

**TRAFFIC SAFETY STUDY
OF THE SEGMENT OF
CTH BB BETWEEN BRINK
ROAD AND HILLSIDE ROAD**

**TOWN OF LINN
WALWORTH COUNTY
WISCONSIN**

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**MEMORANDUM REPORT
NUMBER 115**

**TRAFFIC SAFETY STUDY OF THE SEGMENT OF
CTH BB BETWEEN BRINK ROAD AND HILLSIDE ROAD**

**TOWN OF LINN
WALWORTH COUNTY, WISCONSIN**

Prepared by the

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SEWRPC Memorandum Report No. 115

TRAFFIC SAFETY STUDY OF THE SEGMENT OF CTH BB
BETWEEN BRINK ROAD AND HILLSIDE ROAD IN THE TOWN OF LINN

INTRODUCTION

On March 16, 1993, the Walworth County Highway Commissioner requested that the Regional Planning Commission staff conduct a traffic safety study of CTH BB between Brink Road and Hillside Road in the Town of Linn. The study was to focus on the CTH BB intersection with South Lake Shore Drive/Willow Road and on a perceived speeding problem in the Traver School vicinity. The location of the study segment is shown on Map 1. The study was to identify existing traffic safety problems and recommend traffic engineering actions which may be expected to abate the identified problems. This staff memorandum presents the findings and recommendations of the requested study.

