. As indicated in Table 3, during the evening peak hour, 486 westbound left turns are made and there are 587 eastbound through and left-turning vehicles, for a total of 1,073 conflicting traffic movements. This traffic is provided a maximum 20-second westbound, exclusive, left-turn green arrow and a 45-second eastbound, through green signal indication at this intersection. Accordingly, even though the westbound left turn is provided with two exclusive turn lanes, it would appear that the 486 westbound left-turning vehicles, comprising about 45 percent of the 1,073 conflicting vehicle movements at this intersection, are not receiving their proportion of the total green time available for these conflicting movements. However, based upon the vehicle delay information shown in Table 3, during the evening peak hour the westbound left-turn movement is experiencing a shorter average delay per vehicle--11.0 seconds--than the eastbound through and left-turn movements, which are experiencing an average delay per vehicle of 14.2 seconds. Therefore, retiming the traffic signal sequence to increase the maximum westbound left-turn arrow green time is not recommended.

Signal sequence modification would involve changing the existing protected/ permissive westbound left-turn arrow to a protected-only left-turn arrow. The capital cost of this alternative, which involves adding a westbound red left-turn signal indication to the signal sequence, is estimated at $1,000. The advantage of this alternative is that westbound left-turn movements would be permitted only during the separate left-turn phase portion of the signal cycle, which prohibits westbound left-turns from conflicting with opposing eastbound traffic. This alternative has the disadvantage of increasing average left-turn vehicle delay. Based upon the average westbound left-turn delay during the evening peak hour of only 11.0 seconds per vehicle, which is shorter than the conflicting eastbound through and left-turn vehicle delay of 14.2 seconds; the heavy left-turn demand experienced at this intersection, with 487 vehicles during the evening peak hour, which requires two lanes to operate under uncongested conditions; and the high number of left-turn accidents reported at this intersection, it is recommended that the existing signal sequence be modified to contain a protected-only westbound left-turn arrow. In order to reduce potential vehicle conflicts and manage the left-turn traffic demand, it is also recommended that the existing west-to-southbound double left-turn lane at this intersection be channelized and that the east-to-northbound left-turn lane be offset for improved driver sight distance at an estimated total cost of $20,000.

For reasons provided in the analysis of the Kossow Road/E. Moreland Boulevard intersection, the interconnection of traffic signals for progressive traffic movement and a reduction in the existing 45-mph speed limit are not recommended for implementation on the study segment of E. Moreland Boulevard. This conclusion is supported by the fact that the posted speed limit on E. Moreland Boulevard west of CTH A is 35 mph.

The final alternative considered to have potential to abate the left-turn accident problem at this intersection is the prohibition of westbound left turns. The capital cost of this alternative, which involves the placement of regulatory signs, is estimated at $200. This alternative would eliminate the potential for accidents involving westbound left-turning vehicles. The westbound left-turn movement at this intersection could be diverted eastward to the intersection of Main Street and E. Moreland Boulevard. The intersection of Main Street and E. Moreland Boulevard, however, has been identified in this study as a high accident location with an existing westbound left-turn accident problem. The diversion of left-turning vehicles would only serve to exacerbate the left-turn accident problem at the Main Street intersection. There are no other arterial routes available to readily accommodate the travel demand associated with this heavy left-turn movement. Therefore, implementation of this alternative is not recommended.

Rear-End Accident Problem: The alternative traffic management actions considered to have potential to abate the rear-end accident problem at this intersection include: signal retiming, signal coordination, and reducing the posted speed limit.

The first alternative involves retiming the traffic signal sequence to avoid unnecessary stops. There is no capital cost involved in retiming traffic signals. Since nine, or 45 percent, of the 20 rear-end collision accidents involved right-turning vehicles on the northbound approach to this intersection, it would be desirable to reduce the number of stops required of northbound vehicles. As noted in Table 3, during the evening peak hour approximately 70 percent of the 247 right-turning, northbound vehicles are required to stop at this intersection. Increasing the green time available for northbound right turns, while reducing the number of northbound vehicles required to stop, would increase the number of east- and westbound vehicles required to stop. As also shown in Table 3, approximately 49 percent of the 1,775 east- and westbound vehicles are required to stop at the intersection during the evening peak hour. The northbound right-turn movement is provided with 50 seconds of green time, or about 46 percent of the total signal cycle. The signal sequence modification recommended in this report to provide a protected-only, exclusive, westbound left-turn phase at this intersection would also serve to provide additional green time for the complementary northbound right turn. It is therefore recommended that this alternative be implemented.

For reasons provided in the analysis of the left-turn accident problem at this intersection, reducing the posted speed limit and interconnecting the traffic signals are not recommended for implementation on the study segment of E. Moreland Boulevard. The high percentage of rear-end accidents experienced on the northbound approach of CTH A to this intersection requires these alternative actions to be reconsidered for implementation on CTH A. Reducing the existing 45-mph speed limit on CTH A to 35 mph, which would involve regulatory signing changes, would cost about $400. This alternative would reduce the stopping distance from 350 to 250 feet for vehicles approaching the intersection in a northbound direction. It does not appear from the collision diagram prepared for this intersection that vehicles, particularly northbound vehicles making right turns, are experiencing difficulty in approaching the intersection at a safe speed, but rather that drivers are not anticipating that the vehicle ahead may stop prior to completing a right-turn maneuver. Reducing the posted speed limit may not solve the rear-end accident problem at this intersection and may, in fact, serve to increase the potential for mid-block motor vehicle accident collisions as the speed variation among individual drivers may be expected to increase. Implementation of this alternative is not recommended.

The final alternative considered to abate the rear-end accident problem at this intersection involves interconnecting the traffic signals at the CTH A intersections with E. Moreland Boulevard and Main Street, a distance of about 0.33 mile. The capital cost of this alternative is about $2,000. This alternative has the potential advantage of reducing the number of northbound vehicles required to stop at this intersection by encouraging the formation of vehicle platoons which would be controlled to arrive from the Main Street/CTH A intersection at the start of the exclusive right-turn green phase at E. Moreland Boulevard. The traffic signals at both of these intersections are fully traffic-actuated. The only disadvantage of this alternative is that interconnection would require the signal at the intersection of E. Moreland Boulevard and CTH A to serve as the master controller, which could increase vehicle delays at the Main Street intersection. It is recommended that this alternative be implemented.

<u>Concluding Remarks</u>: In conclusion, it is recommended that the west-to-southbound exclusive protected/permissive left-turn arrow be modified to a protected-only operation; that the northbound right-turn green arrow time be increased to coincide with the revised westbound protected left-turn arrow green time; that the existing west-to-southbound double left-turn be channelized; that the existing east-to-northbound left-turn lane be offset; and that the traffic signals at the CTH A intersections with E. Moreland Boulevard and Main Street be interconnected for the provision of progressive traffic movement on CTH A.

Manhattan Drive and E. Moreland Boulevard Intersection

A total of 18 accidents occurred at this intersection in calendar years 1980 through 1982. The average annual accident rate was 0.88 accident per million vehicles entering the intersection. This intersection exhibited the second lowest accident rate and frequency of the six problem intersections identified along the study segment of E. Moreland Boulevard. The predominant collision pattern experienced at the intersection involved vehicles colliding at right angles--seven accidents. This collision type accounted for 40 percent of the total 18 accidents and 50 percent of the four accidents involving injuries at this intersection. This intersection has been experiencing an increasing accident frequency pattern, with only two accidents in 1980, five accidents in 1981, and 11 accidents in 1982. It is noted that this accident frequency pattern may be expected to continue with the planned 1984 opening of a food warehouse development on the southeast corner of this intersection, which may be expected to increase vehicle volumes and conflicts at the intersection.

Right-Angle Accident Problem: The alternative traffic management actions considered to have potential to abate the right-angle accident problem at this intersection include: reducing the posted speed limit, improving street lighting, and installing a flashing yellow beacon.

The first alternative involves reducing the existing posted speed limit from 35 to 25 mph. The capital cost of this alternative, which involves regulatory signing changes, would be about $400. As in all regulatory procedures, the limit imposed on highway speeds should be reasonable and appropriate. An important basis for establishing the posted speed limit is the nationally recognized "85th percentile speed"--that is, the speed at or below which 85 percent of the observed traffic is moving. Factors used to supplement the 85th percentile speed in establishing speed limits are accident experience and traffic volume. The frequency of right-angle accidents experienced at this intersection could be reduced with a lower posted speed limit. The disadvantage of this alternative is that a reduced speed limit would have to be strictly enforced, as some drivers will have a tendency to drive at a higher speed than the posted speed limit because of the nature of the suburban land development adjacent to E. Moreland Boulevard. Reducing the posted speed limit could result in an increased accident problem as the speed variation among individual drivers would be expected to increase. Implementation of this alternative is not recommended.

Another alternative considered to abate the right-angle accident problem at this intersection involves upgrading the existing street lighting system. Street lighting at this intersection consists of a single overhead light located on the northeast corner of the intersection. The eastern limit of a continuous street lighting system ends about 500 feet west of this intersection. The capital cost of this alternative would be about $10,000. As previously noted, 11, or about 55 percent, of the accidents at this intersection occurred at night. This is an above average number of nighttime accidents. The advantage of improved street lighting on the E. Moreland Boulevard approaches to this intersection is that it would provide for the safer and more efficient flow of traffic through the intersection. This is particularly important along the segment of E. Moreland Boulevard between Manhattan Drive and Highland Avenue because of the roadway's transition from a four-lane, divided highway to a two-lane, undivided arterial facility. There are no significant disadvantages to this alternative. It is therefore recommended that this alternative be implemented.

The final action considered to abate the right-angle accident problem at this intersection involves the installation of a flashing yellow intersection control beacon. The capital cost of this alternative would be about $3,000. Intersection control beacons are intended for use at intersections where traffic or physical conditions do not justify conventional traffic signals, but where high accident rates indicate a special hazard. Although a three-year average accident rate of 0.88 is relatively low, the accident rate for 1982 was 1.61, which would make this intersection the fourth most hazardous along the study segment of E. Moreland Boulevard. The disadvantage of such beacons is that if used at locations where they are not warranted, they soon lose much of their effectiveness. According to criteria set forth in the Manual of Uniform Traffic Control Devices, a flashing intersection control beacon is not warranted at this intersection. Therefore, the installation of such a beacon at this intersection is not recommended.

Concluding Remarks: In conclusion, it is recommended that the street lighting on the east- and westbound approaches to this intersection be upgraded.

SUMMARY

Implementation of the traffic management actions recommended in the short-range highway improvement plan may be expected to result in improved vehicular operating conditions and reduced motor vehicle accident problems along the study segment of E. Moreland Boulevard. As shown in Table 8, a total of 14 actions are recommended for implementation at six locations on E. Moreland Boulevard at a total cost of $105,600.

Table 8

SUMMARY OF RECOMMENDED TRAFFIC MANAGEMENT ACTIONS TO SOLVE OR ABATE TRAFFIC CONGESTION AND ACCIDENT PROBLEMS ON E. MORELAND BOULEVARD FROM BARKER ROAD TO WHITEROCK AVENUE

Problem Location	Total Number of Accidents	Recommended Traffic Management Action	Capital Cost (1983 dollars)
Kossow Road and E. Moreland Boulevard	54	• Relocate north frontage road east of intersection to a new location between Marine Bank and Target Department Store development	$ 20,000
Parklawn Drive and E. Moreland Boulevard	10	• No recommendation	$ --
Springdale Road and E. Moreland Boulevard	44	• Install south-to-eastbound, left-turn pavement marking guideline • Channelize the south-to-eastbound left-turn traffic movement • Construct median opening at eastern intersection of Longview Drive and E. Moreland Boulevard • Reconstruct eastbound left-turn lane as an offset, channelized, exclusive turn lane	$ 100 5,000 10,000 10,000
Springdale Road to Main Street	12	• Install additional street lighting on E. Moreland Boulevard • Relocate Westbrook Shopping Center driveway to Main Street intersection with E. Moreland Boulevard • Modify traffic signals at Main Street and E. Moreland Boulevard to a three-phase design • Vacate Westbrook Shopping Center driveway west of Main Street	$ 2,000 15,000 5,000 2,500
Main Street and E. Moreland Boulevard	65	• Relocate Westbrook Shopping Center driveway to Main Street intersection with E. Moreland Boulevard • Modify traffic signals to a three-phase design • Vacate Westbrook Shopping Center driveway west of Main Street	$ --[a] --[a] --[a]
CTH A and E. Moreland Boulevard	83	• Modify traffic signal sequence • Reconstruct and channelize the west-to-southbound double left-turn lane • Offset the east-to-northbound left-turn lane • Interconnect traffic signals at CTH A intersections with E. Moreland Boulevard and Main Street	$ 1,000 10,000 10,000 5,000
Manhattan Drive and E. Moreland Boulevard	18	• Upgrade street lighting	$10,000
Total	--	--	$105,600

[a] The capital cost of relocating the Westbrook Shopping Center driveway, modifying the traffic signals at the intersection of Main Street and E. Moreland Boulevard, and vacating the Westbrook Shopping Center driveway west of Main Street have been included in the Springdale Road to Main Street roadway segment problem costs.

Source: SEWRPC.

Chapter IV

LONG-RANGE HIGHWAY IMPROVEMENT PLAN

INTRODUCTION

With the volume of vehicles traveling on E. Moreland Boulevard increasing at the rate of about 3.5 percent per year since 1970, and with the increasing intensity of commercial land development immediately adjacent to E. Moreland Boulevard, a need exists for the development of a long-range facility improvement plan for E. Moreland Boulevard. The short-range transportation system management actions recommended in this study were designed to maximize the efficiency and safety of the existing facility without resorting to capital-intensive construction projects. However, as the short-range planning analyses indicated, there is a limit to the improvement in the level of service that can be obtained through the implementation of low-cost traffic management actions. Ultimately, when the maximum capacity that can be obtained through traffic management actions has been reached, it will become necessary to consider the implementation of more capital-intensive construction or reconstruction alternatives to serve expected increases in travel demand. Several of the traffic congestion and accident problems identified at the intersections of E. Moreland Boulevard with Kossow Road, Parklawn Drive, and Main Street that could not be resolved in the short-range segment of the study can be abated through the implementation of the long-range facility improvements recommended herein.

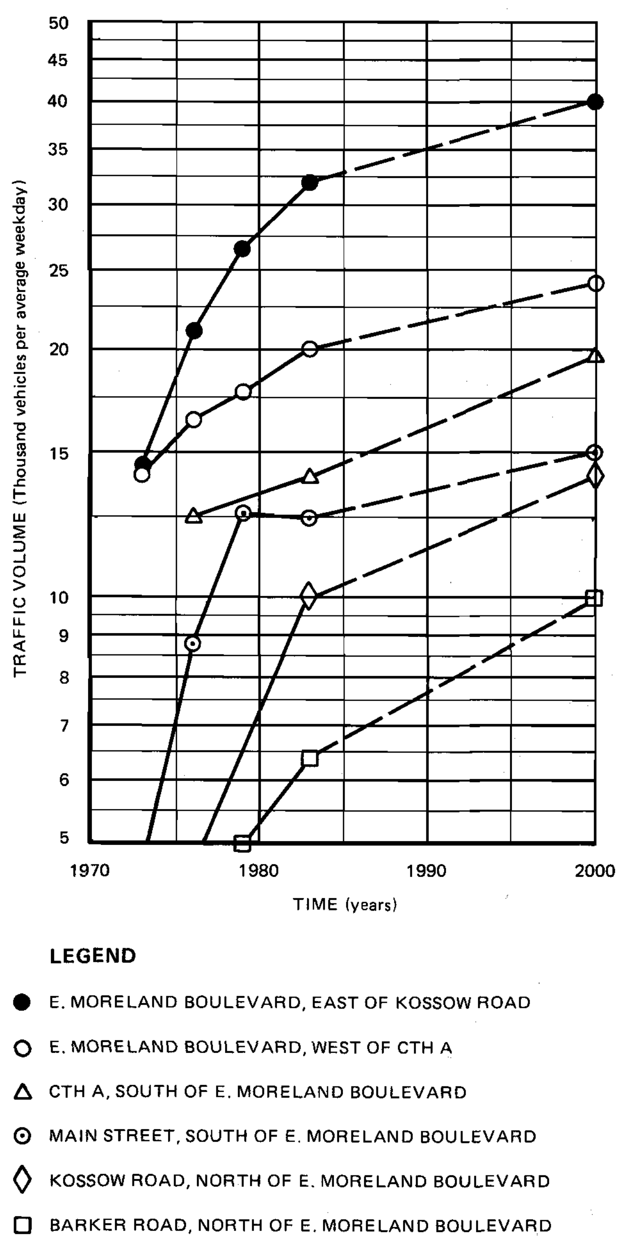
The long-range plan element for E. Moreland Boulevard considers major roadway construction and reconstruction alternatives and attendant traffic engineering improvements which could maintain traffic operating conditions within design-capacity levels as land development and traffic volumes increase in the corridor. The plan addresses the future cross-section of E. Moreland Boulevard and of the arterial streets and highways crossing E. Moreland Boulevard; traffic engineering improvements such as improved traffic signalization, speed limits, street lighting, and turn lanes; and local street access to E. Moreland Boulevard.

FUTURE ROADWAY CROSS-SECTION

As previously noted, E. Moreland Boulevard operates at and, in some cases, below, or worse than, design capacity during the average weekday. Motor vehicle accident problems have been identified at the intersections of E. Moreland Boulevard with Kossow Road, Parklawn Drive, Springdale Road, Main Street, CTH A, and Manhattan Drive, and on the segment of E. Moreland Boulevard between Springdale Road and Main Street. The short-range element of the study contains recommendations for the abatement of all of these identified problems except those at the intersections of E. Moreland Boulevard with Kossow Road and Parklawn Drive. Moreover, traffic volumes on E. Moreland Boulevard may be expected to continue to increase at a rate of at least 1 percent per year to the year 2000. Figure 6 displays the forecast year 2000 traffic volumes. The growth rate of 1 percent is significantly less than the historic rate of 3.5 percent per year. The reduced rate reflects a reduction in land development activity adjacent to E. Moreland Boulevard, as the amount of the available developable

Figure 6

HISTORIC AND PROJECTED AVERAGE WEEKDAY TRAFFIC VOLUMES ON E. MORELAND BOULEVARD AND SELECTED INTERSECTING ARTERIAL STREETS 1970-2000



Source: Wisconsin Department of Transportation and SEWRPC.

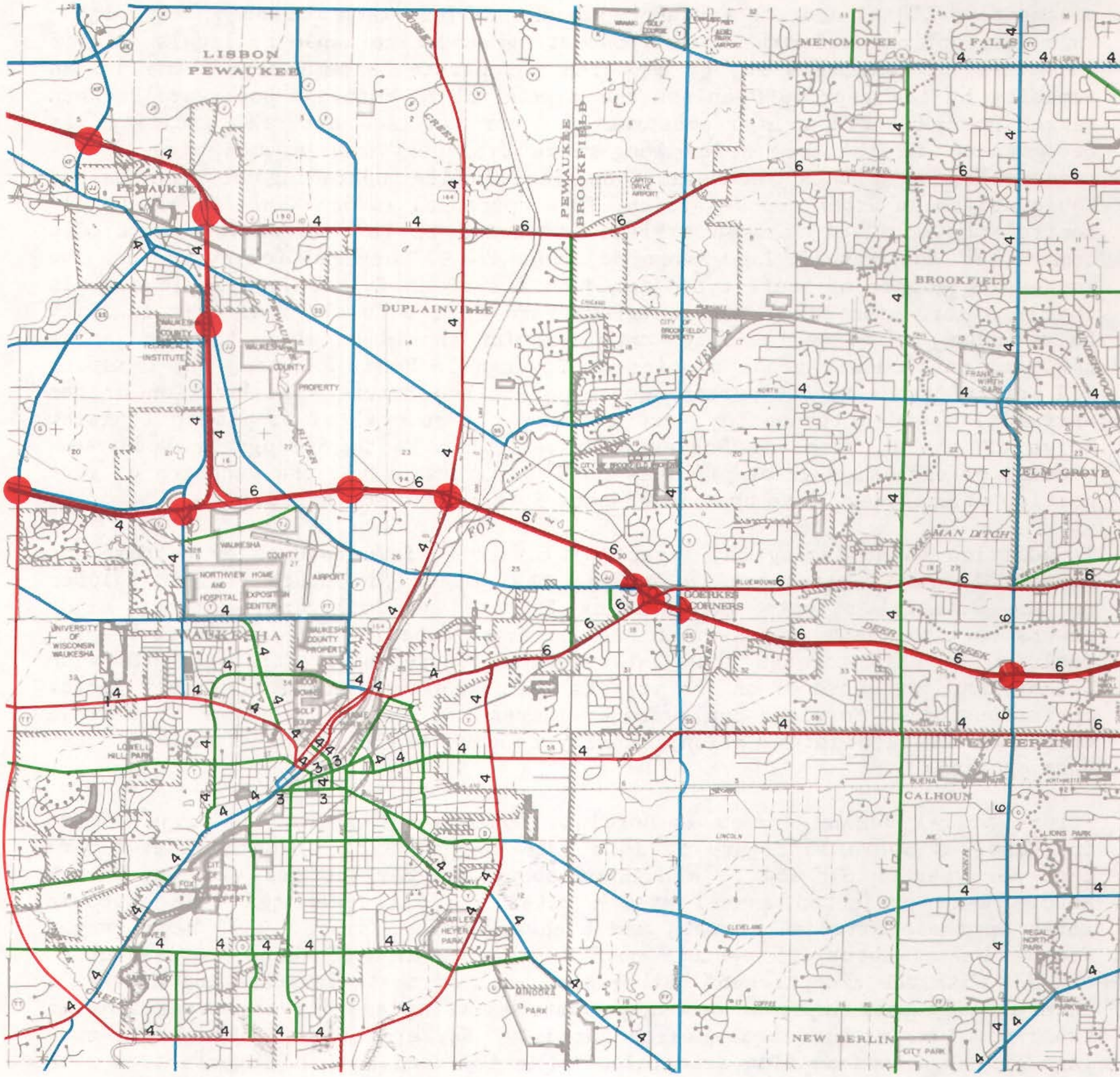
land in the E. Moreland Boulevard travel corridor declines over the next two decades. Even at the significantly lower projected growth rate, the increase in traffic volume may be expected to adversely impact operating conditions on E. Moreland Boulevard, resulting in traffic congestion and extensive vehicle delays and conflicts at the E. Moreland Boulevard intersections with Kossow Road, Springdale Road, Main Street, and CTH A. Vehicle travel speeds may be expected to be reduced because of the increased conflicts between through traffic and traffic attracted to the land development adjacent to E. Moreland Boulevard, resulting in increased motor vehicle accident problems.

Based upon these traffic forecasts, the adopted regional transportation system plan recommends the reconstruction and widening of that segment of E. Moreland Boulevard between Whiterock and Manhattan Avenues to provide four lanes for moving traffic, and the reconstruction and widening of that segment between CTH A and Barker Road to provide six lanes for moving traffic (see Map 3). The segment of E. Moreland Boulevard between Whiterock and Manhattan Avenues is scheduled by the Wisconsin Department of Transportation to be reconstructed in 1984 to a 48-foot-wide roadway to accommodate four lanes of traffic.

Based upon traffic volume increases projected for E. Moreland Boulevard, roadway design-capacity levels may be expected to be exceeded by the year 1990 or earlier on the segment of E. Moreland Boulevard between CTH A and Barker Road. As previously noted, the southbound right-turn traffic movement on Springdale Road, the northbound left-turn movement on Main Street, and the westbound left-turn movement on E. Moreland Boulevard at Whiterock Avenue are currently oper-

Map 3

ADOPTED SEWRPC TRANSPORTATION SYSTEM PLAN IN THE VICINITY OF E. MORELAND BOULEVARD: 2000



LEGEND

ARTERIAL STREET AND HIGHWAY SYSTEM

JURISDICTIONAL CLASSIFICATION

STATE TRUNK HIGHWAY-FREEWAY

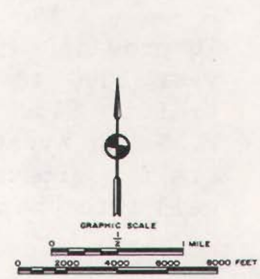
STATE TRUNK HIGHWAY-NONFREEWAY

COUNTY TRUNK

LOCAL TRUNK

FREEWAY-NONFREEWAY INTERCHANGE

4 NUMBER OF TRAFFIC LANES (TWO LANES WHERE UNNUMBERED)



Source: SEWRPC.

ating below design-capacity levels, while the southbound combined left-turn and through traffic movement at Kossow Road, the southbound left-turn movement at Springdale Road, the northbound combined left-turn and through traffic movement on CTH A, and the southbound combined left-turn, through, and right-turn movement on Wolf Road are all operating at design-capacity levels. All of these traffic movements may be expected to operate below (worse than) design capacity by the year 1990 unless the segment of E. Moreland Boulevard between Barker Road and CTH A is reconstructed to a six-lane arterial facility, as recommended in the Commission long-range transportation system plan. It is recommended that this reconstruction include the upgrading of E. Moreland Boulevard to an urban cross-section. This upgrading is necessary to adequately control the conflict between traffic attracted to the intensively developed commercial and retail land uses adjacent to E. Moreland Boulevard and the increasing volume of traffic projected to travel on E. Moreland Boulevard. In the reconstruction of E. Moreland Boulevard from a rural, four-lane facility to an urban, six-lane facility, consideration should be given to eliminating the vertical roadway grade problem at Springdale Road. Reducing the existing 5.2 percent grade to 3.0 percent would permit the future signalization of the Springdale Road intersection, and require the removal of access to Longview Drive at the E. Moreland Boulevard intersection with Springdale Road and, because of excessive grade problems on E. Longview Drive, the vacation of that portion of Longview Drive that intersects E. Moreland Boulevard.

In addition to analyzing the impact of future traffic volumes on E. Moreland Boulevard, it is necessary to analyze the impact of future traffic volumes on the arterial streets intersecting E. Moreland Boulevard. Without major reconstruction, each intersection has a limited capacity to accommodate traffic desiring to pass through that intersection. Increases in traffic volume on E. Moreland Boulevard or on the streets that intersect it can adversely impact operations on E. Moreland Boulevard by increasing the total number of vehicle conflicts at each intersection, thereby causing traffic congestion and accident problems.

Future travel demand across E. Moreland Boulevard may also be expected to increase, as shown in Figure 6, at a rate ranging from a low of about 1 percent per year on STH 164 to a high of about 3.6 percent per year on Barker Road. These projected annual growth rates are all lower than the historic rates on these arterial streets and highways which, since 1970, have ranged from a low of about 2.5 percent on STH 164 to a high of about 9.0 percent on CTH JJ. With the exception of Barker Road, all of these intersecting arterials have already been improved to accommodate existing and forecast increases in traffic volume within their design capacity. Barker Road is currently a two-lane, rural, cross-section arterial with an improved roadway intersection with E. Moreland Boulevard providing two lanes in each direction for vehicular through traffic, in addition to channelization for separate left- and right-turn traffic movements.

To provide sufficient capacity along Barker Road, it will be necessary by the year 2000 to widen and reconstruct E. Barker Road to provide four lanes for traffic flow from its improved intersection with E. Moreland Boulevard to W. North Avenue. Based upon existing traffic volumes and the forecast rate of traffic growth, it should not be necessary to pursue this improvement until well into the next decade.

ALTERNATIVE INTERSECTING ROADWAY IMPROVEMENTS

The following roadway construction projects involving E. Moreland Boulevard are currently under consideration by the City of Waukesha: 1) extension of Manhattan Drive from E. Moreland Boulevard to Main Street, 2) extension of Springdale Road from E. Moreland Boulevard to Davidson Road, 3) extension of Parklawn Drive from Abbott Drive to CTH JJ, and 4) extension of Paramount Drive easterly to the Avalon Drive intersection with E. Moreland Boulevard.

The principal concern with the proposed construction of these roadways is their probable impact on safety and vehicular operating conditions on E. Moreland Boulevard.

Manhattan Drive Extension

The proposed extension of Manhattan Drive from E. Moreland Boulevard to Main Street may be expected to improve traffic service to the existing land development along E. Moreland Boulevard. More importantly, it may also be expected to relieve traffic access problems to the large food retailing development now under construction on the southeast corner of the intersection of E. Moreland Boulevard and Manhattan Drive, as well as provide traffic service to the residential and light industrial development planned for the vacant land located south of E. Moreland Boulevard between Manhattan Drive and Waukesha Avenue. About 3,000 vehicles per day may be expected to use this new roadway, which should slightly reduce traffic volumes on the segment of E. Moreland Boulevard between Manhattan Drive and Whiterock Avenue, with a portion of the vehicle trips having a trip origin or destination in the southwest quadrant of the City of Waukesha and/or at the existing and proposed land development in the vicinity of Manhattan Drive being redistributed from the Whiterock Avenue and E. Moreland Boulevard route to the Main Street and Manhattan Drive route.

This roadway improvement is expected to help control any adverse impact that may result from the traffic generated by the proposed large food retailing development and by the increasing accident problem at the intersection of E. Moreland Boulevard and Manhattan Drive. The installation of traffic signals at the intersection of E. Moreland Boulevard and Manhattan Drive is not now warranted, but may be required in the future to abate the increasing accident problem at the intersection and to improve vehicular operating conditions. The intersection of Manhattan Drive and E. Moreland Boulevard is located about 3,300 feet from the Whiterock Avenue intersection and about 1,700 feet from the CTH A intersection with E. Moreland Boulevard. This street spacing is not favorable for the development of efficient, progressive traffic signalization along E. Moreland Boulevard.

Because of the benefits that would be derived from implementation of the Manhattan Drive extension, it is recommended that such implementation be undertaken by the City of Waukesha.

Springdale Road Extension

The proposed extension of Springdale Road from E. Moreland Boulevard to Davidson Road would provide traffic service across E. Moreland Boulevard and provide for the more direct movement of vehicles to E. Moreland Boulevard from existing and planned urban development located in an area bounded by Barker

Road on the east, W. Greenfield Avenue on the south, CTH A on the west, and E. Moreland Boulevard on the north. About 2,000 vehicles per day would use this new roadway by the year 2000, which should result in slightly reduced traffic volumes on segments of Davidson Road, Kossow Road, and Main Street.

The proposed extension of Springdale Road may be expected to increase traffic volumes and vehicle conflicts at its intersection with E. Moreland Boulevard, requiring the installation of traffic signals at this intersection to control traffic flow and abate the accident problem which would be exacerbated without such traffic control. As noted in the accident analysis section of this report, however, the installation of traffic signals at this intersection would also require major reconstruction of the E. Moreland Boulevard roadway, owing to the existing 5.2 percent vertical grade on the westbound approach to Springdale Road.

The intersection of Springdale Road and E. Moreland Boulevard is located about 2,400 feet from the Kossow Road intersection and about 1,100 feet from the Main Street intersection with E. Moreland Boulevard. These are not favorable street spacings for the development of efficient, progressive traffic signalization along E. Moreland Boulevard. This spacing problem is exacerbated by the westbound vertical roadway grade on E. Moreland Boulevard which encourages vehicle platoons from the Kossow Road intersection to disperse, resulting in a steady flow of westbound vehicles at Springdale Road. Installation of traffic signals at this location would also serve to increase vehicle travel times and delays on E. Moreland Boulevard.

Although construction of the Springdale Road extension south of E. Moreland Boulevard may be expected to provide a minor improvement in existing and future traffic service to the land development along E. Moreland Boulevard and Springdale Road, it would also serve to increase vehicle conflicts at the intersection of E. Moreland Boulevard and Springdale Road, and to increase vehicle delays on E. Moreland Boulevard. Thus, implementation of this alternative is not recommended. This recommendation is supported by the long-range recommendation to reconstruct E. Moreland Boulevard to an urban six-lane arterial facility with a reduced vertical roadway grade east of Springdale Road, and the recommended vacation of the Longview Drive access at the E. Moreland Boulevard intersection with Springdale Road.

Two modifications to the Springdale Road extension were analyzed. The first modification involves moving the Springdale Road intersection with E. Moreland Boulevard from its present location to a point about 200 feet west of that location. This would alleviate the westbound vertical roadway grade problem by relocating the intersection on the crest of the vertical curve on E. Moreland Boulevard and permitting the Springdale Road extension to be constructed adjacent to the eastern boundary of the Russ Darrow automobile dealership site. However, this alternative has the disadvantage of further increasing the traffic signal spacing problem since it would place the relocated intersection closer to the existing Main Street traffic signals. Furthermore, under this alternative the relocated intersection would also be closer than the existing intersection to the mid-block accident problem at the Russ Darrow-Westbrook Shopping Center driveways, and a portion of the Westbrook Shopping Center parking lot would need to be removed. Implementation of this alternative is not recommended.

An alternative modification to the Springdale Road extension would close that segment of Main Street between E. Moreland Boulevard and Davidson Road and reroute traffic from Main Street to Davidson Road and the Springdale Road extension. This alternative would solve the existing accident problem at the intersection of E. Moreland Boulevard and Main Street and the traffic signal spacing problem between the Main Street and Springdale Road intersections, while concentrating vehicle conflicts at the Springdale Road intersection. However, this action may be expected to increase vehicle delay, traffic congestion, and westbound left-turn accident problems at the CTH A intersection with E. Moreland Boulevard, as a large portion of the westbound left turns currently made at Main Street may be expected to be diverted to the CTH A intersection. This alternative would not solve the mid-block accident problem identified at the Russ Darrow-Westbrook Shopping Center driveway area, nor the existing westbound vertical roadway grade problem at Springdale Road, without major reconstruction of E. Moreland Boulevard. Implementation of this alternative is not recommended.

Parklawn Drive Extension

The proposed extension of Parklawn Drive from Abbott Drive to CTH JJ may be expected to provide improved access to the industrial and residential development planned for the vacant land in the vicinity of Parklawn Drive south of CTH JJ and north of E. Moreland Boulevard. Construction of the Parklawn Drive extension should serve to decrease the impact of traffic generated by these planned land developments on vehicular operating conditions on Springdale Road, Kossow Road, and CTH JJ. This generated traffic may be expected to increase vehicle conflicts at the intersection of Parklawn Drive and E. Moreland Boulevard, which has been identified as an accident problem location.

Although the installation of traffic signals at the intersection of E. Moreland Boulevard and Parklawn Drive would have the potential to control vehicle conflicts at this intersection, it is unlikely that the traffic volume warrants set forth for such installation in the Manual on Uniform Traffic Control Devices could be met. Traffic signals at this intersection, which is located about 1,100 feet from the Kossow Road intersection and about 2,400 feet from the Main Street intersection with E. Moreland Boulevard, are not in a favorable location to provide for the efficient progression of traffic along E. Moreland Boulevard. In addition, the vertical roadway grade problem on the westbound approach to the Springdale Road intersection creates a problem on the eastbound approach of the Parklawn Drive intersection, which is located at the bottom of the 5.2 percent vertical grade, creating a potential for rear-end collisions with eastbound vehicles required to stop for the traffic signal. Without efficient traffic progression, vehicle travel times and delays may be expected to increase on E. Moreland Boulevard.

Ideally, from a traffic engineering basis, the proposed extension of Parklawn Drive would not be implemented and the Parklawn Drive extension would instead be in the form of a cul-de-sac north of Abbott Drive, with access to the planned land development served by the Parklawn Drive extension provided by Hollidale Drive, Springdale Road, and CTH JJ. However, in order to respond to the eminent nature of the proposed development and platted street status of the proposed Parklawn Drive extension, which precludes the implementation of the traffic engineering proposal, it is recommended that the proposed Parklawn

Drive extension be implemented in accordance with current city agreements. However, the Wisconsin Department of Transportation should monitor traffic conditions at the intersection of Parklawn Drive and Moreland Boulevard to detect and correct any significant increases in motor vehicle accidents that may result from the anticipated increased vehicle conflicts at that intersection.

Paramount Drive Extension

The proposed extension of Paramount Drive from its existing terminus easterly to Avalon Drive may be expected to provide improved access to the existing and planned commercial development adjacent to Paramount Drive. This proposed extension should serve to redistribute traffic from the existing Gateway Drive intersection with E. Moreland Boulevard, thereby reducing delays and vehicle conflicts at that intersection. The extension of Paramount Drive would, however, create new vehicle delays and conflicts at the intersection of E. Moreland Boulevard and Avalon Drive. The proposed intersection of Paramount Drive and E. Moreland Boulevard would be located about 1,700 feet from the CTH A intersection with E. Moreland Boulevard. The installation of traffic signals at this intersection is currently not warranted, and would not be warranted with the extension of Paramount Drive. In order to control vehicle conflicts and minimize their impact on vehicle operating conditions, it is recommended that the proposed extension of Paramount Drive to E. Moreland Boulevard not be implemented and that the Paramount Drive extension instead be in the form of a cul-de-sac in the vicinity of Avalon Drive to provide land access to the planned adjacent commercial development. It is also recommended that the existing Waukesha Datsun automobile dealership be encouraged to relocate its existing driveway westward, opposite the Avalon Drive intersection with E. Moreland Boulevard, and that a shared driveway at that location be used to provide access to both the Waukesha Datsun and the proposed Dodge automobile dealership at that location, thereby controlling access along E. Moreland Boulevard by consolidating vehicle turning movements and providing direct access from the intersection median opening to both developments for east- and westbound traffic.