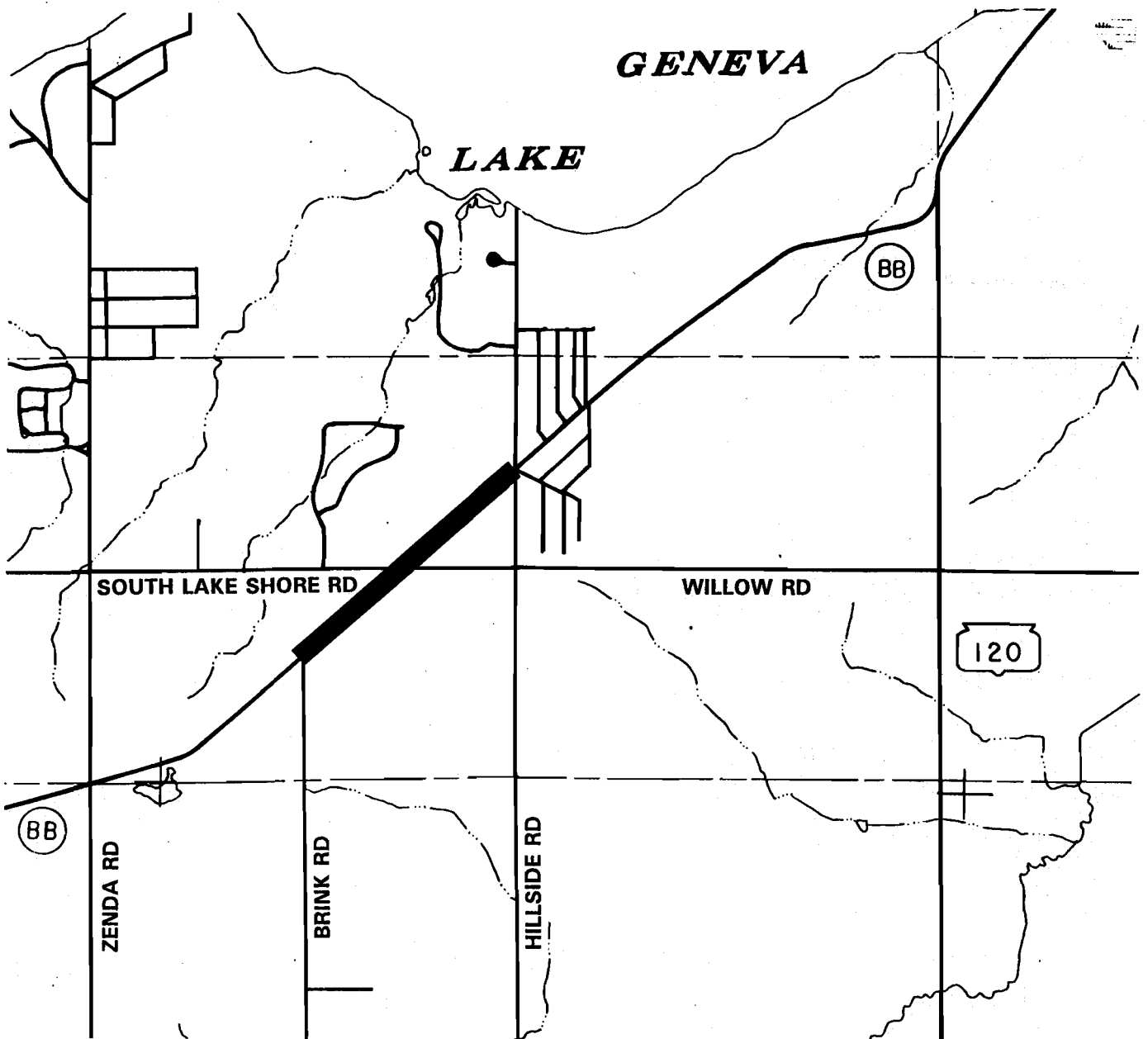
STUDY SEGMENT OF CTH BB BETWEEN BRINK ROAD AND HILLSIDE ROAD

Central to the identification of the existing traffic problems is the collection of data with respect to existing roadway physical and operational characteristics, including the average weekday traffic volumes, peak hour traffic volumes and turning movements, and a history of motor vehicle accident patterns and frequencies. Because of the request to focus on the intersection of CTH BB and South Lake Shore Drive/Willow Road and the perceived speed problem at Traver School, data collection efforts focused on these areas.

Jurisdictional Classification

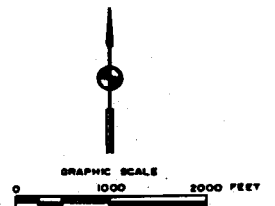
The study segment of CTH BB is a County Trunk Highway under the jurisdiction of Walworth County. As such, any actions taken that would substantially alter the use or capacity of the intersection of CTH BB and South Lake Shore Drive/Willow Road would require the approval of the Walworth County Highway Department. Brink

THE CTH BB STUDY SEGMENT IN THE TOWN OF LINN



LEGEND

STUDY SEGMENT



Source: SEWRPC

Road; South Lake Shore Drive; Willow Road; and Hillside Road are land access streets under the jurisdiction of the Town of Linn.

Intersection Physical and Operational Characteristics

The study segment of CTH BB is constructed to a rural type cross section with shoulders and open ditches for storm water drainage. The facility has an existing pavement width of 22 feet with 5 foot wide gravel shoulders. The posted speed limit is 45 miles per hour. The speed limit, however, does change from 55 miles per hour to 45 miles per hour approximately 125 feet southwest of Brink Road.

As shown on Map 1 the study segment of CTH BB is intersected by public streets at three locations. The intersection of CTH BB and South Lake Shore Drive/Willow Road is a "four-legged" intersection, with an acute angle of intersection of about 41 degrees. An exclusive right turn lane for southbound traffic is provided on CTH BB at its intersection with South Lake Shore Drive/Willow Road. Willow Road, east of CTH BB, has an existing pavement width of 18 feet with gravel shoulders ranging from 0 up to 2 feet in width, and a posted speed limit of 45 miles per hour. A right-turn lane is provided for westbound traffic. South Lake Shore Drive, west of CTH BB, has an existing pavement width of 18 feet with gravel shoulders ranging from 0 up to 2 feet in width, and a posted speed limit of 45 miles per hour.

The Brink Road and Hillside Road intersections are "four legged" and "five legged" intersections respectively; intersecting CTH BB with an acute angle of intersection of approximately 49 degrees. The fourth leg of the Brink Road intersection is the southernmost driveway at Traver School, and the fifth leg at the Hillside intersection is Hilltop Drive which intersects the study segment at approximately 65 degrees. Brink Road is constructed to a rural type cross-section and has an existing pavement width of approximately 20 feet with grass shoulders about three feet in width. Hillside Road is constructed to a rural type cross-section as well with an existing pavement width of approximately 18 feet and gravel shoulders about two feet in width. The speed limit on Brink Road is 55 miles per hour and on Hillside Road is 30 miles per hour. Hilltop Drive is

constructed to a rural type cross-section also with an existing pavement width of approximately 14 feet with two foot wide shoulders.

The horizontal alignment of the CTH BB study segment is relatively straight from Brink Road to Hillside Road. The vertical alignment of the study segment consists of a series of gradients connected by vertical curves beginning with a long downgrade from Brink Road to a "sag" vertical curve with the lowest point of the curve located in the vicinity of the intersection of CTH BB with South Lake Shore Drive/Willow Road. Continuing northward, the vertical alignment rises to a "crest" vertical curve with the high point located about 300 feet north of the CTH BB and South Lake Shore Drive/Willow Road intersection, the roadway then enters another downgrade to Hillside Road.

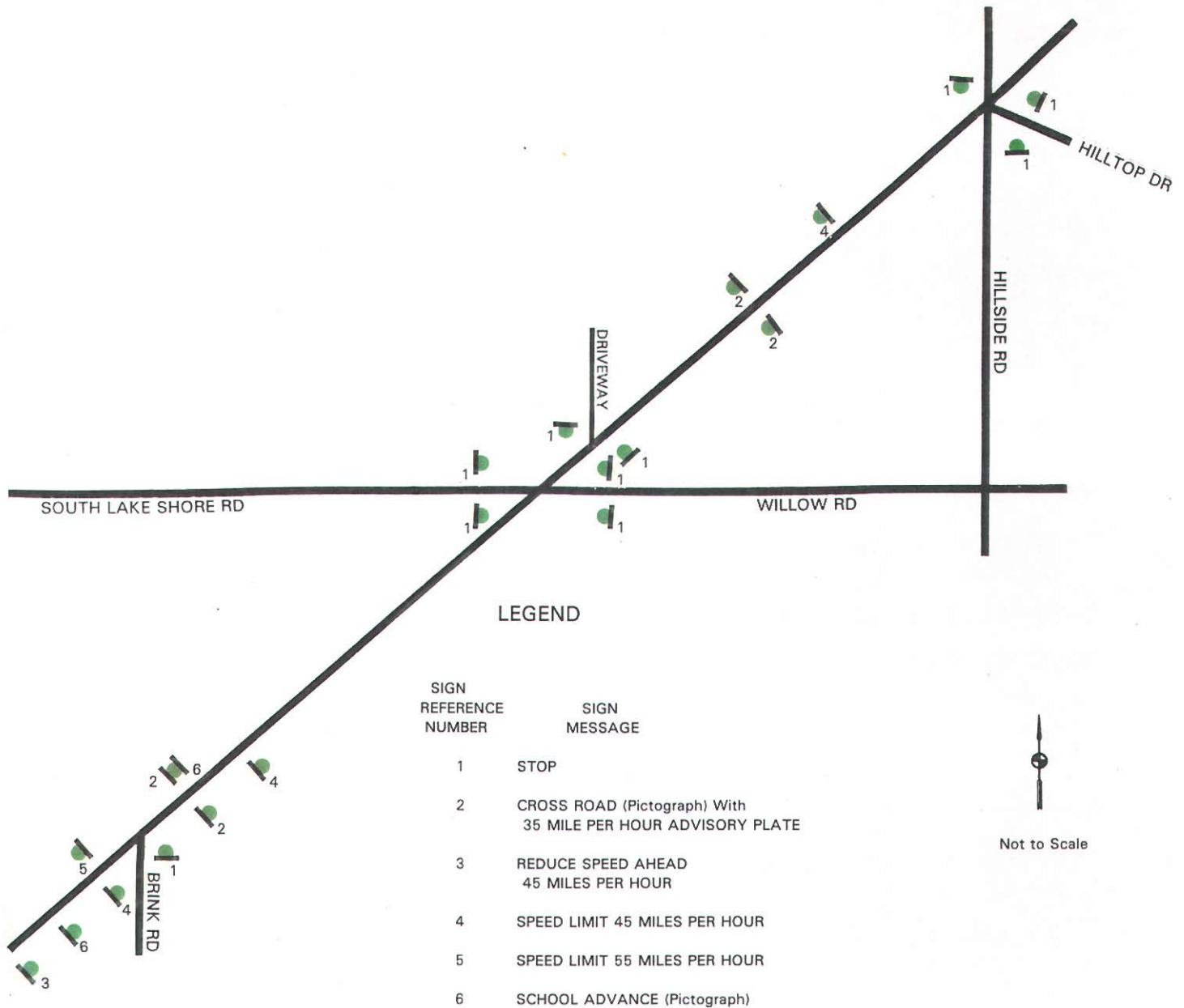
Traffic on all intersecting roadway approaches along the study segment is controlled by stop signs. Advance signing warning of the CTH BB and South Lake Shore Drive/Willow Road intersection is located on both sides of CTH BB approximately 870 feet south and approximately 720 feet north of South Lake Shore Drive/Willow Road. Posted with each of the four "Cross Road" warning signs is a 35 mile per hour speed advisory plate. Advance signing warning of a stop ahead is posted on both sides of both the South Lake Shore Drive and the Willow Road approaches to their intersection with CTH BB. Warning and regulatory signing on the study segment of CTH BB is shown on Figure 1.

Driveway Location and Spacing

Substandard spacing between adjacent driveways or driveways and streets increases the potential for conflict between vehicles entering and exiting the study segment to and from intersecting streets and driveways. The driving task becomes more complex for motorists required to simultaneously monitor multiple closely spaced points of egress and ingress. Unrestricted access to parking lots which are paved contiguous with the shoulder of the adjacent roadway causes the same operational problems associated with substandard driveway spacing, and may in fact further complicate the driving task for motorists who must now monitor the potential for access to and egress from the entire frontage rather than a series of specific locations.

Figure 1

TRAFFIC CONTROL SIGNING ON THE CTH BB STUDY SEGMENT: 1993



Specific operational problems which may result from substandard driveway spacing or when unrestricted access is permitted to parking areas paved contiguous to adjacent roadway shoulders include: 1) an increase in the number vehicular conflict points in proportion to the number of driveways and intersection present; 2) a reduction in roadway capacity caused by the temporary blockage of traffic in one direction while left-turning vehicles await gaps in the opposing traffic stream of sufficient length to execute the left turn; 3) the necessity for motorists to be cognizant of arterial street traffic and cross street and multiple driveway traffic simultaneously; and 4) a potential for conflict between a motorist accelerating from a driveway with a motorist decelerating into an adjacent driveway or cross-street. Thus, substandard driveway spacing may be expected to present a traffic safety problem.