Traffic Engineering Improvements

In addition to the roadway construction projects recommended as a part of the long-range highway improvement plan for E. Moreland Boulevard, several traffic engineering actions designed to maintain the safe and efficient operation of future vehicular traffic on E. Moreland Boulevard were analyzed. The improvements considered under this analysis included speed limit reductions, traffic signal interconnection, improved street lighting, and turn-lane construction.

As noted previously in this report, reducing the posted speed limit would serve to reduce some accident problems on E. Moreland Boulevard. It was noted, however, that a reduced speed limit may also increase other accident problems along E. Moreland Boulevard, as many drivers may be expected to exceed the posted speed limit, causing vehicle conflicts with those drivers traveling at or below the posted speed. The attainment of operating conditions under which all vehicles travel at about the same speed becomes increasingly important as traffic volumes increase and approach the capacity of a roadway segment. It is envisioned that E. Moreland Boulevard will remain the principal arterial link between the City of Waukesha and the Milwaukee urban area at least through the year 2000. As such, it will be necessary for this facility to continue to serve two conflicting functions: the provision of arterial service for vehicle trips with origins and/or destinations in Waukesha and the rest of the greater Milwaukee area; and the provision of land access for vehicle trips destined to the land uses located adjacent to E. Moreland Boulevard. These are basically incompatible functions and can best be served through the maintenance of the existing posted speed limit and the strict control of land access, including the present practice of utilizing frontage roads to remove land access vehicle conflicts from the arterial traffic system. Therefore, reducing the posted speed limit on E. Moreland Boulevard is not recommended.

As also noted in this report, efficient traffic progression along E. Moreland Boulevard would not be accomplished through the interconnection of traffic signals because of the existing traffic signal spacing and the vertical roadway grade problems. The construction of new intersecting streets with E. Moreland Boulevard to provide a more favorable traffic signal spacing is not recommended herein because of the vertical alignment of E. Moreland Boulevard, and the extensive disruption and relocation of existing land development that would be required. The existing traffic-actuated signal system along E. Moreland Boulevard is providing a very efficient operation, with a high level of service and minimum vehicle delays. This system is expected to continue to provide the level of service necessary to assure satisfactory traffic operation along E. Moreland Boulevard. As indicated in the long-range plan element of this study, the segment of E. Moreland Boulevard from Barker Road to CTH A is recommended to be reconstructed to provide six lanes for vehicle traffic. The increased intersection and mid-block capacity afforded by these additional two lanes should permit the signalized intersections along E. Moreland Boulevard to continue to operate at or better than design levels, even as traffic increases in the corridor. Therefore, the interconnection of the traffic signals along E. Moreland Boulevard is not recommended.

Improved street lighting along E. Moreland Boulevard may be expected to become increasingly important as traffic volumes and vehicle conflicts between arterial and land access travel patterns increase. Improved street lighting through the provision of a continuous lighting system along E. Moreland Boulevard, and in the vicinity of Manhattan Drive and along the segment of E. Moreland Boulevard between Main Street and Springdale Road, should effectively serve to prevent other segments of E. Moreland Boulevard from becoming nighttime accident problem locations. It is therefore recommended that improved street lighting be installed along E. Moreland Boulevard from Barker Road to Manhattan Drive.

Finally, as an integral part of a land access management program, minor roadway improvement projects consisting of left- and right-turn lane channelization at intersection approaches and median openings, as shown in Table 9, should be considered along E. Moreland Boulevard. These improvements would serve to reduce and control the conflict between arterial and land access travel patterns. The implementation of these minor roadway improvements can be undertaken incrementally over time as an integral part of maintenance or reconstruction projects on E. Moreland Boulevard. An engineering analysis of the existing and/or future need for such improvements should be conducted during the planning stage of each maintenance and reconstruction project to assure their cost-effective implementation.

Table 9

RECOMMENDED CHANNELIZATION IMPROVEMENT PROJECTS ON E. MORELAND BOULEVARD FROM BARKER ROAD TO WHITEROCK AVENUE: 1984 THROUGH 2000

Location	Right-Turn Lane		Left-Turn Lane	
	Eastbound	Westbound	Eastbound	Westbound
Kossow Road	X	--	--	--
Parklawn Drive......	--	X	--	X
Springdale Road.....	--	X	--	--
Main Street.........	--	X	--	--
Ramona Road.........	--	X	--	X
Avalon Drive........	--	--	X	X
Jennifer Lane.......	--	--	X	X
Manhattan Drive.....	X	--	--	X

Source: SEWRPC.

ALTERNATIVE E. MORELAND BOULEVARD LAND ACCESS IMPROVEMENTS

Existing land development plans and proposals along E. Moreland Boulevard, as shown on Map 4, include: 1) a movie theater on a parcel of land located north of E. Moreland Boulevard and immediately west of IH 94[1]; 2) industrial and residential development along the segment of Parklawn Drive north of E. Moreland Boulevard; 3) a 12,000-square-foot addition to the Westbrook Shopping Center development; 4) a Dodge automobile dealership adjacent to the south side of E. Moreland Boulevard at Avalon Drive; 5) a Curtis Mathes dealership adjacent to the south side of E. Moreland Boulevard west of Avalon Drive[2]; 6) additional commercial development along Paramount Drive adjacent to the south side of E. Moreland Boulevard; 7) a large retail food store on the southeast corner of E. Moreland Boulevard and Manhatten Drive; and 8) additional residential and light industrial development along the south side of E. Moreland Boulevard between Waukesha Avenue and Manhatten Drive. These planned and proposed developments would utilize almost all of the existing vacant land adjacent to E. Moreland Boulevard except for a parcel of land located south of E. Moreland Boulevard between Barker Road and Kossow Road, and two small parcels of land located adjacent to the north side of E. Moreland Boulevard, one near Parklawn Drive and one near Ramona Road. These developments may be expected to increase traffic volumes and vehicle conflicts along E. Moreland Boulevard.

It is recommended that the site plan for each individual proposed development be carefully reviewed by the City of Waukesha engineering staff prior to the approval of each development to assure that basic roadway access controls are provided to minimize any adverse impact on the operating conditions on E. Moreland Boulevard. Roadway access control should be directed, in general, at: 1) limiting the number of conflict points, 2) separating basic conflict areas, 3) limiting deceleration requirements, and 4) removing turning vehicles or queues from through lanes. The implementation of roadway access controls that accomplish these objectives can serve to substantially reduce traffic accidents and delay. Table 10 summarizes the roadway access control measures that are available to accomplish each of these objectives.

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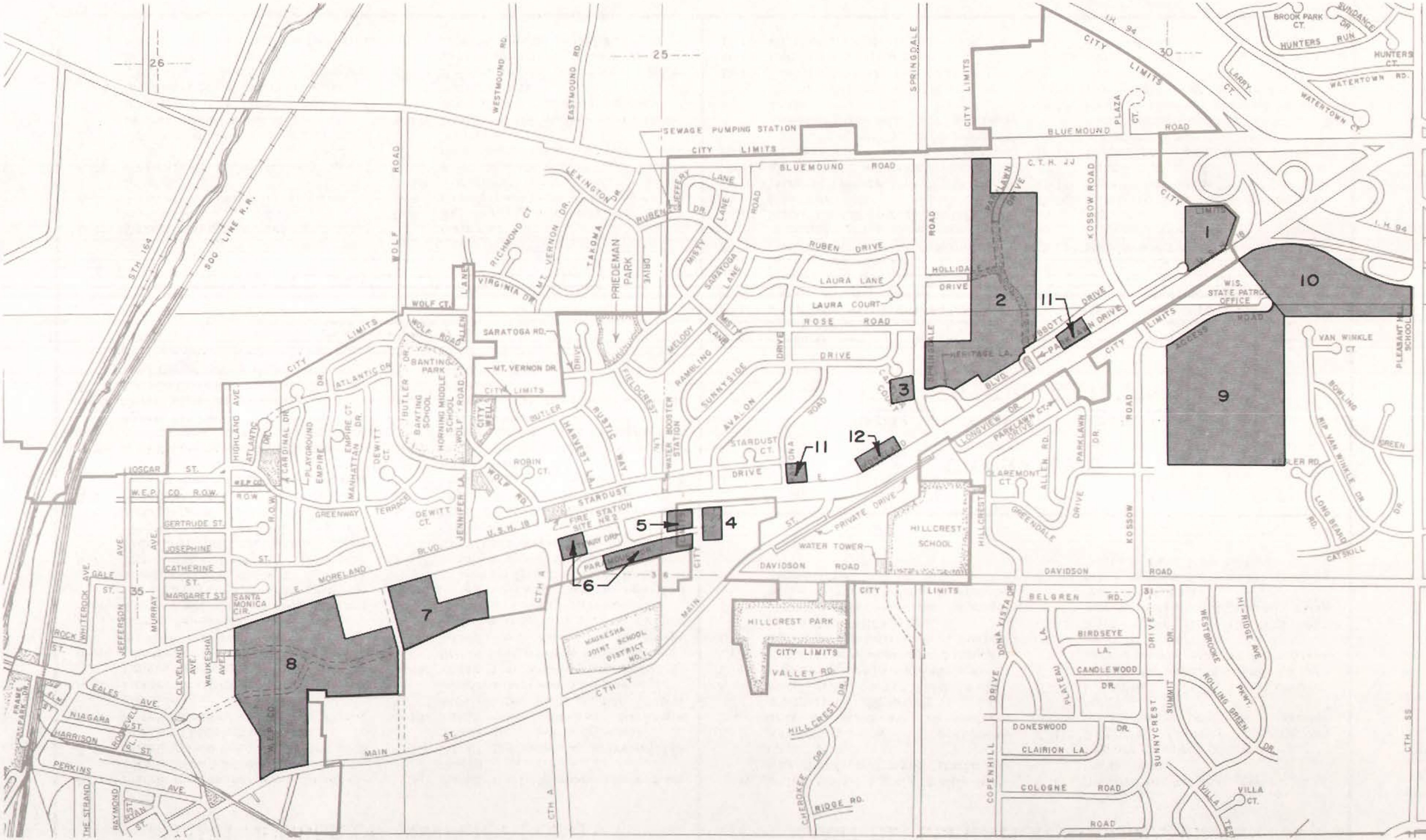
[1]This development was constructed and opened for business during December 1983.

[2]This development was constructed and opened for business early in 1984.

Map 4

PLANNED AND PROPOSED LAND USE DEVELOPMENT FOR EXISTING PARCELS OF VACANT LAND ADJACENT TO E. MORELAND BOULEVARD: 1983



LEGEND

1 WESTOWNE MOVIE THEATER
2 PROPOSED LIGHT INDUSTRIAL AND RESIDENTIAL DEVELOPMENT
3 PLANNED WESTBROOK SHOPPING CENTER ADDITION
4 PROPOSED DODGE AUTOMOBILE DEALERSHIP
5 CURTIS MATHES
6 PLANNED COMMERCIAL DEVELOPMENT
7 PROPOSED SUPER FOOD WAREHOUSE
8 PLANNED LIGHT INDUSTRIAL AND RESIDENTIAL DEVELOPMENT
9 PLANNED RESIDENTIAL DEVELOPMENT
10 PLANNED COMMERCIAL DEVELOPMENT
11 PLANNED COMMERCIAL DEVELOPMENT
12 PROPOSED FAST FOOD AND AND OFFICE BUILDING

GRAPHIC SCALE
0 1000 2000 FEET

Source: City of Waukesha.

Table 10

LAND ACCESS MANAGEMENT TECHNIQUES

CATEGORY A

LIMIT NUMBER OF CONFLICT POINTS

- A.1: Install median barrier with no direct left-turn access
- A-2: Install raised median divider with left-turn deceleration lanes
- A-3: Install one-way operations on the highway
- A-4: Install traffic signal at high-volume driveways
- A-5: Channelize median openings to prevent left-turn ingress and/or egress maneuvers
- A-6: Widen right through lane to limit right-turn encroachment onto the adjacent lane to the left
- A-7: Install channelizing islands to prevent left-turn deceleration lane vehicles from returning to the through lanes
- A-8: Install physical barrier to prevent uncontrolled access along property frontages
- A-9: Install medial channelization to control the merge of left-turn egress vehicles
- A-10: Offset opposing driveways
- A-11: Locate driveway opposite a three-leg intersection or driveway and install traffic signals where warranted
- A-12: Install two one-way driveways in lieu of one two-way driveway
- A-13: Install two two-way driveways with limited turns in lieu of one standard two-way driveway
- A-14: Install two one-way driveways in lieu of two two-way driveways
- A-15: Install two two-way driveways with limited turns in lieu of two standard two-way driveways
- A-16: Install driveway channelizing island to prevent left-turn maneuvers
- A-17: Install driveway channelizing island to prevent driveway encroachment conflicts
- A-18: Install channelizing island to prevent right-turn deceleration lane vehicles from returning to the through lanes
- A-19: Install channelizing island to control the merge area of right-turn egress vehicles
- A-20: Regulate the maximum width of driveways

CATEGORY B

SEPARATE BASIC CONFLICT AREAS

- B-1: Regulate minimum spacing of driveways
- B-2: Regulate minimum corner clearance
- B-3: Regulate minimum property clearance
- B-4: Optimize driveway spacing in the permit authorization stage
- B-5: Regulate maximum number of driveways per property frontage
- B-6: Consolidate access for adjacent properties
- B-7: Require highway damages for extra driveways
- B-8: Buy abutting properties
- B-9: Deny access to small frontage
- B-10: Consolidate existing access whenever separate parcels are assembled under one purpose, plan, entity, or usage
- B-11: Designate the number of driveways regardless of future subdivision of that property
- B-12: Require access on collector street (when available) in lieu of additional driveway on highway

CATEGORY C

LIMIT DECELERATION REQUIREMENTS

- C-1: Install traffic signals to slow highway speeds and meter traffic for larger gaps
- C-2: Restrict parking on the roadway next to driveways to increase driveway turning speeds
- C-3: Install visual cues of the driveway
- C-4: Improve driveway sight distance
- C-5: Regulate minimum sight distance
- C-6: Optimize sight distance in the permit authorization stage
- C-7: Increase the effective approach width of the driveway (horizontal geometrics)
- C-8: Improve the vertical geometrics of the driveway
- C-9: Require driveway paving
- C-10: Regulate driveway construction (performance bond) and maintenance
- C-11: Install right-turn acceleration lane
- C-12: Install channelizing islands to prevent driveway vehicles from backing onto the highway
- C-13: Install channelizing islands to move ingress merge point laterally away from the highway
- C-14: Move sidewalk-driveway crossing laterally away from highway

CATEGORY D

REMOVE TURNING VEHICLES FROM THE THROUGH LANES

- D-1: Install two-way left-turn lane
- D-2: Install continuous left-turn lane
- D-3: Install alternating left-turn lane
- D-4: Install isolated median and deceleration lane to shadow and store left-turning vehicles
- D-5: Install left-turn deceleration lane in lieu of right-angle crossover
- D-6: Install medial storage for left-turn egress vehicles
- D-7: Increase storage capacity of existing left-turn deceleration lane
- D-8: Increase the turning speed of right-angle median crossovers by increasing the effective approach width
- D-9: Install continuous right-turn lane
- D-10: Construct a local service road
- D-11: Construct a bypass road
- D-12: Reroute through traffic
- D-13: Install supplementary one-way right-turn driveways to divided highway (noncapacity warrant)
- D-14: Install supplementary access on collector street when available (noncapacity warrant)
- D-15: Install additional driveway when total driveway demand exceeds capacity
- D-16: Install right-turn deceleration lane
- D-17: Install additional exit lane on driveway
- D-18: Encourage connections between adjacent properties (even when each has highway access)
- D-19: Require two-way driveway operation where internal circulation is not available
- D-20: Require adequate internal design and circulation plan

Source: U. S. Department of Transportation, Federal Highway Administration.

Table 11

SUMMARY OF LONG-RANGE ROADWAY CONSTRUCTION AND RECONSTRUCTION ACTIONS AND TRAFFIC ENGINEERING IMPROVEMENTS CONSIDERED TO ABATE FUTURE TRAFFIC PROBLEMS AND PROVIDE LAND ACCESS TO FUTURE LAND DEVELOPMENT ALONG E. MORELAND BOULEVARD FROM BARKER ROAD TO WHITEROCK AVENUE: 1984-2000

Action	Recommendation
Reconstruct E. Moreland Boulevard Between Barker Road and CTH A to Provide Six Lanes of Traffic.........	Implement with reduced vertical roadway grade at Springdale Road and vacation of Longview Drive intersection with E. Moreland Boulevard at Springdale Road
Manhattan Drive Extension Between E. Moreland Boulevard and Main Street.........................	Implement
Springdale Road Extension Between E. Moreland Boulevard and Davidson Road......................	Do not implement
Parklawn Drive Extension Between Abbott Drive and CTH JJ.................	Implement
Paramount Drive Extension Between Existing Paramount Drive and Avalon Drive..................	Implement with cul-de-sac west of Avalon Drive intersection Relocate Waukesha Datsun driveway to align with Avalon Drive median opening on E. Moreland Boulevard
Reduce Speed Limit on E. Moreland Boulevard...................	Do not implement
Interconnect Traffic Signals Along E. Moreland Boulevard............	Do not implement
Install Street Lighting System Along E. Moreland Boulevard............	Implement
Minor Roadway Improvements: Exclusive Left-Turn Lanes and Right-Turn Acceleration and Deceleration Lanes.....................	Implement as required

Source: SEWRPC.

SUMMARY

Implementation of the roadway construction and reconstruction actions and traffic engineering improvements recommended in the long-range highway improvement plan may be expected to maintain traffic operating conditions at acceptable design levels and to provide the arterial and land access service required by future increases in through traffic and land development along the study segment of E. Moreland Boulevard. As shown in Table 11, a total of 10 long-range highway improvement alternatives were analyzed in this report, with seven alternative actions being recommended for future implementation.

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Chapter V

PLAN IMPLEMENTATION

INTRODUCTION

The recommended short- and long-range highway improvement plans for E. Moreland Boulevard involves the following three distinct but interrelated levels of implementation: 1) implementation of actions on the state trunk highway system under the jurisdiction of the Wisconsin Department of Transportation; 2) implementation of actions on the county trunk highway system under the jurisdiction of the Waukesha County Highway and Transportation Committee; and 3) implementation of actions on the local arterial street and highway system under the jurisdiction of the City of Waukesha. The recommended plan implementation actions are summarized below by level or unit of government concerned.

Wisconsin Department of Transportation

It is recommended, as shown in Table 12, that a total of 14 actions at seven locations be implemented by the Wisconsin Department of Transportation. These 14 actions are composed of 11 short-range plan element actions and three long-range plan element actions.

Waukesha County

It is recommended that Waukesha County, acting through the County Highway and Transportation Committee, assits the Wisconsin Department of Transportation in the interconnection of the traffic signals at the CTH A intersections with E. Moreland Boulevard and Main Street.

City of Waukesha

It is recommended, as shown in Table 12, that a total of eight actions at seven different locations be implemented by the City of Waukesha. These eight actions are comprised of three short-range plan element actions and five long-range plan element actions.

Amendment to the Adopted Transportation System Plan

The Waukesha County Highway and Transportation Committee, on February 2, 1982, requested the Commission staff to review both the functional and jurisdictional recommendations for E. Main Street from N. Hartwell Avenue to E. Moreland Boulevard as contained in the adopted year 2000 long-range transportation system plan. The criteria set forth in the jurisdictional highway system plan for Waukesha County was analyzed and it was found that the facility met criteria for classification as a Type III facility--local trunk highway arterial facility--based on average trip length, land use service, arterial spacing, traffic mobility, and control of access--and met trip criteria for classification as a Type I facility--state trunk highway facility--based on traffic volume. Accordingly, it was recommended by the Technical Coordinating

Table 12

TRAFFIC MANAGEMENT AND ROADWAY CONSTRUCTION ACTIONS RECOMMENDED TO BE IMPLEMENTED BY THE WISCONSIN DEPARTMENT OF TRANSPORTATION, WAUKESHA COUNTY, AND THE CITY OF WAUKESHA ON E. MORELAND BOULEVARD FROM BARKER ROAD TO WHITEROCK AVENUE: 1984-2000

Location	Recommended Action	Plan Element	Implementing Agency
Barker Road to CTH A	● Reconstruct to provide six lanes of traffic........................	Long range	Wisconsin Department of Transportation
Barker Road to Manhattan Drive	● Install street lighting system..........	Long range	City of Waukesha
	● Construct minor roadway improvements .... (exclusive left- and right-turn lanes)...	Long range	Wisconsin Department of Transportation
Kossow Road and E. Moreland Boulevard	● Relocate north frontage road on east side of intersection to a new locations between the Marine Bank and Target Department Store developments.....	Short range	City of Waukesha
Parklawn Drive and E. Moreland Boulevard	● Construct extension from CTH JJ to Abbott Drive..................	Long range	City of Waukesha
Springdale Road and E. Moreland Boulevard	● Reconstruct eastbound left-turn lane as an offset, channelized, exclusive turn lane......................	Short range	Wisconsin Department of Transportation
	● Install south-to-eastbound left-turn pavement marking guideline..........	Short range	Wisconsin Department of Transportation
	● Channelize southbound left-turn lane through E. Moreland Boulevard median........................	Short range	Wisconsin Department of Transportation
	● Construct median opening at eastern intersection of Longview Drive and E. Moreland Boulevard..........	Short range	Wisconsin Department of Transportation
	● Vacate western Longview Drive intersection with E. Moreland Boulevard and Springdale Road............	Long range	City of Waukesha
Springdale Road to Main Street	● Upgrade street lighting	Short range	City of Waukesha
	● Relocate Westbrook Shopping center driveway to Main Street intersection with E. Moreland Boulevard	Short range	Wisconsin Department of Transportation
	● Vacate Westbrook Shopping Center driveway west of Main Street.............	Short range	Wisconsin Department of Transportation
Main Street and E. Moreland Boulevard	● Modify traffic signals to a three-phase design with northbound right-turn control............	Short range	Wisconsin Department of Transportation
Paramount Drive	● Construct extension eastward to a cul-de-sac west of Avalon Drive intersection..........................	Long range	City of Waukesha
	● Relocate Waukesha Datsun driveway to align with Avalon Drive median opening on E. Moreland Boulevard.........	Long range	Wisconsin Department of Transportation

Table 12 (continued)

Location	Recommended Action	Plan Element	Implementing Agency
CTH A and E. Moreland Boulevard	● Modify traffic signal sequence...........	Short range	Wisconsin Department of Transportation
	● Reconstruct and channelize the west-to-southbound double left-turn lane......	Short range	Wisconsin Department of Transportation
	● Offset the east-to-northbound left-turn..............................	Short range	Wisconsin Department of Transportation
	● Interconnect traffic signals at CTH A intersections with E. Moreland Boulevard and Main Street................	Short range	Wisconsin Department of Transportation
Manhattan Drive and E. Moreland	● Upgrade street lighting..................	Short range	City of Waukesha
	● Construct extension from E. Moreland Boulevard to Main Street.................	Long range	City of Waukesha

Source: SEWRPC.

and Advisory Committee on Jurisdictional Highway Planning for Waukesha County that E. Main Street from N. Hartwell Avenue to E. Moreland Boulevard be added to the planned arterial street and highway system as a Type III facility.

This action would not result in any actions that would change the quantity or nature of traffic operating on E. Main Street. Therefore, it is recommended that:

1. The Regional Planning Commission act to amend the adopted transportation system plan, adding this segment of E. Main Street to the long-range plan.

2. The Waukesha County Board of Supervisors amend the adopted long-range transportation system plan by adding this segment of E. Main Street to the long-range system plan.

3. This segment of E. Main Street be jurisdictionally classified as a local trunk arterial facility.

SUMMARY

Three different levels or units of government were identified as being responsible for implementation of the actions recommended in the short- and long-range highway improvement plan for E. Moreland Boulevard. In total, 14 actions are proposed to be implemented by the Wisconsin Department of Transportation, one action is proposed to be implemented by Waukesha County in cooperation with the Wisconsin Department of Transportation, and eight actions are proposed to be implemented by the City of Waukesha.

It is also recommended, based upon a review of the long-range functional and jurisdictional classifications of the segment of E. Main Street from N. Hartwell Avenue to E. Moreland Boulevard, that both the Waukesha County Board of Supervisors and the Regional Planning Commission act to amend the adopted year 2000 long-range transportation system plan to classify this segment of E. Main Street as a local trunk arterial facility.

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Chapter VI

SUMMARY AND CONCLUSIONS

INTRODUCTION

Because of concern expressed by local elected officials and residents of the City of Waukesha over the increasing traffic volumes and vehicle conflicts along the segment of E. Moreland Boulevard between Barker Road and Whiterock Avenue, the Common Council of the City of Waukesha requested the assistance of the Southeastern Wisconsin Regional Planning Commission in the conduct of a traffic management plan for the corridor.

Based upon the need to abate existing and probable future traffic problems along the study segment of E. Moreland Boulevard, the plan was designed with a short-range and a long-range element. The short-range plan element recommends relatively low capital-cost traffic engineering improvements to resolve existing traffic conflict and accident problems, while the long-range plan element recommends higher capital-cost roadway improvements to serve probable future traffic volumes efficiently and safely.

SHORT-RANGE HIGHWAY IMPROVEMENT PLAN

The short-range highway improvement plan element for E. Moreland Boulevard recommends traffic management actions designed to solve existing traffic congestion and accident problems identified through the inventory and analysis of data on existing traffic operating conditions. The actions considered in the short-range plan consist primarily of low-cost traffic engineering improvements such as traffic control device modifications, speed limits and turn restrictions, and isolated roadway improvements.

Existing Conditions

It is only through the careful, detailed analysis of the existing arterial street and highway system, and particularly of those factors directly affecting the operation of that system, that the deficiencies of that system and the causes of those deficiencies can be identified. Alternative actions can then be designed and evaluated to determine the most effective means of correcting those deficiencies. To facilitate the necessary analysis, information on vehicular traffic volumes, traffic operating conditions, and motor vehicle accidents was collected. Information was also gathered on existing traffic controls, roadway geometrics, and land development.

The highest traffic volumes on the study segment of E. Moreland Boulevard were found to occur east of Kossow Road at 32,100 vehicles per average weekday; with the lowest volumes occurring on the study segment west of CTH A at 20,300 vehicles per average weekday. Since 1970 these traffic volumes have been steadily increasing at a rate of about 3.5 percent per year. The morning peak hour was found to occur between 7:00 a.m. and 8:00 a.m., and to comprise about 6 percent of the average weekday traffic volume. The mid-day traffic during the noon to 1:00 p.m. time period was found to comprise about 7 percent of the average weekday traffic volume. The evening peak hour was found to occur between 4:00 p.m. and 5:00 p.m. and between 5:00 p.m. and 6:00 p.m., with both time periods comprising about 8.5 percent of the average weekday volume. Heavy-duty trucks were found to comprise between 3 and 5 percent of the hourly traffic volumes on E. Moreland Boulevard.

High left-turn volumes were found to occur on E. Moreland Boulevard at the eastbound approaches to Springdale Road, Kossow Road, and Barker Road, and at the westbound approaches to CTH A and Main Street, ranging from 170 to 486 vehicles per hour. High left-turn volumes were also found to occur on the northbound approach of Barker Road and the southbound approaches of Kossow Road and Barker Road, ranging from 156 to 294 vehicles per hour. High right-turn volumes were found to occur on E. Moreland Boulevard at the eastbound approach to Barker Road and at the westbound approach to Kossow Road, ranging from 162 to 243 vehicles per hour. High right-turn volumes were also found to occur on the northbound approaches of CTH A and Main Street, and the southbound approaches of Springdale Road, Kossow Road, and Barker Road, ranging from 173 to 416 vehicles per hour.

Indicators of street system operating conditions include average travel speed, intersection delay, and traffic accidents. Based upon intersection delay measurements taken during the evening peak period, the westbound left turn on E. Moreland Boulevard at Whiterock Avenue, the southbound right turn on Springdale Road, and the northbound left turn on Main Street were all found to be operating below (worse than) design capacity, with delays averaging between 31.9 and 37.2 seconds per vehicle. The southbound combined left-turn and through movement on Kossow Road; the southbound left turn on Springdale Road; the combined southbound left-turn, through, and right-turn movement on Wolf Road; and the northbound combined left-turn and through movement on CTH A were all found to be operating at design capacity, with delays averaging between 20.4 and 28.8 seconds per vehicle.

Based upon vehicular operating speed measurements, average travel speeds on the 45 mph-posted segment of E. Moreland Boulevard between Barker Road and CTH A were found to range from 40 to 44 mph during the mid-day period, and from 37 to 44 mph during the evening peak period. Average travel speeds on the 35 mph-posted segment of E. Moreland Boulevard between CTH A and the Manhattan Drive area were found to range from 30 to 34 mph during both the mid-day and evening peak periods; and on the 25 mph-posted segment between Manhattan Drive and Whiterock Avenue, from 17 to 21 mph during both the mid-day and evening peak periods.

A total of 146 traffic accidents occurred on E. Moreland Boulevard in 1980, 121 accidents in 1981, and 112 accidents in 1982. Of these 379 accidents, 333 accidents, or 88 percent, occurred at street and highway intersections. There was one fatal accident reported in 1980, with no fatal accidents reported in 1981 or 1982. A total of 269 of the accidents, or 71 percent, resulted in property damage only, with the remaining 109 accidents involving personal injuries. A total of seven locations experienced a minimum of at least four accidents in 1982, or averaged at least four accidents during the three-year period from 1980 through 1982. These seven high-accident locations are the intersections of E. Moreland Boulevard with Kossow Road, 54 accidents; Parklawn Drive, 10 accidents; Springdale Road, 44 accidents; Main Street, 65 accidents;

CTH A, 83 accidents; Manhattan Drive, 18 accidents; and the mid-block segment between Springdale Road and Main Street, 12 accidents, accounting for a total of 286 accidents, or about 75 percent of the total accidents on E. Moreland Boulevard during this time period. Annual accident rates at the six high-frequency accident locations were found to range from 0.42 to 0.32 accident per hundred million vehicles entering the intersection.

Recommended Traffic Management Actions

Several alternative traffic management actions designed to solve or mitigate the existing problems identified on the study segment of E. Moreland Boulevard were evaluated. The alternative actions recommended for implementation, as presented below, were those judged to provide the most improvement in the level of overall transportation service at the least cost.

It is recommended that at the Kossow Road intersection, the existing access road to the Westown Theater be vacated and a new access road be constructed between the existing Marine Bank and Target Department Store development.

It is recommended that at the Springdale Road intersection, a south-to-eastbound left-turn pavement marking guideline be placed; the south-to-eastbound left-turn movement be channelized through the E. Moreland Boulevard median opening; the existing eastbound left-turn lane be reconstructed as an offset, channelized left-turn lane to reduce and control vehicle conflicts and improve driver sight distance; the Longview Drive intersection with Springdale Road and E. Moreland Boulevard be vacated; and a new median opening be constructed opposite the east intersection of Longview Drive with E. Moreland Boulevard.

It is recommended that the two existing Westbrook Shopping Center driveways on E. Moreland Boulevard be vacated, that a new driveway be constructed at the Main Street intersection, and that street lighting be improved between Springdale Road and Main Street.

It is recommended that at the CTH A intersection, the west-to-southbound left-turn arrow be changed to a protected-only operation; the northbound right-turn green arrow be timed to coincide with the protected westbound left-turn arrow; the traffic signals be interconnected with the signals at the CTH A intersection with Main Street; the west-to-southbound double left-turn lane be channelized; and the east-to-northbound left-turn lane be offset within the roadway median.

Finally, it is recommended that the street lighting along E. Moreland Boulevard in the vicinity of Manhattan Drive be improved.

The total investment, in 1984 dollars, required to implement these low-cost, short-range actions is estimated at $105,600.

LONG-RANGE IMPROVEMENT PLAN

The long-range highway improvement plan element for E. Moreland Boulevard recommends major roadway construction and reconstruction and attendant traffic engineering improvements which will maintain future traffic operations at acceptable design-capacity levels as land development along, and traffic volumes on, E. Moreland Boulevard continue to increase. Based upon projections of future traffic volumes and land development, the plan recommends an improved roadway cross-section for E. Moreland Boulevard and for the arterial streets and highways crossing E. Moreland Boulevard, modified local street access to E. Moreland Boulevard, and attendant traffic engineering improvements.

Future Roadway Cross-Section

Traffic volumes on E. Moreland Boulevard have increased steadily since 1970 at an annual rate of about 3.5 percent, resulting in a 1983 volume of 32,100 vehicles per average weekday east of Kossow Road. This annual growth rate is expected to decline to about 1 percent as the amount of developable vacant land in the E. Moreland Boulevard corridor declines over the next two decades. This would result in a year 2000 traffic volume on E. Moreland Boulevard of between 24,000 and 40,000 vehicles per average weekday. Even at this lower growth rate, traffic may be expected to experience severe congestion with extensive vehicle delays on E. Moreland Boulevard in the absence of roadway capacity expansion. In addition, average travel speeds may be expected to be lower than existing travel speeds and motor vehicle accidents may be expected to increase because of the increased conflict between through traffic and traffic attracted to the new and existing land development adjacent to E. Moreland Boulevard.

Based upon analyses of existing operating conditions, recommended short-range traffic management actions, traffic volume forecasts, and land development proposals in the corridor, it may be concluded that six lanes need to be provided for moving traffic between Barker Road and CTH A, and four lanes need to be provided for moving traffic between CTH A and Whiterock Avenue. This need for future roadway improvements reaffirms the recommendations contained in the year 2000 long-range transportation system plan prepared by the Regional Planning Commission. The existing roadway design capacities may be expected to be exceeded before the year 1990 on the segment of E. Moreland Boulevard between Barker Road and CTH A. The improvement of this roadway segment from a rural four-lane to an urban six-lane facility should provide the necessary capacity to accommodate the projected increases in traffic volume and expected conflicts between through and local traffic attracted to the intensively developed commercial and retail land development ajacent to E. Moreland Boulevard. Reconstruction to six lanes would also permit a reduction in the vertical roadway grade on E. Moreland Boulevard in the vicinity of Springdale Road, which may be expected to improve vehicular operating conditions, reduce motor vehicle accident problems, and allow the future signalization of that intersection. A reduction in roadway grade would require the vacation of a portion of Longview Drive at its intersection with E. Moreland Boulevard and Springdale Road. The roadway segment between Manhattan Drive and Whiterock Avenue is scheduled to be reconstructed to four lanes in 1984 and should adequately serve the projected traffic demand on that segment of E. Moreland Boulevard to the turn of the century.

In addition to analyzing the impact of future traffic volumes on E. Moreland Boulevard, it was necessary to analyze the impact of traffic volumes on those arterial streets that intersect E. Moreland Boulevard. Increases in traffic volumes on the streets that intersect E. Moreland Boulevard directly impact the vehicle conflicts and operating conditions on all approaches to each intersection. Traffic volumes on those arterial streets intersecting the study segment of E. Moreland Boulevard have increased steadily since 1970 at an annual rate of about 6.2 percent, somewhat greater than the traffic growth rate on E. Moreland Boulevard. Depending, however, upon the arterial facility concerned, the traffic growth rate on these intersecting arterial streets may be expected to decline to between 1 and 3.5 percent per year. With the exception of Barker Road, all of the arterial streets intersecting E. Moreland Boulevard have already been improved to accommodate existing and projected traffic volumes within their design capacity. Barker Road has been improved at its intersection with E. Moreland Boulevard to adequately accommodate traffic demand through that intersection. In order to provide sufficient capacity to serve projected increases in traffic on Barker Road, it is recommended that Barker Road be reconstructed by the year 2000 to provide four lanes for traffic from its improved intersection with E. Moreland Boulevard to W. North Avenue.

Alternative Intersecting Roadway Improvements

Several new roadway construction projects were analyzed in the study to identify their potential impact on vehicular safety and operating conditions on E. Moreland Boulevard. These proposed roadway construction projects consisted of: 1) the extension of Manhattan Drive from E. Moreland Boulevard to Main Street, 2) the extension of Springdale Road from E. Moreland Boulevard to Davidson Road, 3) the extension of Parklawn Drive from Abbott Drive to CTH JJ, and 4) the extension of Paramount Drive easterly to the intersection of Avalon Drive and E. Moreland Boulevard.

Based upon an analysis of each proposed roadway construction improvement, it is recommended that the Manhattan Drive extension be constructed to provide access to the proposed large food retailing development, to provide traffic service to the proposed residential and light industrial development located between Manhattan Drive and Waukesha Avenue, and to abate vehicle conflict problems at the intersection of Manhattan Drive and E. Moreland Boulevard.

Implementation of the Springdale Road extension between E. Moreland Boulevard and Davidson Road is not recommended because of the increased vehicle conflict amd delay that would result, and because of the adverse safety impact the extension would have on the intersection of Springdale Road with E. Moreland Boulevard. Two modifications to the Springdale Road extension proposal were considered: 1) moving the Springdale Road intersection to a location about 200 feet west of its present location; and 2) closing the segment of Main Street between E. Moreland Boulevard and Davidson Road, with traffic rerouted from Main Street to Davidson Road on the proposed Springdale Road extension. Neither of these two alternatives is recommended to be implemented.

Implementation of the Parklawn Drive extension between Abbott Drive and CTH JJ is recommended because of the eminent nature of the proposed development and platted street status of Parklawn Drive. It is also recommended that the Wisconsin Department of Transportation monitor traffic conditions at the intersection of Parklawn Drive and E. Moreland Boulevard to detect and correct any significant increases in motor vehicle accidents.