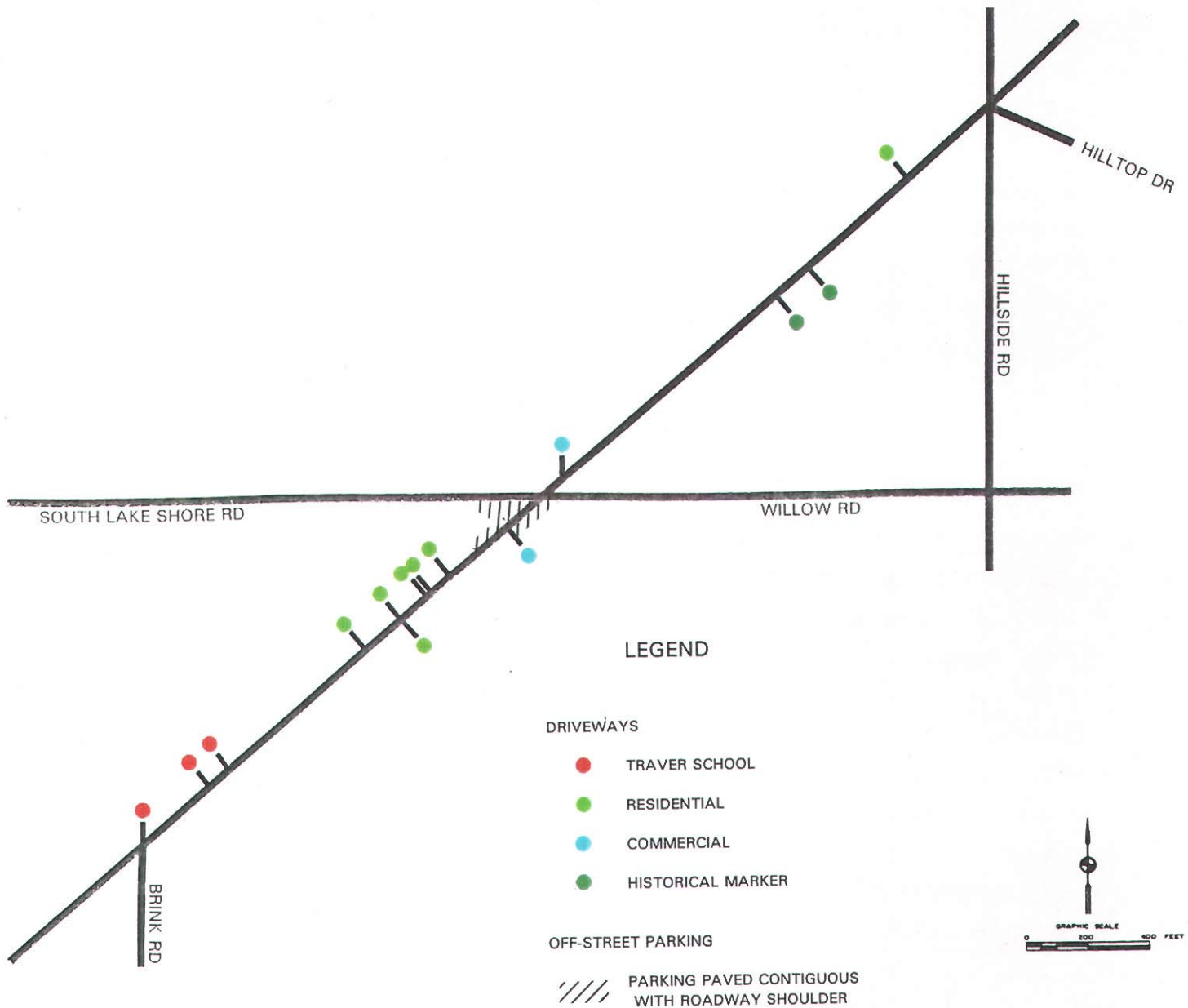
The study segment is intersected by a total of 14 driveways serving six residences; Traver School; the Lake Geneva Country Club; Engerman Contracting Company, Incorporated, and a historical marker. The location of these driveways is shown on Figure 2. Driveway spacing along the study segment ranges from about 20 feet to more than 910 feet. Eleven of the 14 driveways are located between Brink Road and South Lake Shore Drive/Willow Road. The spacing of these 11 driveways ranges from about 20 to about 570 feet. While the average spacing is about 156 feet; eight of the 11 driveways are spaced at distances ranging from about 20 to about 145 feet.

With respect to driveway spacing along the CTH BB study segment in the vicinity of study segment intersections, the following should be noted: 1) the southernmost Traver School driveway is the fourth leg of the Brink Road intersection; 2) a commercial driveway serving Engerman Contracting Company, Incorporated is located about 175 feet southwest of the South Lake Shore Drive/Willow Road intersection on the east side of the study segment; and, 3) the Lake Geneva Country Club driveway is located about 65 feet north of the South Lake Shore Drive/Willow Road intersection on the west side of the study segment.