Implementation of the Paramount Drive extension from its existing terminus easterly to Avalon Drive is not recommended because of the need to control traffic conflicts along E. Moreland Boulevard. It is recommended instead that the extension of Paramount Drive be in the form of a cul-de-sac short of its intersection with E. Moreland Boulevard and Avalon Drive, and that the existing Waukesha Datsun automobile dealership be encouraged to relocate its existing driveway opposite Avalon Drive and that a shared driveway at that location be used to provide access to both the Waukesha Datsun and the adjacent proposed Dodge automobile dealerships, thereby controlling vehicle conflicts along E. Moreland Boulevard and utilizing the existing median opening at that location to provide direct access to both developments.

Traffic Engineering Improvements

Several traffic engineering actions designed to maintain the safe and efficient operation of travel on E. Moreland Boulevard were analyzed in the study. These traffic engineering improvements consisted of speed limit reductions, traffic signal interconnection, improved street lighting, and the construction of exclusive turn lanes.

The posted speed limit on E. Moreland Boulevard is not recommended to be lowered to accommodate future traffic volumes. East Moreland Boulevard has been designated in the year 2000 long-range transportation system plan to remain as the principal arterial street between Waukesha and the Milwaukee urban area, and as such it will be required to serve both through and local traffic in a safe and efficient manner. A reduction in the posted speed limit would not meet this transportation service requirement because many drivers may be expected to exceed the posted speed limit, thereby causing vehicle conflict problems with other drivers who are traveling at or below the posted speed.

It is not recommended to interconnect the traffic signals along the study segment of E. Moreland Boulevard. Efficient traffic progression on E. Moreland Boulevard would not be successfully achieved because of the unfavorable traffic signal/arterial street spacing and vertical roadway grades. The existing traffic-actuated signal system should be able to continue to provide an efficient, high level of service under future traffic demand.

It is recommended that street lighting be improved along E. Moreland Boulevard. The need for a continuous lighting system may be expected to become increasingly important as future traffic volumes and vehicle conflicts between arterial and land access travel patterns increase.

It is also recommended that a minor roadway improvement program of left-turn channelization at intersections and median openings and right-turn deceleration and acceleration lanes be considered with all future roadway improvement projects undertaken along E. Moreland Boulevard, both to reduce and control increasing vehicle conflicts and to improve traffic flow.

Alternative E. Moreland Boulevard Land Access Improvement

A total of eight new land development plans are proposed or are currently under implementation along E. Moreland Boulevard. These plans include: 1) the Westown Movie Theater at the Kossow Road intersection; 2) industrial and residential development north of the Parklawn Drive intersection; 3) a 12,000-square-foot addition to the Westbrook Shopping Center at the Springdale Road

Table 13

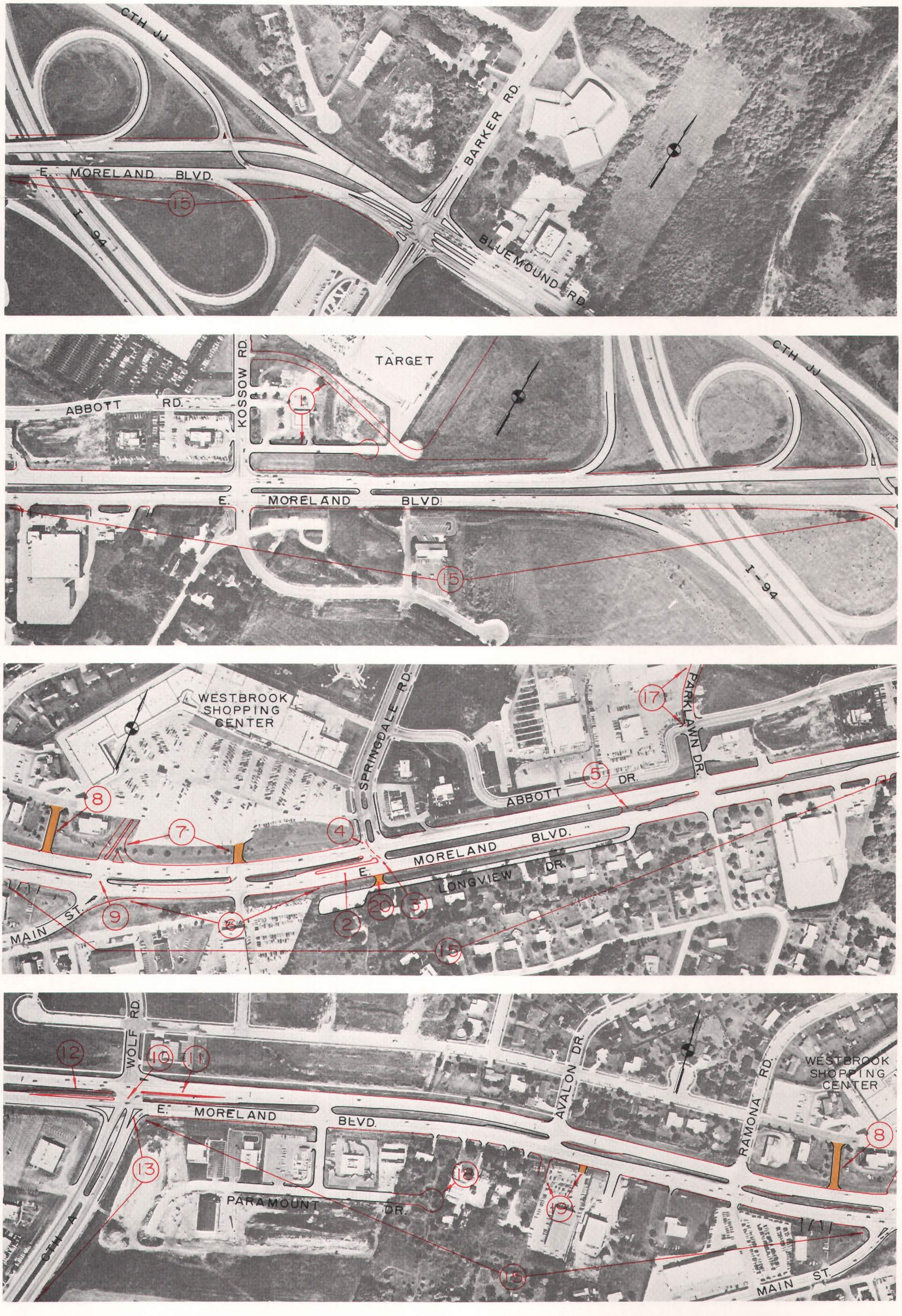
SUMMARY OF TRAFFIC MANAGEMENT AND ROADWAY CONSTRUCTION ACTIONS RECOMMENDED TO SOLVE EXISTING AND FUTURE TRAFFIC PROBLEMS ON E. MORELAND BOULEVARD FROM BARKER ROAD TO WHITEROCK AVENUE: 1984 THROUGH 2000

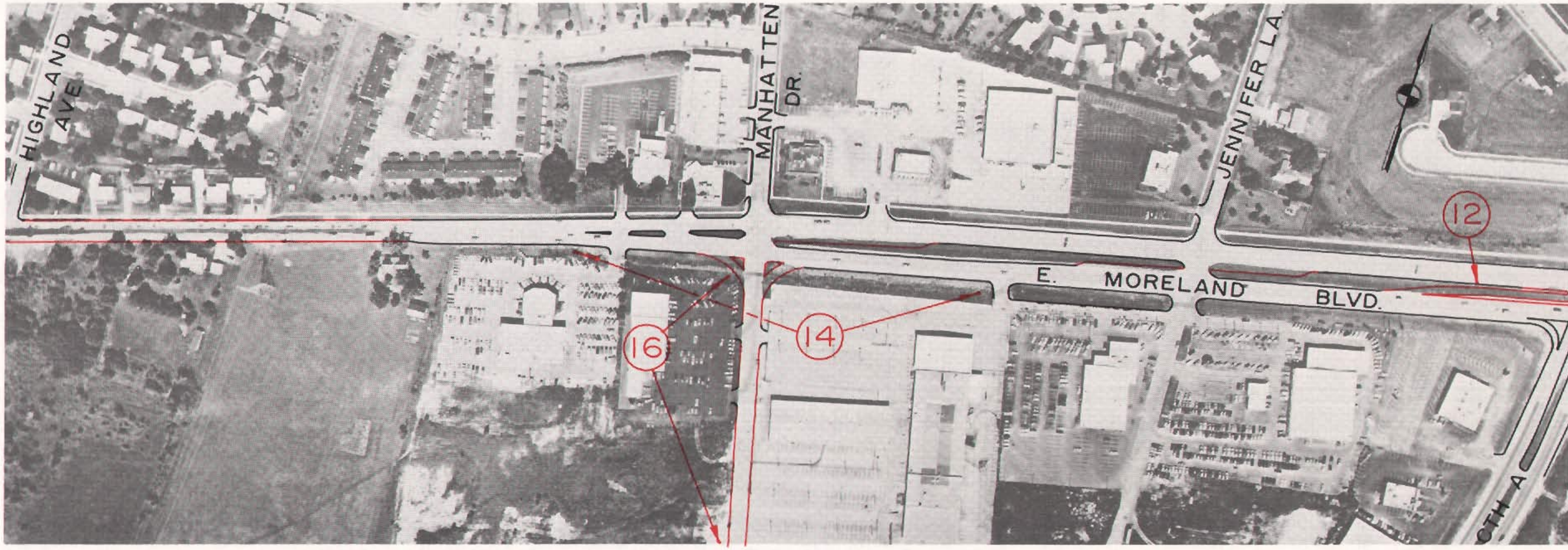
Location	Recommendation	Number on Figure 7
<u>Short-Range Plan</u> Kossow Road and E. Moreland Boulevard	● Relocate north frontage road east of intersection to a new location between the Marine Bank and Target Department Store developments	1
Springdale Road and E. Moreland Boulevard	● Reconstruct eastbound left-turn lane as an offset, channelized, exclusive turn lane	2
	● Channelize southbound left-turn movement through median	3
	● Install south-to-eastbound left-turn pavement marking guideline	4
	● Construct median opening at eastern intersection of Longview Drive and E. Moreland Boulevard	5
Springdale Road to Main Street	● Upgrade street lighting	6
	● Relocate Westbrook Shopping Center driveway to Main Street intersection with E. Moreland Boulevard	7
	● Vacate Westbrook Shopping Center driveway west of Main Street	8
Main Street and E. Moreland Boulevard	● Modify traffic signals to a three-phase design with northbound right-turn control	9
CTH A and E. Moreland Boulevard	● Modify traffic signal sequence	10
	● Channelize westbound exclusive double left-turn lanes	11
	● Offset eastbound left-turn lane	12
	● Interconnect traffic signals at CTH A intersections with E. Moreland Boulevard and Main Street	13
Manhattan Drive and E. Moreland Boulevard	● Upgrade street lighting	14
<u>Long-Range Plan</u> Barker Road to CTH A	● Reconstruct to provide six lanes of traffic	15
Manhattan Drive	● Construct extension from E. Moreland Boulevard to Main Street	16
Parklawn Drive	● Construct extension from CTH JJ to Abbott Drive	17
Paramount Drive	● Construct extension eastward to a cul-de-sac west of Avalon Drive intersection with E. Moreland Boulevard	18
	● Relocate Waukesha Datsun driveway to align with Avalon Drive median opening on E. Moreland Boulevard	19
Springdale Road and E. Moreland Boulevard	● Vacate portion of Longview Drive at intersection of Springdale Road and E. Moreland Boulevard	20
Barker Road to Manhattan	● Install street lighting system	--
	● Construct minor roadway improvements (exclusive left-turn lanes and right-turn acceleration/deceleration lanes) as required	--

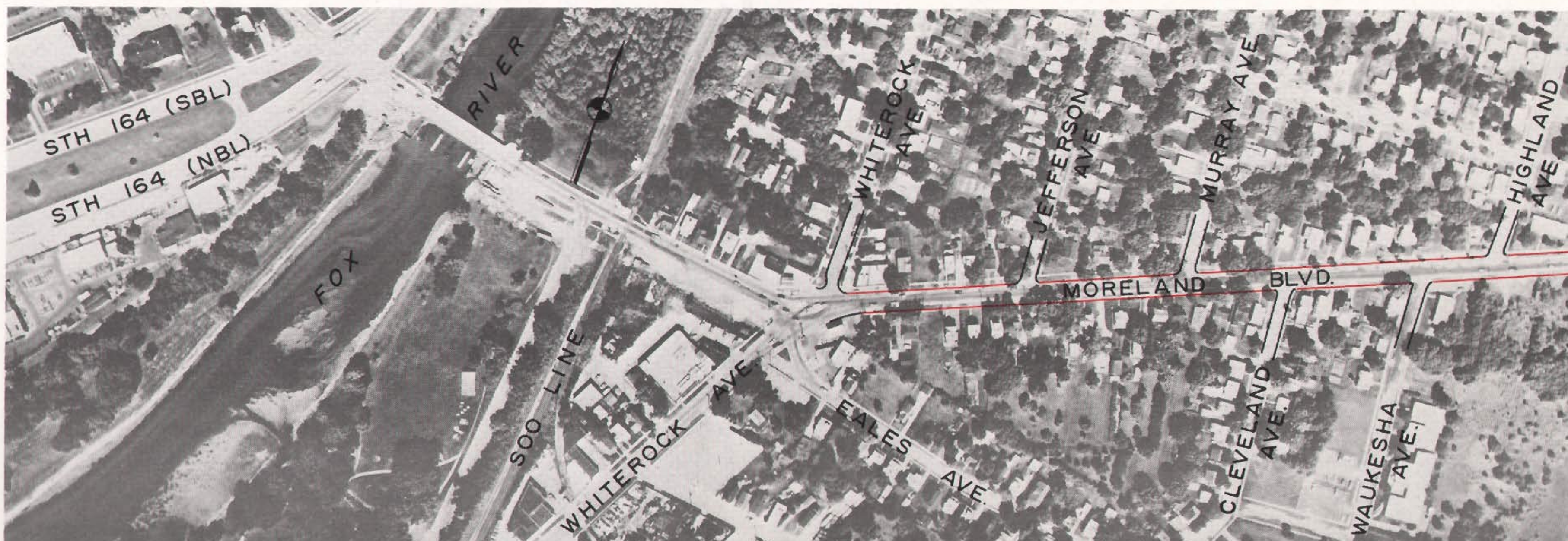
Source: SEWRPC.

Figure 7

LOCATIONS OF TRAFFIC MANAGEMENT AND ROADWAY CONSTRUCTION ACTIONS RECOMMENDED TO SOLVE EXISTING AND FUTURE TRAFFIC PROBLEMS ON E. MORELAND BOULEVARD FROM BARKER ROAD TO WHITEROCK AVENUE: 1984 THROUGH 2000







LEGEND

EXISTING ROADWAY

NEW OR WIDENED ROADWAY

CLOSED ROADWAY

8 RECOMMENDED IMPROVEMENT NUMBER (SEE TABLE 13)

GRAPHIC SCALE

0 200 400 FEET

intersection; 4) a Dodge automobile dealership at the Avalon Drive intersection; 5) a Curtis Mathes dealership west of the Avalon Drive intersection; 6) a commercial development along Paramount Drive east of CTH A; 7) a large retail food store at the Manhattan Drive intersection; and 8) residential and commercial development west of Manhattan Drive. These developments may be expected to utilize almost all of the vacant land adjacent to E. Moreland Boulevard, and will result in increased traffic volumes and vehicle conflicts along E. Moreland Boulevard. It is therefore recommended that, prior to approving the preliminary site plan for each development, the City of Waukesha analyze the traffic impact of each proposal with the objective of limiting the number of vehicle conflict points, separating basic vehicle conflict areas, reducing vehicle deceleration requirements, and removing turning vehicles and queues from E. Moreland Boulevard. The implementation of roadway access control measures that accomplish these objectives at each new land development along E. Moreland Boulevard should serve to minimize accidents and traffic delay attributable to vehicle traffic generated by the developments.

SUMMARY

Implementation of the short- and long-range highway improvement plans recommended in this study should serve to improve existing and maintain future operating conditions and safety along the study segment of E. Moreland Boulevard. The short-range plan identifies existing traffic problems and recommends a set of 15 traffic management actions designed to solve or abate those problems, emphasizing low-capital, short-range solutions. The long-range plan analyzes future travel demand increases on E. Moreland Boulevard and the arterial streets that intersect it. The plan recommends a set of eight long-range roadway construction and traffic engineering actions designed to serve future travel needs in a safe and efficient manner. A total of 14 recommended actions are to be implemented by the Wisconsin Department of Transportation, one action is to be implemented by Waukesha County through the Highway and Transportation Committee in cooperation with the Wisconsin Department of Transportation, and eight actions are to be implemented by the City of Waukesha. In addition, it is recommended that the Southeastern Wisconsin Regional Planning Commission and Waukesha County both act to amend the adopted transportation system plan by adding the segment of E. Main Street from N. Hartwell Avenue to E. Moreland Boulevard to the long-range transportation system plan and that this segment be jurisdictionally classified as a local trunk arterial facility. The short- and long-range management and roadway construction actions recommended for E. Moreland Boulevard are listed in Table 13 and keyed to Figure 7. Action taken now will eliminate, or at least ameliorate, the impact on existing operating conditions of traffic generated by planned and proposed land development along E. Moreland Boulevard, and will provide the direction required to meet future through and local travel demand on E. Moreland Boulevard.