Parking areas, paved contiguous with the roadway shoulders are located in the southeast and southwest quadrants of the CTH BB and South Lake Shore Drive/Willow Road intersection. There is no defined driveway to the parking area in the

Figure 2

THE LOCATION OF DRIVEWAYS
INTERSECTING THE CTH BB STUDY SEGMENT: 1993



southeast intersection quadrant with access permitted along the entire length of the parking area of about 175 feet. In the southwest intersection quadrant, a fence located at the CTH BB right-of-way line restricts access to the remainder of the paved parking lot in that quadrant for a distance of about 50 feet. The fence does not, however, prevent motorists from parking on the paved area adjacent to the CTH BB study segment, which extends for a distance of about 275 feet south of South Lake Shore Drive/Willow Road. Access to the paved parking area abutting the roadway is unrestricted.

Roadway Stopping Sight Distance

The safe stopping sight distance is defined as the distance required for a motorist to perceive an object in the roadway and to safely brake to a stop prior to colliding with the object. Determination of restricted roadway stopping distance is based on an eye height of 3.5 feet and an object height of 0.5 feet. Safe stopping sight distance is dependent upon and increases with vehicle speed. Safe stopping sight distance ranges from 375 to 475 feet for an assumed speed condition of 44 to 50 miles per hour.¹

This analysis indicates that the crest of the vertical curve located approximately 300 feet north of the CTH BB intersection with South Lake Shore Drive/Willow Road restricts the available roadway stopping sight distance. In the northbound direction, the available roadway stopping sight distance ranges between approximately 315 to 365 feet from a point beginning about 50 feet north of the intersection and extending for a distance of about 125 feet. In the southbound direction, the available roadway stopping sight distance ranges between approximately 340 to 365 feet from a point beginning about 460 feet north of the intersection and extending for a distance of about 125 feet. It may be noted that the CTH BB intersection with South Lake Shore Drive/Willow Road is blocked from the view of southbound motorists by the crest of the hill until they are about 440 feet north of the intersection.

¹Based on operating speed data presented later in this report, 85 percent of all motorists on the study segment were observed to be traveling at or below about 48.3 miles per hour.

Intersection Sight Distance

Because the requested traffic study was to focus on the CTH BB intersection with South Lake Shore Drive/Willow Road the intersection sight distances were analyzed at this intersection. Intersection sight distance in this situation may be defined as the distance required between a vehicle on a major street and a stop sign controlled intersecting minor street which would permit a motorist stopped on the minor street approach to either cross or enter the major street traffic stream without causing the vehicle on the major street to reduce speed. Determination of restricted intersection sight distance is based on an eye height of 3.5 feet on the minor street and an object weight of 4.25 feet on the major street, and assumes a stopped condition on the intersecting minor street. The stopped vehicle is assumed to be offset from the major street edge of pavement by ten feet. The intersection sight distances increases with vehicle speed. The necessary safe sight distance in feet for a passenger vehicle to complete an indicated maneuver from a crossing street is shown in Table 1.

At the intersection of CTH BB and South Lake Shore Drive/Willow Road the intersection sight distance to the north is limited to about 585 feet by the crest of the hill located approximately 300 feet north of the intersection. To the south, the intersection sight distance is limited to about 200 feet if a vehicle is parked in the most disadvantageous location possible in the parking areas paved contiguous to the roadway shoulders on CTH BB. The sight distance to the south is also restricted by tree limbs which overhang the right-of-way line on both sides of the study segment about 180 feet south of South Lake Shore Drive/Willow Road. These tree limbs limit the sight distance to about 670 feet. The minimum sight distance at the intersection for vehicles at a stopped condition at either South Lake Shore Drive or at Willow Road required to safely maneuver onto CTH BB, and for a speed of 45 miles per hour on CTH BB is approximately 485 feet.

While not restricting the sight distance, the acute angle of intersection between CTH BB and South Lake Shore Drive/Willow Road--about 41 degrees-- tends to exacerbate the situation by requiring motorists stopped on South Lake Shore Drive/Willow Road to look back over their shoulder to check for on-coming vehicles on CTH BB. Further, as the acute angle of intersection decreases the

Table 1

SAFE SIGHT DISTANCE IN FEET FOR AN AUTOMOBILE TO COMPLETE
INDICATED MANEUVER FROM A STOPPED CONDITION FROM AN INTERSECTING CROSS STREET APPROACH*

Speed (Miles per Hour)	Crossing CTH BB Eastbound or Westbound Safe Sight Distance		Right Turn Onto CTH BB Safe Sight Distance to Left		Westbound Left Turn Onto CTH BB Safe Sight Distance		Eastbound Left Turn Onto CTH BB Safe Sight Distance	
	Looking to North (feet)	Looking to South (feet)	Eastbound Looking North (feet)	Westbound Looking South (feet)	Looking to North (feet)	Looking to South (feet)	Looking to North (feet)	Looking to South (feet)
30	325	335	430	440	430	450	440	440
35	375	390	540	555	540	540	525	555
40	430	450	705	725	705	610	590	725
45	485	505	875	895	875	675	655	895
50	540	560	1,090	1,110	1,090	755	735	1,110
55	590	615	1,290	1,315	1,290	815	790	1,315

*Sight distance required for vehicle from minor street to complete maneuver without causing vehicle on major street to reduce speed below the average running speed.

Source: American Association of State Transportation Officials.

time vehicles are exposed to the cross-street traffic flow increases thereby increasing the accident potential.

Traffic Volumes

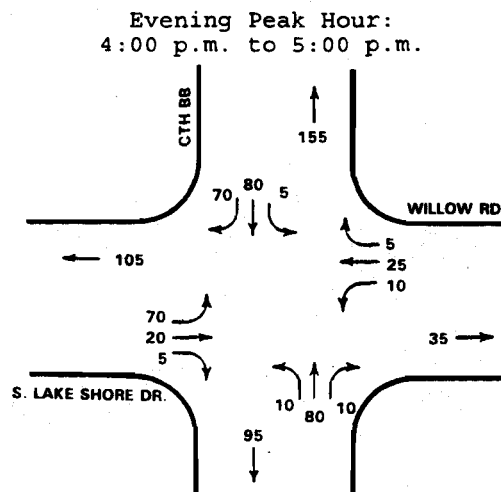
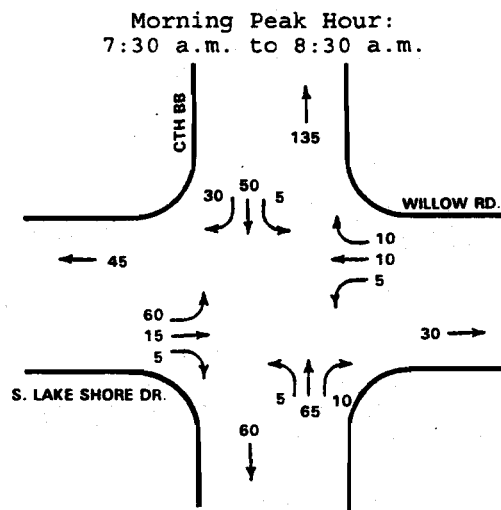
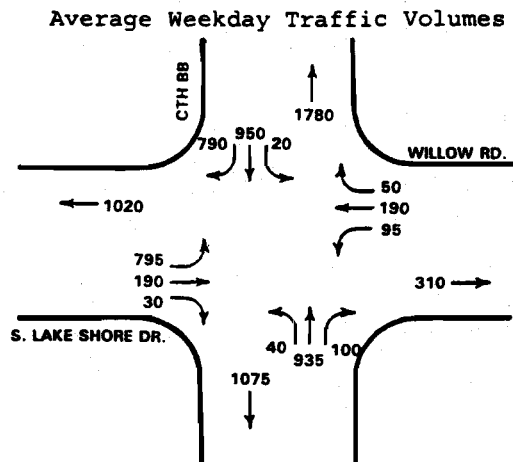
Based on 24-hour machine counts conducted by the Commission staff at the intersection of CTH BB and South Lake Shore Drive/Willow Road the average weekday traffic volume on CTH BB in May 1993 approximated 3,550 vehicles just north of South Lake Shore Drive/Willow Road; and 2,150 vehicles just south of South Lake Shore Drive/Willow Road. A volume of about 1,900 vehicles per average weekday was observed just west of CTH BB on South Lake Shore Drive; and a volume of about 700 vehicles per average weekday was observed just east of CTH BB on Willow Road. The data indicate that traffic volumes on the study segment of CTH BB have increased approximately 1.3 percent annually since a Wisconsin Department of Transportation traffic count in 1989.

The Commission staff also conducted manual turning movement counts at the intersection of CTH BB and South Shore Drive/Willow Road from 6:00 a.m. to 8:00 p.m. This time period included the morning and afternoon peak traffic hours and accounted for approximately 89 percent of the 24-hour average weekday traffic volume. These count data were used to evaluate current intersection operating conditions. Figure 3 shows the turning movements recorded at the intersection of CTH BB and South Lake Shore Drive/Willow Road during: 1) the morning peak hour; 2) the evening peak hour; and 3) the estimated 24-hour turning movement volumes.

It should be noted that a significant percentage of the southbound traffic stream on CTH BB turns right onto South Lake Shore Drive. During the evening peak hour, approximately 70 vehicles, or about 45 percent of the traffic on the southbound intersection approach was observed turning right. A substantial percentage of the South Lake Shore Drive is involved in a turning movement during the evening hour. Approximately 70 vehicles, or 74 percent of the traffic on the eastbound intersection approach was observed turning left. This pattern of turning movements exists throughout the day. Collectively, 46 percent of the total vehicles entering this intersection were observed to engage in turning movements.