APPENDICES

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Appendix A

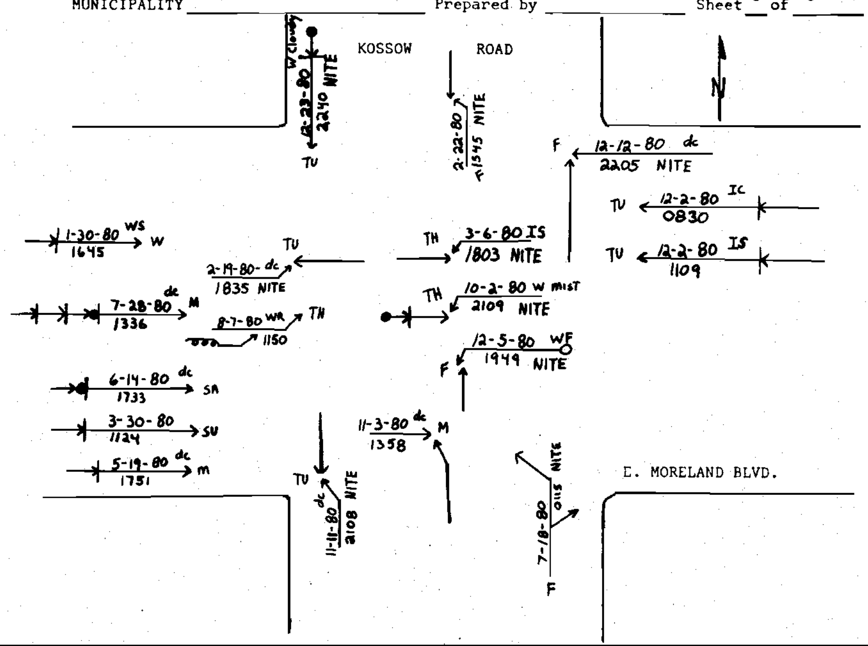
MOTOR VEHICLE COLLISION DIAGRAMS

COLLISION DIAGRAM
Southeastern Wisconsin Regional Planning Commission

INTERSECTION E. MORELAND BLVD. and KOSSOW ROAD

PERIOD THREE YEAR From JAN. 1980 To JAN. 1981

MUNICIPALITY WAUKESHA Prepared by SEWRPC Sheet 1 of 3



SHOW FOR EACH ACCIDENT	LEGEND: SYMBOLS	LEGEND: TYPES OF COLLISION
1. Time, Day, & Date.	Moving vehicle	Rear end
2. Pavement: D= Dry; I= Icy; W= Wet.	Backing vehicle	Head on
3. Weather: C= Clear; F= Fog; R= Rain; SL= Sleet S= Snow	Non- involed vehicle	Side Swipe
4. Nite- if between dusk and dawn.	Pedestrian	Out of control
	Parked vehicle	Left turn
	Fixed object	Right angle
	Fatal accident	
	Injury accident	

SUMMARY

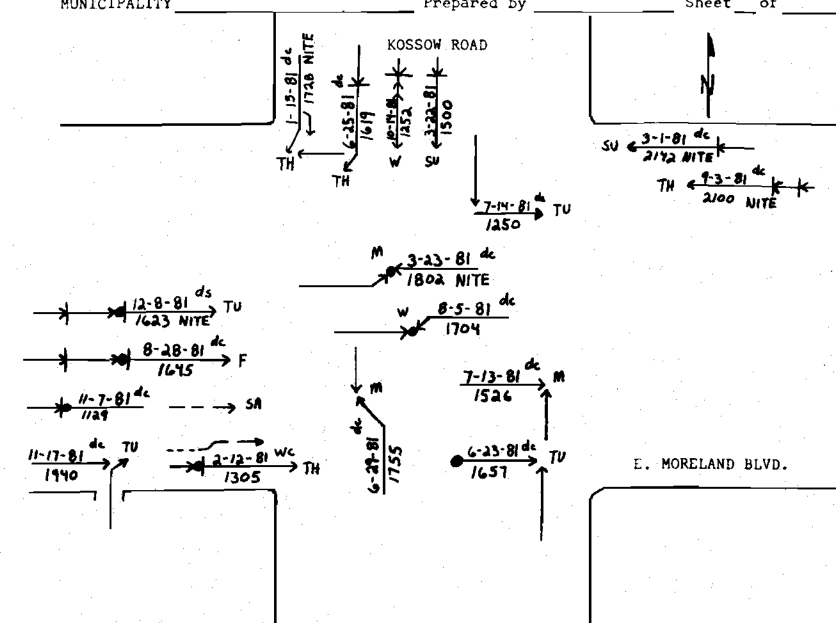
TYPE	DAY	NIGHT	TOTAL
Fatal			
Ped. Injury			
Other Injury	2	3	5
Prop. Damage Only	7	6	13
Total	9	9	18

COLLISION DIAGRAM
Southeastern Wisconsin Regional Planning Commission

INTERSECTION E. MORELAND BLVD. and KOSSOW ROAD

PERIOD THREE YEARS From JAN. 1981 To JAN. 1982

MUNICIPALITY WAUKESHA Prepared by SEWRPC Sheet 2 of 3



SHOW FOR EACH ACCIDENT	LEGEND: SYMBOLS	LEGEND: TYPES OF COLLISION
1. Time, Day, & Date.	Moving vehicle	Rear end
2. Pavement: D= Dry; I= Icy; W= Wet.	Backing vehicle	Head on
3. Weather: C= Clear; F= Fog; R= Rain; SL= Sleet S= Snow	Non- involed vehicle	Side Swipe
4. Nite- if between dusk and dawn.	Pedestrian	Out of control
	Parked vehicle	Left turn
	Fixed object	Right angle
	Fatal accident	
	Injury accident	

SUMMARY

TYPE	DAY	NIGHT	TOTAL
Fatal			
Ped. Injury			
Other Injury	5	2	7
Prop. Damage Only	7	3	10
Total	12	5	17

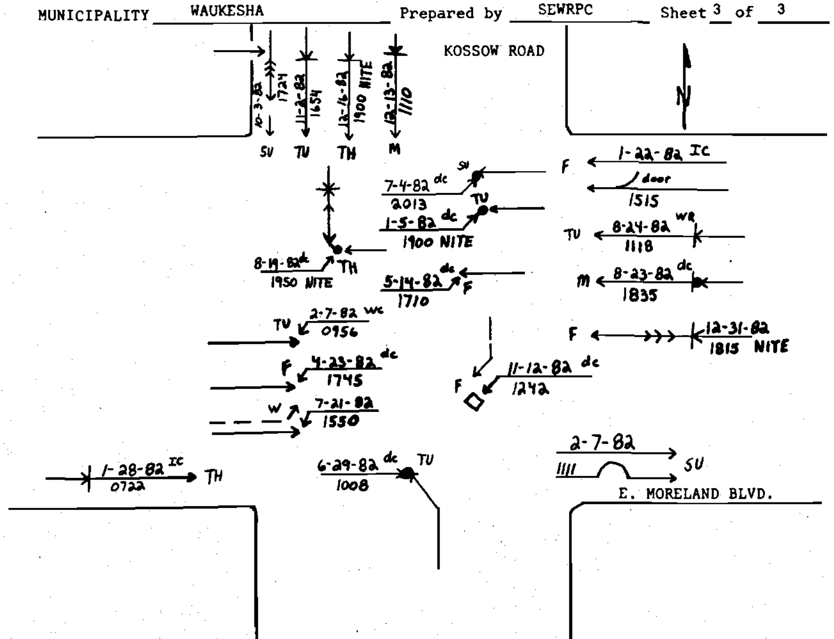
COLLISION DIAGRAM

Southeastern Wisconsin Regional Planning Commission

INTERSECTION E. MORELAND BLVD. and KOSSOW ROAD

PERIOD THREE YEARS From JAN. 1982 To JAN. 1983

MUNICIPALITY WAUKESHA Prepared by SEWRPC Sheet 3 of 3



SHOW FOR EACH ACCIDENT

1. Time, Day, & Date.
2. Pavement:
   D= Dry; I= Icy;
   W= Wet.
3. Weather:
   C= Clear; F= Fog;
   R= Rain; SL= Sleet
   S= Snow
4. Nite- if between dusk and dawn.

LEGEND

SYMBOLS	TYPES OF COLLISION
Moving vehicle	Rear end
Backing vehicle	Head on
Non- involed vehicle	Side Swipe
Pedestrian	Out of control
Parked vehicle	Left turn
Fixed object	Right angle
Fatal accident	
Injury accident	

SUMMARY

TYPE	DAY	NIGHT	TOTAL
Fatal			
Ped. Injury			
Other Injury	4	1	5
Prop. Damage Only	11	3	14
Total	15	4	19

ACCIDENT SUMMARY

PERIOD: FROM 1980 TO 1982 INTERSECTION MORELAND & KOSSOW

YEAR	NO. OF ACCIDENTS
1980	18
1981	17
1982	19
TOTAL	54

TIME OF YEAR	NO. OF ACCIDENTS			
WINTER(DEC.to FEB.)	19	8	3	8
SPRING(MAR.to MAY)	8	3	3	2
SUMMER(JUNE to AUG.)	17	4	7	6
FALL(SEPT.to NOV.)	10	3	4	3
TOTAL	54	18	17	19

TIME OF DAY	NO. OF ACCIDENTS			
6am.to 10am.	3	1	0	2
10am.to 6pm.	19	6	6	7
4pm.to 7pm.	21	5	8	8
7pm.to 12MID.	10	5	3	2
12MID.to 6am.	1	1	0	0
TOTAL	54	18	17	19

ACCIDENT TYPE	NO. OF ACCIDENTS			
Right Angle	10	3	5	2
Left Turn	15	5	3	7
Rear End	24	8	9	7
Side Swipe	4	2	0	2
Pedestrian	0	0	0	0
Other	21	0	0	1
TOTAL	54	18	17	19

WEATHER	NO. OF ACCIDENTS			
CLEAR	35	10	13	12
RAIN	3	2	0	1
SNOW/SLEET	4	3	1	0
FOG	1	1	0	0
TOTAL	43	16	14	13

ACC. SEVERITY	NO. OF ACCIDENTS			
FATAL	0	0	0	0
PERSONAL INJURY	17	5	7	5
PROPERTY DAMAGE	37	13	10	14
TOTAL	54	18	17	19

PAVEMENT	NO. OF ACCIDENTS			
DRY	30	8	14	8
WET	8	5	1	2
ICY	6	3	0	3
UNKNOWN	10	2	2	6
TOTAL	54	18	17	19

LIGHT COND.	NO. OF ACCIDENTS			
DAYLIGHT	36	9	12	15
NIGHT	18	9	5	4
UNKNOWN	0	0	0	0
TOTAL	54	18	17	19

DAY OF WEEK	NO. OF ACCIDENTS			
MONDAY	8	3	3	2
TUESDAY	14	5	4	5
WEDNESDAY	4	1	2	1
THURSDAY	10	3	4	3
FRIDAY	10	4	1	5
SATURDAY	2	1	1	0
SUNDAY	6	1	2	3
TOTAL	54	18	17	19

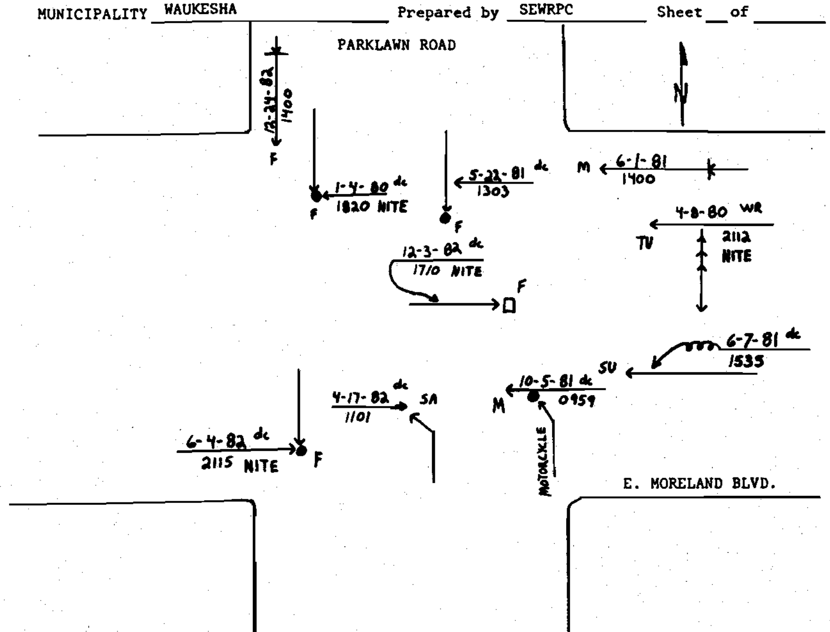
COLLISION DIAGRAM

Southeastern Wisconsin Regional Planning Commission

INTERSECTION E. MORELAND BLVD. and PARKLAWN

PERIOD THREE YEAR From JAN. 1980 To JAN. 1983

MUNICIPALITY WAUKESHA Prepared by SEWRPC Sheet ___ of ___



SHOW FOR EACH ACCIDENT

1. Time, Day, & Date.
2. Pavement:
   D= Dry; I= Icy;
   W= Wet.
3. Weather:
   C= Clear; F= Fog;
   R= Rain; SL= Sleet
   S= Snow
4. Nite- if between dusk and dawn.

LEGEND

SYMBOLS	TYPES OF COLLISION
Moving vehicle	Rear end
Backing vehicle	Head on
Non- involed vehicle	Side Swipe
Pedestrian	Out of control
Parked vehicle	Left turn
Fixed object	Right angle
Fatal accident	
Injury accident	

SUMMARY

TYPE	DAY	NIGHT	TOTAL
Fatal			
Ped. Injury			
Other Injury	2	2	4
Prop. Damage Only	4	2	6
Total	6	4	10

ACCIDENT SUMMARY

PERIOD: FROM 1980 TO 1982 INTERSECTION MORELAND & PARKLAWN

YEAR	NO. OF ACCIDENTS
1980	2
1981	4
1982	4
TOTAL	10

TIME OF YEAR	NO. OF ACCIDENTS
WINTER(DEC.to FEB.)	3
SPRING(MAR.to MAY)	3
SUMMER(JUNE to AUG.)	2
FALL(SEPT.to NOV.)	1
TOTAL	10

TIME OF DAY	NO. OF ACCIDENTS
6am.to 10am.	1
10am.to 4pm.	5
4pm.to 7pm.	2
7pm.to 12MID.	2
12MID.to 6am.	0
TOTAL	10

ACCIDENT TYPE	NO. OF ACCIDENTS
Right Angle	5
Left Turn	0
Rear End	2
Side Swipe	0
Pedestrian	0
Other	3
TOTAL	10

WEATHER	NO. OF ACCIDENTS
CLEAR	6
RAIN	1
SNOW/SLEET	0
FOG	0
UNKNOWN	3
TOTAL	10

ACC. SEVERITY	NO. OF ACCIDENTS
FATAL	0
PERSONAL INJURY	4
PROPERTY DAMAGE	6
TOTAL	10

PAVEMENT	NO. OF ACCIDENTS
DRY	7
WET	1
ICY	0
UNKNOWN	2
TOTAL	10

LIGHT COND.	NO. OF ACCIDENTS
DAYLIGHT	6
NIGHT	4
UNKNOWN	0
TOTAL	10

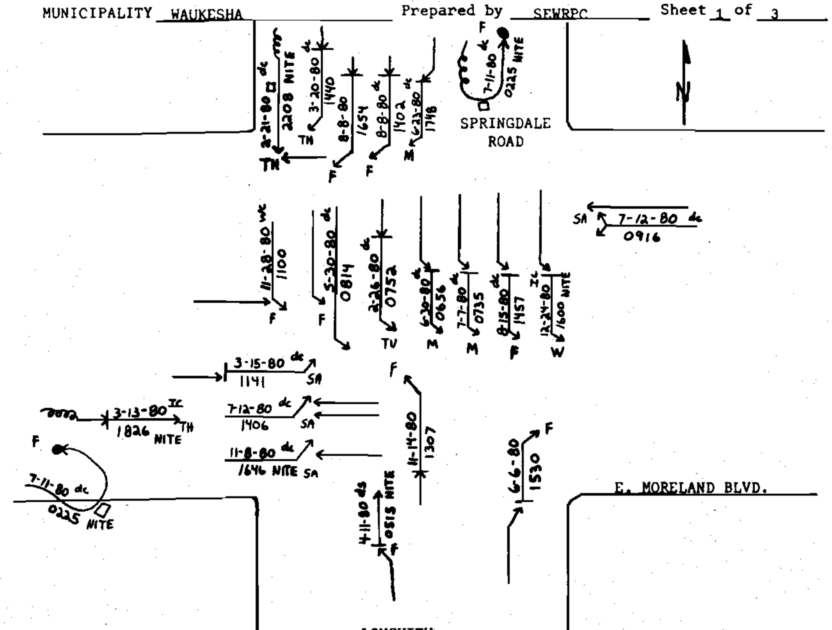
DAY OF WEEK	NO. OF ACCIDENTS
MONDAY	2
TUESDAY	1
WEDNESDAY	0
THURSDAY	0
FRIDAY	5
SATURDAY	1
SUNDAY	1
TOTAL	10

COLLISION DIAGRAM
Southeastern Wisconsin Regional Planning Commission

INTERSECTION E. MORELAND BLVD. and SPRINGDALE ROAD

PERIOD THREE YEAR From JAN. 1980 To JAN. 1981

MUNICIPALITY WAUKESHA Prepared by SEWRPC Sheet 1 of 3



SHOW FOR EACH ACCIDENT

1. Time, Day, & Date.
2. Pavement:
   D= Dry; I= Icy;
   W= Wet.
3. Weather:
   C= Clear; F= Fog;
   R= Rain; SL= Sleet
   S= Snow
4. Nite- if between dusk and dawn.

LEGEND

SYMBOLS	TYPES OF COLLISION
Moving vehicle	Rear end
Backing vehicle	Head on
Non- involed vehicle	Side Swipe
Pedestrian	Out of control
Parked vehicle	Left turn
Fixed object	Right angle
Fatal accident	
Injury accident	

SUMMARY

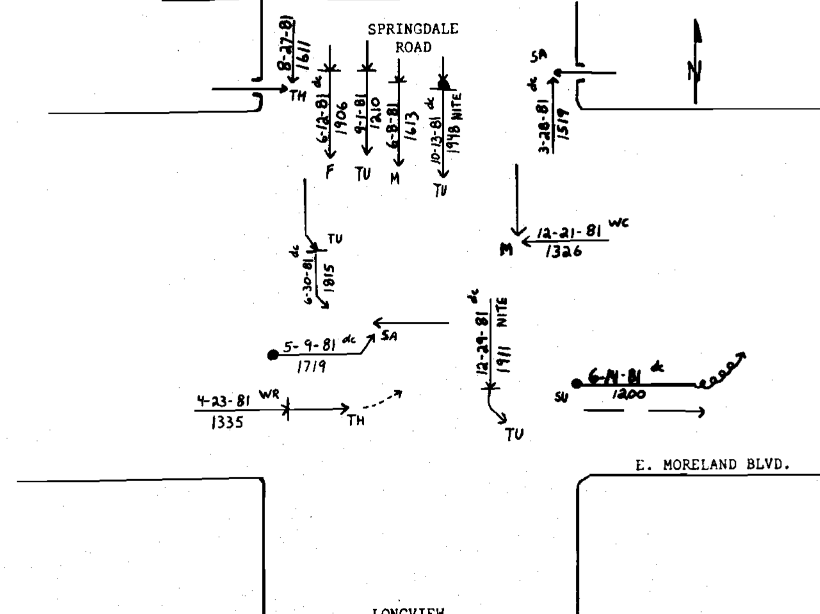
TYPE	DAY	NIGHT	TOTAL
Fatal			
Ped. Injury			
Other Injury		2	2
Prop. Damage Only	15	5	20
Total	15	7	22

COLLISION DIAGRAM
Southeastern Wisconsin Regional Planning Commission

INTERSECTION E. MORELAND BLVD. and SPRINGDALE ROAD

PERIOD THREE YEAR From JAN. 1981 To JAN. 1982

MUNICIPALITY WAUKESHA Prepared by SEWRPC Sheet 2 of 3



SHOW FOR EACH ACCIDENT

1. Time, Day, & Date.
2. Pavement:
   D= Dry; I= Icy;
   W= Wet.
3. Weather:
   C= Clear; F= Fog;
   R= Rain; SL= Sleet
   S= Snow
4. Nite- if between dusk and dawn.