Figure 3

AVERAGE WEEKDAY TURNING MOVEMENT VOLUMES AT THE INTERSECTION
OF CTH BB AND SOUTH LAKE SHORE DRIVE/WILLOW ROAD: 1993



Traffic Accidents

The incidence and pattern of traffic accidents can provide an indication of the efficiency and operating characteristics of roadways and intersections. A four and one half year motor vehicle accident history--from January, 1989 through June, 1993--for the study segment of CTH BB, between Brink Road and Hillside Road, was collected and analyzed. As shown on Table 2, a total of 20 accidents occurred on the study segment--four each in 1989 and 1990, and six each in 1991 and 1992. No accidents were reported in 1993 through June. None of the 20 accidents reported involved a fatality. Of the 20 accidents reported, three accidents in 1989, one in 1990, five in 1991, and none in 1992, involved personal injuries. Of the 20 total accidents, 19 accidents occurred at an intersection with two accidents occurring at the intersection of CTH BB and Brink Road; 11 at the intersection of CTH BB and South Lake Shore Drive/Willow Road; and, six at the intersection of CTH BB and Hillside Road.² Collision diagrams for the intersections are presented in Appendix A to this memorandum.

Because the highest incidence of accidents occurred at the CTH BB and South Lake Shore Drive/Willow Road intersection and because the incidence of accidents has been increasing annually at that intersection--as shown in Table 2--, its historical accident data was analyzed to determine if any patterns exist. The predominant accident type was the right angle collision, which accounted for eight of the eleven total accidents at the intersection, or 73 percent. Of the eleven total accidents at the intersection, wet pavement may have contributed to five accidents, or 45 percent, and four of those five accidents, or 80 percent were right angle collisions. Of the eight right angle collisions accidents, five accidents, or 63 percent resulted in injuries. As shown on the collision diagram for this intersection in Appendix A, all of the right angle collision accidents involved a vehicle southbound on CTH BB. This may confirm the restricted roadway stopping sight distance on CTH BB just north of this intersection.

Operating Speeds

A spot speed study was conducted by the Commission staff on the study segment of

²An accident was considered an intersection accident if it occurred within 200 feet of an intersection.

Table 2

INCIDENCE AND SEVERITY OF MOTOR VEHICLE
ACCIDENTS ON THE CTH BB STUDY SEGMENT
FROM JANUARY 1989 TO JUNE, 1993

Time Period	Accident Type			Total Accidents
	Injury	Fatality	Property Damage	
1989	3	0	1	4
1990	1	0	3	4
1991	5	0	1	6
1992	0	0	6	6
1st half of 1993	0	0	0	0
Total	9	0	11	20

INCIDENCE AND SEVERITY OF MOTOR VEHICLE
ACCIDENTS AT THE INTERSECTION OF CTH BB
AND SOUTH LAKE SHORE DRIVE/WILLOW ROAD
FROM JANUARY 1989 TO JUNE, 1993

Time Period	Accident Type			Total Accidents
	Injury	Fatality	Property Damage	
1989	2	0	0	2
1990	1	0	1	2
1991	2	0	1	3
1992	0	0	4	4
1st half of 1993	0	0	0	0
Total	5	0	6	11

CTH BB about midway between Brink Road and South Lake Shore Drive/Willow Road on May 5, 1993, between the hours 9:00 a.m. and 4:00 p.m. Table 3 summarizes the operating speed data collected at this location. The 85th percentile speed--the speed at or below which 85 percent of the traffic was observed to be traveling--may be considered to be the speed which motorists perceive to be safe and reasonable for the roadway segment being traveled. It is generally those vehicles traveling at speeds exceeding the 85th percentile which create the citizen perception of excessive speeds on a roadway segment. The 10 mile per hour pace is the 10 mile per hour speed range which includes the largest number of vehicles. The greater the percentage of motorists traveling within the 10 mile per hour pace speed, the greater the uniformity in travel speeds of the traffic stream.

The 85th percentile speed of northbound vehicles was observed to be approximately 4.2 miles per hour faster than the posted speed limit, and 71 percent of the northbound traffic was observed to be traveling within the 10 mile per hour pace. The 85th percentile speed of southbound vehicles was observed to be approximately 2.5 mile per hour faster than the posted speed limit, and 71 percent of all traffic was also observed to be traveling within the 10 mile per hour pace. The 85th percentile speed for the northbound traffic was thus found to be somewhat higher than for the southbound traffic. While 55 and 65 percent of the northbound and southbound vehicles respectively were observed traveling at or below the speed limit, the maximum observed speed for north and southbound vehicles was 61 and 58 miles per hour, respectively.

The 85th percentile speed of the northbound and southbound traffic streams combined was observed to be about 3.3 miles per hour above the posted speed limit. Seventy percent of all motorists were observed traveling within the 10 mile per hour pace, and 60 percent of all vehicles were observed traveling at or below the posted speed limit. Further, one of every four vehicles was observed traveling at a speed outside the ten mile per hour range of pace speeds. It should be noted the speed data reported for the combined north- and southbound traffic streams are typical of the speed data on the remainder of the study segment based on staff observation.