LEGEND

SYMBOLS	TYPES OF COLLISION
Moving vehicle	Rear end
Backing vehicle	Head on
Non- involed vehicle	Side Swipe
Pedestrian	Out of control
Parked vehicle	Left turn
Fixed object	Right angle
Fatal accident	
Injury accident	

SUMMARY

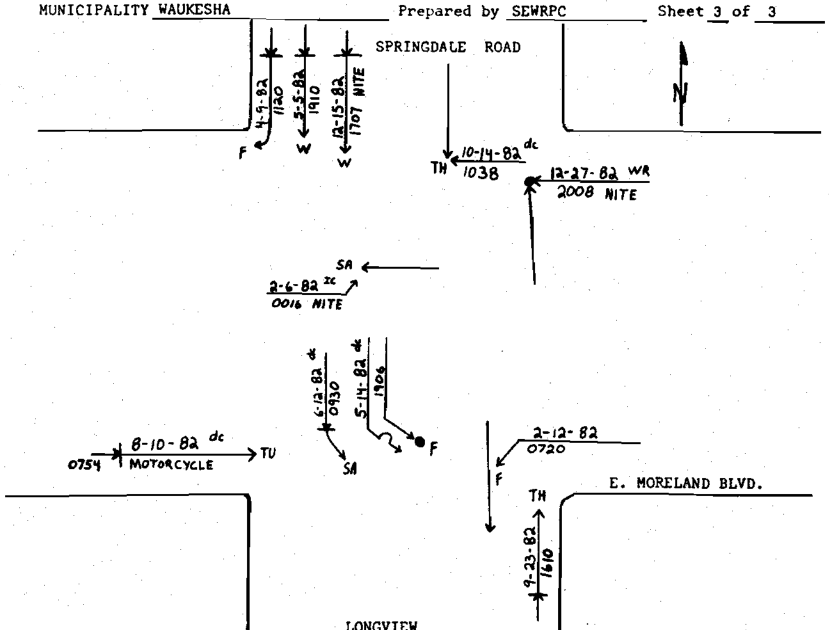
TYPE	DAY	NIGHT	TOTAL
Fatal			
Ped. Injury			
Other Injury	2	1	3
Prop. Damage Only	8	1	9
Total	10	2	12

COLLISION DIAGRAM
Southeastern Wisconsin Regional Planning Commission

INTERSECTION E. MORELAND BLVD. and SPRINGDALE ROAD

PERIOD THREE YEAR From JAN. 1982 To JAN. 1983

MUNICIPALITY WAUKESHA Prepared by SEWRPC Sheet 3 of 3



SHOW FOR EACH ACCIDENT

1. Time, Day, & Date.
2. Pavement:
   D= Dry; I= Icy;
   W= Wet.
3. Weather:
   C= Clear; F= Fog;
   R= Rain; SL= Sleet
   S= Snow
4. Nite- if between dusk and dawn.

LEGEND

SYMBOLS
- Moving vehicle
- Backing vehicle
- Non- involed vehicle
- Pedestrian
- Parked vehicle
- Fixed object
- Fatal accident
- Injury accident

TYPES OF COLLISION
- Rear end
- Head on
- Side Swipe
- Out of control
- Left turn
- Right angle

SUMMARY

TYPE	DAY	NIGHT	TOTAL
Fatal			
Ped. Injury			
Other Injury	1	1	2
Prop. Damage Only	7	2	9
Total	8	3	11

ACCIDENT SUMMARY

PERIOD: FROM 1980 TO 1982 INTERSECTION MORELAND & SPRINGDALE

YEAR	NO. OF ACCIDENTS
1980	22
1981	12
1982	11
TOTAL	45

TIME OF YEAR	NO. OF ACCIDENTS			
WINTER(DEC.to FEB.)	9	3	2	4
SPRING(MAR.to MAY)	11	5	3	3
SUMMER(JUNE to AUG.)	18	11	5	2
FALL(SEPT.to NOV.)	7	3	2	2
TOTAL	45	22	12	11

TIME OF DAY	NO. OF ACCIDENTS			
6am.to 10am.	8	5	0	3
10am.to 4pm.	15	8	5	2
4pm.to 7pm.	12	5	4	3
7pm.to 12MID.	6	1	3	2
12MID.to 6am.	4	3	0	1
TOTAL	45	22	12	11

ACCIDENT TYPE	NO. OF ACCIDENTS			
Right Angle	7	2	3	2
Left Turn	4	2	1	1
Rear End	27	14	7	6
Side Swipe	3	2	0	1
Pedestrian	0	0	0	0
Other	4	2	1	1
TOTAL	45	22	12	11

WEATHER	NO. OF ACCIDENTS			
CLEAR	31	18	8	5
RAIN	2	0	1	1
SNOW/SLEET	1	1	0	0
FOG	0	0	0	0
TOTAL	34	19	9	6

ACC. SEVERITY	NO. OF ACCIDENTS			
FATAL	0	0	0	0
PERSONAL INJURY	7	2	3	2
PROPERTY DAMAGE	38	20	9	9
TOTAL	45	22	12	11

PAVEMENT	NO. OF ACCIDENTS			
DRY	27	16	7	4
WET	4	1	2	1
ICY	3	2	0	1
UNKNOWN	11	3	3	5
TOTAL	45	22	12	11

LIGHT COND.	NO. OF ACCIDENTS			
DAYLIGHT	33	15	10	8
NIGHT	12	7	2	3
UNKNOWN	0	0	0	0
TOTAL	45	22	12	11

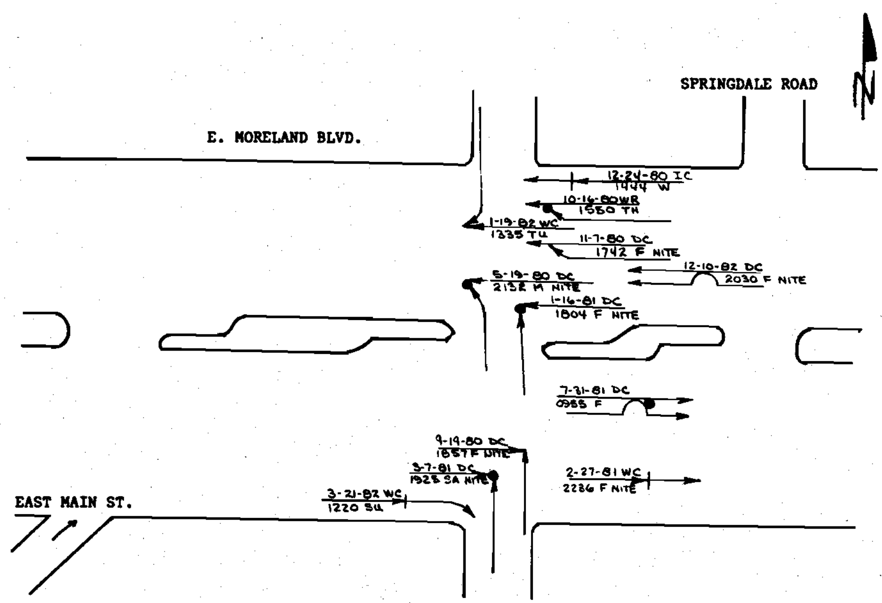
DAY OF WEEK	NO. OF ACCIDENTS			
MONDAY	6	3	2	1
TUESDAY	6	1	4	1
WEDNESDAY	3	1	0	2
THURSDAY	7	3	2	2
FRIDAY	14	10	1	3
SATURDAY	8	4	2	2
SUNDAY	1	0	1	0
TOTAL	45	22	12	11

COLLISION DIAGRAM
Southeastern Wisconsin Regional Planning Commission

INTERSECTION E. MORELAND BLVD. and MAIN STREET TO SPRINGDALE ROAD

PERIOD THREE YEARS From JAN. 1980 To JAN. 1983

MUNICIPALITY WAUKESHA Prepared by SEWRPC Sheet 1 of 1



SHOW FOR EACH ACCIDENT

1. Time, Day, & Date.
2. Pavement:
   D= Dry; I= Icy;
   W= Wet.
3. Weather:
   C= Clear; F= Fog;
   R= Rain; SL= Sleet
   S= Snow
4. Nite- if between
   dusk and dawn.

LEGEND

SYMBOLS
- Moving vehicle
- Backing vehicle
- Non- involed vehicle
- Pedestrian
- Parked vehicle
- Fixed object
- Fatal accident
- Injury accident

TYPES OF COLLISION
- Rear end
- Head on
- Side Swipe
- Out of control
- Left turn
- Right angle

SUMMARY

TYPE	DAY	NIGHT	TOTAL
Fatal			
Ped. Injury			
Other Injury	2	3	5
Prop. Damage Only	3	4	7
Total	5	7	12

ACCIDENT SUMMARY

MORELAND-SPRINGDALE to MAIN STREET

PERIOD: FROM 1980 TO 1982

YEAR	NO. OF ACCIDENTS
1980	5
1981	4
1982	3
TOTAL	12

TIME OF YEAR	NO. OF ACCIDENTS
WINTER(DEC.to FEB.)	5
SPRING(MAR.to MAY)	2
SUMMER(JUNE to AUG.)	1
FALL(SEPT.to NOV.)	4
TOTAL	12

TIME OF DAY	NO. OF ACCIDENTS
6am.to 10am.	1
10am.to 4pm.	4
4pm.to 7pm.	3
7pm.to 12MID.	4
12MID.to 6am.	0
TOTAL	12

ACCIDENT TYPE	NO. OF ACCIDENTS
Right Angle	6
Left Turn	0
Rear End	2
Side Swipe	3
Pedestrian	0
Other	1
TOTAL	12

WEATHER	NO. OF ACCIDENTS
CLEAR	11
RAIN	1
SNOW/SLEET	0
FOG	0
TOTAL	12

ACC. SEVERITY	NO. OF ACCIDENTS
FATAL	0
PERSONAL INJURY	5
PROPERTY DAMAGE	7
TOTAL	12

PAVEMENT	NO. OF ACCIDENTS
DRY	7
WET	4
ICY	1
UNKNOWN	0
TOTAL	12

LIGHT COND.	NO. OF ACCIDENTS
DAYLIGHT	5
NIGHT	7
UNKNOWN	0
TOTAL	12

DAY OF WEEK	NO. OF ACCIDENTS
MONDAY	1
TUESDAY	1
WEDNESDAY	0
THURSDAY	1
FRIDAY	6
SATURDAY	0
SUNDAY	3
TOTAL	12

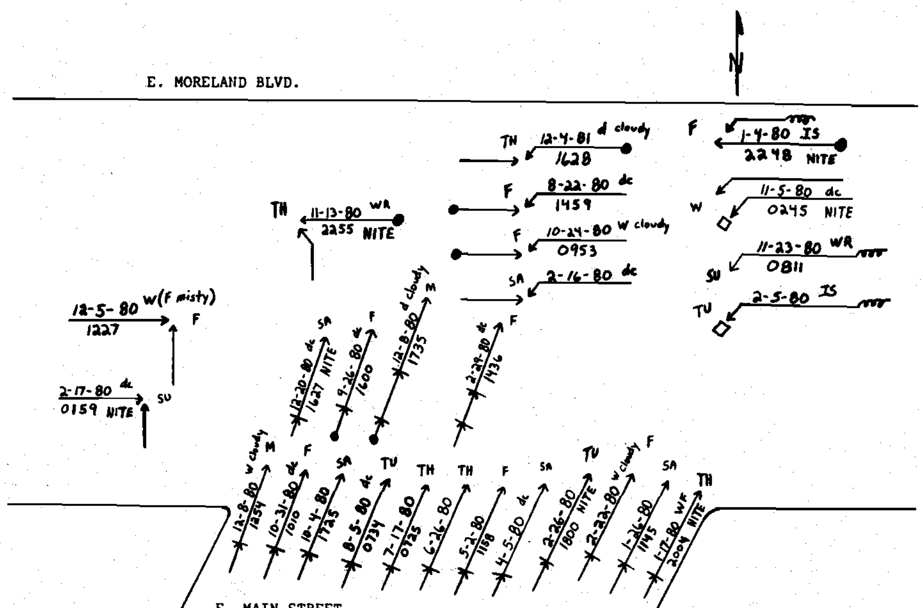
COLLISION DIAGRAM

Southeastern Wisconsin Regional Planning Commission

INTERSECTION E. MORELAND BLVD. and E. MAIN STREET

PERIOD THREE YEAR From JAN. 1980 To JAN. 1981

MUNICIPALITY WAUKESHA Prepared by SEWRPC Sheet 1 of 3



SHOW FOR EACH ACCIDENT	LEGEND: SYMBOLS	LEGEND: TYPES OF COLLISION
1. Time, Day, & Date.	Moving vehicle	Rear end
2. Pavement: D= Dry; I= Icy; W= Wet.	Backing vehicle	Head on
3. Weather: C= Clear; F= Fog; R= Rain; SL= Sleet S= Snow	Non- involed vehicle	Side Swipe
4. Nite- if between dusk and dawn.	Pedestrian	Out of control
	Parked vehicle	Left turn
	Fixed object	Right angle
	Fatal accident	
	Injury accident	

SUMMARY

TYPE	DAY	NIGHT	TOTAL
Fatal			
Ped. Injury			
Other Injury	4	3	7
Prop. Damage Only	15	5	20
Total	19	8	27

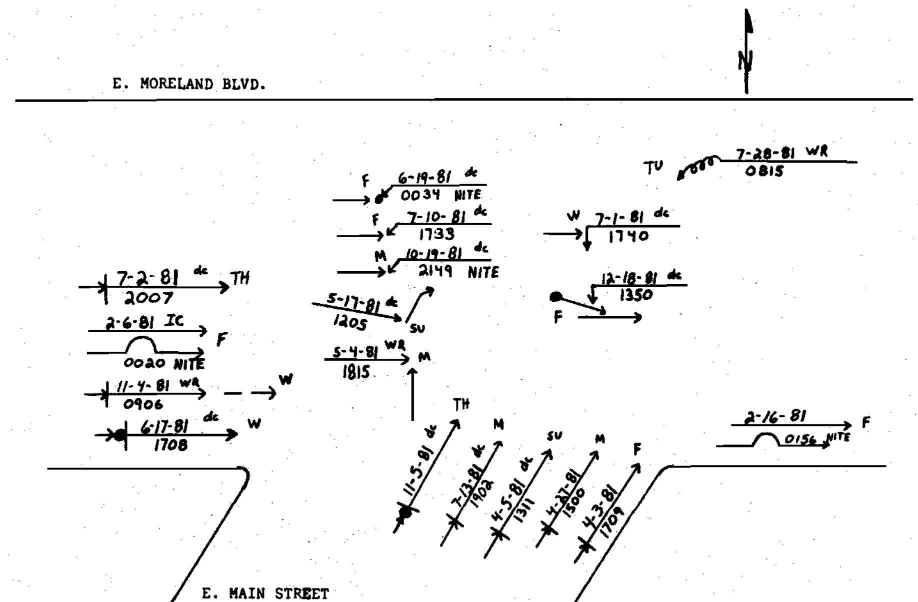
COLLISION DIAGRAM

Southeastern Wisconsin Regional Planning Commission

INTERSECTION E. MORELAND BLVD. and E. MAIN STREET

PERIOD THREE YEAR From JAN. 1981 To JAN. 1982

MUNICIPALITY WAUKESHA Prepared by SEWRPC Sheet 2 of 3



SHOW FOR EACH ACCIDENT	LEGEND: SYMBOLS	LEGEND: TYPES OF COLLISION
1. Time, Day, & Date.	Moving vehicle	Rear end
2. Pavement: D= Dry; I= Icy; W= Wet.	Backing vehicle	Head on
3. Weather: C= Clear; F= Fog; R= Rain; SL= Sleet S= Snow	Non- involed vehicle	Side Swipe
4. Nite- if between dusk and dawn.	Pedestrian	Out of control
	Parked vehicle	Left turn
	Fixed object	Right angle
	Fatal accident	
	Injury accident	

SUMMARY

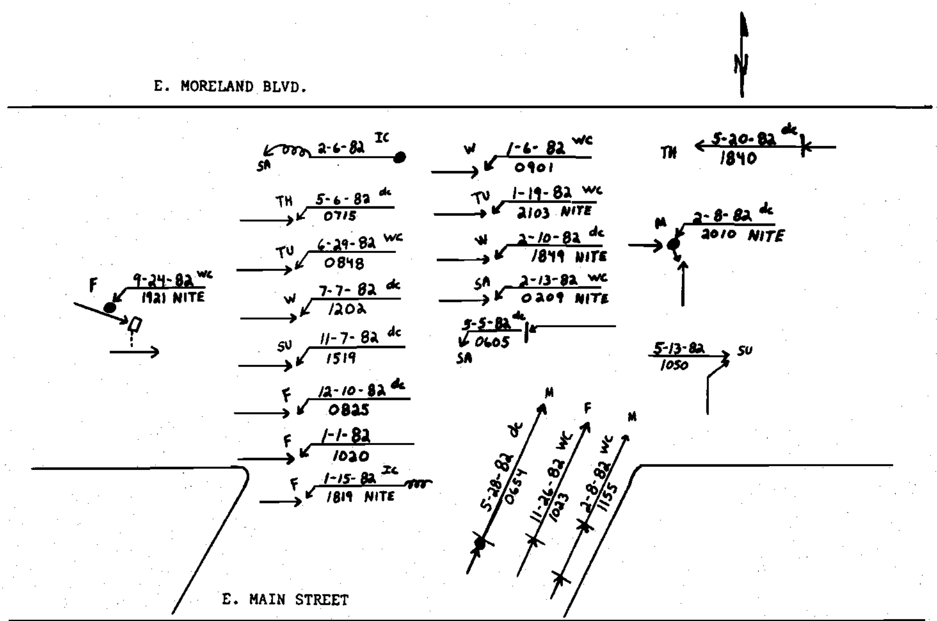
TYPE	DAY	NIGHT	TOTAL
Fatal			
Ped. Injury			
Other Injury	3	1	4
Prop. Damage Only	11	3	14
Total	14	4	18

COLLISION DIAGRAM
Southeastern Wisconsin Regional Planning Commission

INTERSECTION E. MORELAND BLVD. and E. MAIN STREET

PERIOD THREE YEAR From JAN. 1982 To JAN. 1983

MUNICIPALITY WAUKESHA Prepared by SEWRPC Sheet 3 of 3



SHOW FOR EACH ACCIDENT	LEGEND: SYMBOLS	LEGEND: TYPES OF COLLISION
1. Time, Day, & Date.	Moving vehicle	Rear end
2. Pavement: D= Dry; I= Icy; W= Wet.	Backing vehicle	Head on
3. Weather: C= Clear; F= Fog; R= Rain; SL= Sleet S= Snow	Non- involed vehicle	Side Swipe
4. Nite- if between dusk and dawn.	Pedestrian	Out of control
	Parked vehicle	Left turn
	Fixed object	Right angle
	Fatal accident	
	Injury accident	

SUMMARY TYPE	DAY	NIGHT	TOTAL
Fatal			
Ped. Injury			
Other Injury	1	3	4
Prop. Damage Only	12	4	16
Total	13	7	20

ACCIDENT SUMMARY

PERIOD: FROM 1980 TO 1982 INTERSECTION E. MORELAND & E. MAIN STREET

YEAR	NO. OF ACCIDENTS
1980	27
1981	18
1982	20
TOTAL	65

TIME OF YEAR	NO. OF ACCIDENTS			
WINTER(DEC.to FEB.)	27	14	3	10
SPRING(MAR.to MAY)	12	2	5	5
SUMMER(JUNE to AUG.)	13	4	7	2
FALL(SEPT.to NOV.)	13	7	3	3
TOTAL	65	27	18	20

TIME OF DAY	NO. OF ACCIDENTS			
6am.to 10am.	12	4	2	6
10am.to 4pm.	18	8	4	6
4pm.to 7pm.	12	4	5	3
7pm.to 12MID.	9	3	3	3
12MID.to 6am.	7	2	3	2
TOTAL	58	21	17	20

ACCIDENT TYPE	NO. OF ACCIDENTS			
Right Angle	6	3	2	1
Left Turn	22	4	5	13
Rear End	29	16	8	5
Side Swipe	3	1	2	0
Pedestrian	0	0	0	0
Other	5	3	1	1
TOTAL	65	27	18	20

WEATHER	NO. OF ACCIDENTS			
CLEAR	45	15	12	18
RAIN	5	2	3	0
SNOW/SLEET	2	2	0	0
FOG	2	2	0	0
TOTAL	54	21	15	18

ACC. SEVERITY	NO. OF ACCIDENTS			
FATAL	0	0	0	0
PERSONAL INJURY	15	7	4	4
PROPERTY DAMAGE	50	20	14	16
TOTAL	65	27	18	20

PAVEMENT	NO. OF ACCIDENTS			
DRY	32	12	11	9
WET	17	7	3	7
ICY	5	2	1	2
UNKNOWN	11	6	3	2
TOTAL	65	27	18	20

LIGHT COND.	NO. OF ACCIDENTS			
DAYLIGHT	46	19	14	13
NIGHT	19	8	4	7
UNKNOWN	0	0	0	0
TOTAL	65	27	18	20

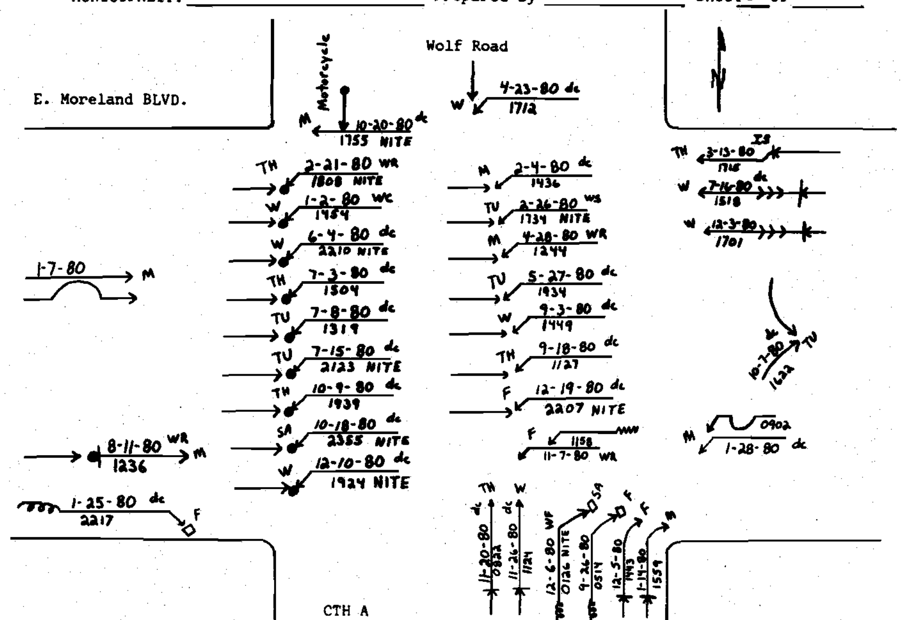
DAY OF WEEK	NO. OF ACCIDENTS			
MONDAY	9	2	4	3
TUESDAY	6	3	1	2
WEDNESDAY	7	1	3	3
THURSDAY	9	5	2	2
FRIDAY	20	9	6	5
SATURDAY	8	5	0	3
SUNDAY	6	2	2	2
TOTAL	65	27	18	20

COLLISION DIAGRAM
Southeastern Wisconsin Regional Planning Commission

INTERSECTION E. Moreland BLVD. and Wolf Road & CTH A

PERIOD Three Years From Jan. 1980 To Jan. 1981

MUNICIPALITY Waukesha Prepared by SEWRPC Sheet 1 of 3



SHOW FOR EACH ACCIDENT

1. Time, Day, & Date.
2. Pavement:
   D= Dry; I= Icy;
   W= Wet.
3. Weather:
   C= Clear; F= Fog;
   R= Rain; SL= Sleet
   S= Snow
4. Nite- if between dusk and dawn.

LEGEND

SYMBOLS
- Moving vehicle
- Backing vehicle
- Non- involed vehicle
- Pedestrian
- Parked vehicle
- Fixed object
- Fatal accident
- Injury accident

TYPES OF COLLISION
- Rear end
- Head on
- Side Swipe
- Out of control
- Left turn
- Right angle

SUMMARY

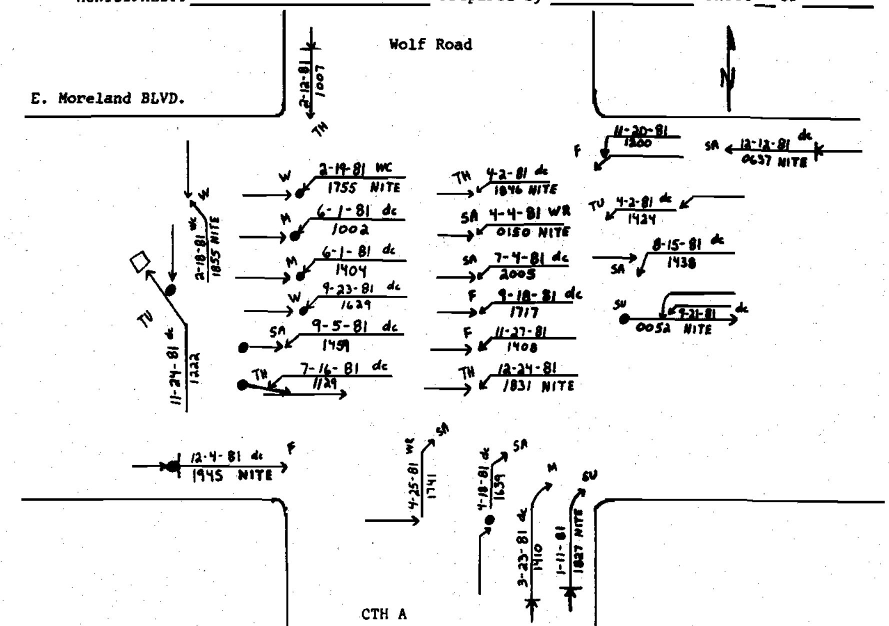
TYPE	DAY	NIGHT	TOTAL
Fatal			
Ped. Injury			
Other Injury	6	6	12
Prop. Damage Only	19	3	22
Total	25	9	34

COLLISION DIAGRAM
Southeastern Wisconsin Regional Planning Commission

INTERSECTION E. Moreland BLVD. and Wolf Road & CTH A

PERIOD Three Years From Jan. 1981 To Jan. 1982

MUNICIPALITY Waukesha Prepared by SEWRPC Sheet 2 of 3



SHOW FOR EACH ACCIDENT

1. Time, Day, & Date.
2. Pavement:
   D= Dry; I= Icy;
   W= Wet.
3. Weather:
   C= Clear; F= Fog;
   R= Rain; SL= Sleet
   S= Snow
4. Nite- if between dusk and dawn.

LEGEND

SYMBOLS
- Moving vehicle
- Backing vehicle
- Non- involed vehicle
- Pedestrian
- Parked vehicle
- Fixed object
- Fatal accident
- Injury accident

TYPES OF COLLISION
- Rear end
- Head on
- Side Swipe
- Out of control
- Left turn
- Right angle

SUMMARY

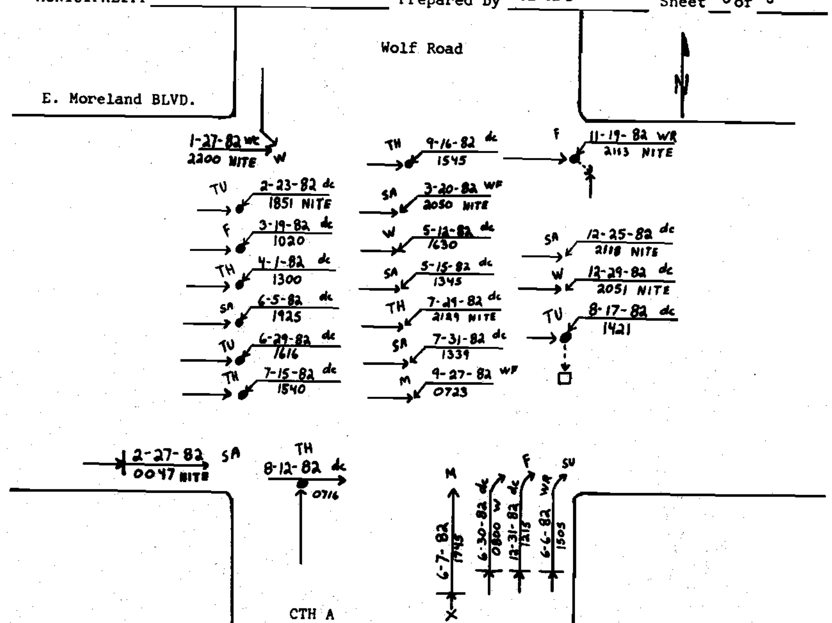
TYPE	DAY	NIGHT	TOTAL
Fatal			
Ped. Injury			
Other Injury	7	3	10
Prop. Damage Only	9	6	15
Total	16	9	25

COLLISION DIAGRAM
Southeastern Wisconsin Regional Planning Commission

INTERSECTION E. Moreland BLVD. and Wolf Road & CTH A

PERIOD Three Years From Jan. 1982 To Jan. 1983

MUNICIPALITY Waukesha Prepared by SEWRPC Sheet 3 of 3



SHOW FOR EACH ACCIDENT
1. Time, Day, & Date.
2. Pavement: D= Dry; I= Icy; W= Wet.
3. Weather: C= Clear; F= Fog; R= Rain; SL= Sleet S= Snow
4. Nite- if between dusk and dawn.

LEGEND

SYMBOLS	TYPES OF COLLISION
Moving vehicle	Rear end
Backing vehicle	Head on
Non- involed vehicle	Side Swipe
Pedestrian	Out of control
Parked vehicle	Left turn
Fixed object	Right angle
Fatal accident	
Injury accident	

SUMMARY

TYPE	DAY	NIGHT	TOTAL
Fatal			
Ped. Injury			
Other Injury	8	2	10
Prop. Damage Only	8	6	14
Total	16	8	24

ACCIDENT SUMMARY

PERIOD: FROM 1980 TO 1982 INTERSECTION Moreland & CTH A

YEAR	NO. OF ACCIDENTS
1980	34
1981	25
1982	24
TOTAL	83

TIME OF YEAR	NO. OF ACCIDENTS			
WINTER(12,DEC.to 2,FEB.)	26	13	7	6
SPRING(3,MAR.to 5,MAY)	15	4	6	5
SUMMER(6,JUNE to 8,AUG.)	22	7	5	10
FALL(9,SEPT.to 11,NOV.)	20	10	7	3
TOTAL	83	34	25	24

TIME OF DAY	NO. OF ACCIDENTS			
6am. to 10am.	6	2	1	3
10am. to 4pm.	34	14	11	9
4pm. to 7pm.	20	7	9	4
7pm.to 12MID.	17	8	2	7
12MID.to 6am.	5	2	2	1
TOTAL	82	33	25	24

ACCIDENT TYPE	NO. OF ACCIDENTS			
Right Angle	6	3	1	2
Left Turn	49	17	15	17
Rear End	20	8	7	5
Side Swipe	5	3	2	0
Pedestrian	0	0	0	0
Other	3	3	0	0
TOTAL	83	34	25	24

WEATHER	NO. OF ACCIDENTS			
CLEAR	58	22	19	17
RAIN	8	4	2	2
SNOW/SLEET	2	2	0	0
FOG	3	1	0	2
TOTAL	71	29	21	21

ACC. SEVERITY	NO. OF ACCIDENTS			
FATAL	0	0	0	0
PERSONAL INJURY	32	12	10	10
PROPERTY DAMAGE	51	22	15	14
TOTAL	83	34	25	24

PAVEMENT	NO. OF ACCIDENTS			
DRY	54	21	17	16
WET	17	8	4	5
ICY	1	1	0	0
UNKNOWN	11	4	4	3
TOTAL	83	34	25	24

LIGHT COND.	NO. OF ACCIDENTS			
DAYLIGHT	57	25	16	16
NIGHT	26	9	9	8
UNKNOWN	0	0	0	0
TOTAL	83	34	25	24

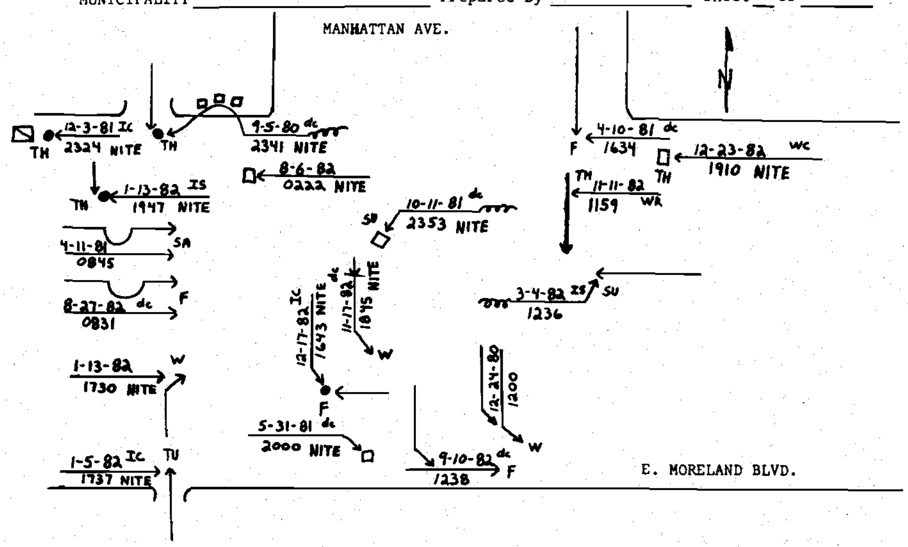
DAY OF WEEK	NO. OF ACCIDENTS			
MONDAY	12	7	3	2
TUESDAY	10	5	2	3
WEDNESDAY	15	8	3	4
THURSDAY	15	6	4	5
FRIDAY	12	5	4	3
SATURDAY	16	3	7	6
SUNDAY	3	0	2	1
TOTAL	83	34	25	24

COLLISION DIAGRAM
Southeastern Wisconsin Regional Planning Commission

INTERSECTION E. MORELAND BLVD. and MANHATTAN AVE.

PERIOD THREE YEAR From JAN. 1980 To JAN. 1983

MUNICIPALITY WAUKESHA Prepared by SEWRPC Sheet ___ of ___



SHOW FOR EACH ACCIDENT	LEGEND: SYMBOLS	LEGEND: TYPES OF COLLISION
1. Time, Day, & Date.	Moving vehicle	Rear end
2. Pavement: D= Dry; I= Icy; W= Wet.	Backing vehicle	Head on
3. Weather: C= Clear; F= Fog; R= Rain; SL= Sleet S= Snow	Non- involed vehicle	Side Swipe
4. Nite- if between dusk and dawn.	Pedestrian	Out of control
	Parked vehicle	Left turn
	Fixed object	Right angle
	Fatal accident	
	Injury accident	

SUMMARY

TYPE	DAY	NIGHT	TOTAL
Fatal			
Ped. Injury			
Other Injury	0	4	4
Prop. Damage Only	7	7	14
Total	7	11	18

ACCIDENT SUMMARY

PERIOD: FROM 1980 TO 1982 INTERSECTION MORELAND & MANHATTAN

YEAR	NO. OF ACCIDENTS
1980	2
1981	5
1982	11
TOTAL	18

TIME OF YEAR	NO. OF ACCIDENTS
WINTER(DEC.to FEB.)	7
SPRING(MAR.to MAY)	4
SUMMER(JUNE to AUG.)	3
FALL(SEPT.to NOV.)	4
TOTAL	18

TIME OF DAY	NO. OF ACCIDENTS
6am.to 10am.	2
10am.to 4pm.	4
4pm.to 7pm.	5
7pm.to 12MID.	6
12MID.to 6am.	1
TOTAL	18

ACCIDENT TYPE	NO. OF ACCIDENTS
Right Angle	7
Left Turn	1
Rear End	1
Side Swipe	3
Pedestrian	0
Other	6
TOTAL	18

WEATHER	NO. OF ACCIDENTS
CLEAR	11
RAIN	1
SNOW/SLEET	2
FOG	0
TOTAL	14

ACC. SEVERITY	NO. OF ACCIDENTS
FATAL	0
PERSONAL INJURY	4
PROPERTY DAMAGE	14
TOTAL	18

PAVEMENT	NO. OF ACCIDENTS
DRY	7
WET	2
ICY	5
UNKNOWN	4
TOTAL	18

LIGHT COND.	NO. OF ACCIDENTS
DAYLIGHT	7
NIGHT	11
UNKNOWN	0
TOTAL	18

DAY OF WEEK	NO. OF ACCIDENTS
MONDAY	0
TUESDAY	1
WEDNESDAY	4
THURSDAY	4
FRIDAY	5
SATURDAY	1
SUNDAY	3
TOTAL	18