TABLE 3

OBSERVED OPERATING SPEED ON CTH BB SOUTH OF LAKE
SHORE DRIVE/WILLOW ROAD IN THE OFF-PEAK TRAFFIC HOURS: 1993

	NORTHBOUND CTH BB	SOUTHBOUND CTH BB	COMBINED NORTH- AND SOUTHBOUND
Posted Speed Limit.....	45 miles per hour	45 miles per hour	45 miles per hour
Average Speed.....	-0.1 miles per hour below the speed limit	-2.2 miles per hour below the speed limit	-1.0 miles per hour below the speed limit
Percentage of Motorists Traveling at or Below the Posted Speed Limit.....	55	65	60
85th Percentile Speed...	+4.2 miles per hour over the speed limit	+2.5 miles per hour over the speed limit	+3.3 miles per hour over the speed limit
10 Mile per hour Pace...	41 to 50 miles per hour	39 to 48 miles per hour	39 to 48 miles per hour
Percentage of Motorists Traveling Within the 10 Mile Per Hour Pace..	71	71	70
Highest Observed Speed.....	61	58	61

Source: SEWRPC

The Commission staff did observe travel speeds while students were being dismissed from Traver School. No appreciable differences in travel speeds were observed during school dismissal times than at other times during the day.

Problem Identification

The inventory data were compared to generally accepted traffic engineering standards to determine if any traffic problems exist on the study segment. The minimum roadway sight distance on the CTH BB study was observed at the crest of the hill located about 300 feet north of the South Lake Shore Drive/Willow Road intersection and ranges from approximately 315 to 365 feet. These sight distances were compared to the stopping sight distances set forth in "A Policy on Geometric Design of Streets and Highways" published by the American Association of State Highway and Transportation Officials. The required roadway stopping sight distances for travel speeds between 44 and 50 miles per hour ranges between 375 to 475 feet. The required roadway stopping sight distance for travel speeds between 40 and 45 miles hour ranges between 325 and 400 feet. Thus, it may be concluded that inadequate roadway stopping sight exists on the study segment due to the crest of the vertical curve located about 300 feet north of South Lake Shore Drive/Willow Road.

The intersection sight distance to the north is about 585 feet. The intersection sight distance to the south is dependent upon whether or not vehicles are parked adjacent to the roadway and their location in that parking area. Parked vehicles may restrict sight distance to as little as 200 feet. When no parked vehicles are present, the intersection sight distance to the south is restricted to about 700 feet by tree limbs on both sides of the study segment. The available intersection sight distances were compared to the distances set forth in Table 1. Based on that comparison, the existing sight distance to the north is inadequate for all turning maneuvers, but is adequate for a crossing maneuver. The available sight distance to the south is inadequate for all maneuvers if restricted by a parked vehicle. Similar to the available sight distance to the north, the sight distance to the south is adequate for a crossing maneuver and for a westbound left turn onto CTH BB, but is inadequate for all other turning maneuvers.

The acute angle of intersection between the CTH BB study segment and South Lake Shore Drive/Willow Road--41 degrees--is less than both the optimum intersecting angle of 90 degrees and the minimum desirable intersecting angle of 60 degrees. This acute angle of intersection may therefore be considered substandard.

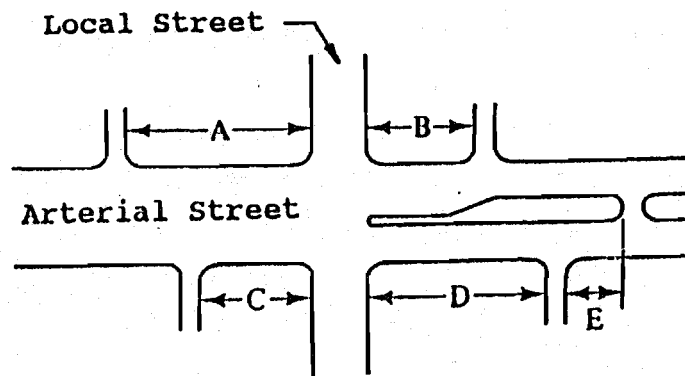
Driveway location and spacing were compared to the standards for the minimum desirable corner clearances at unsignalized intersections, shown on Figure 4. The Lake Geneva Country Club driveway intersects the CTH BB study segment from the west approximately 65 feet north of South Lake Shore Drive/Willow Road, or about 75 feet less than the desired 140 feet for a driveway upstream of an intersection.

Parking areas, paved contiguous with the shoulder of the study segment roadway are located in the southeast and southwest quadrants of the intersection of CTH BB and South Lake Shore Drive/Willow Road. In the southeast quadrant, there is a parking area paved contiguous with the edge of the CTH BB shoulder which extends southerly from Willow Road for a distance of about 175 feet. In the southwest quadrant, there is a parking area paved contiguous with the edge of the CTH BB shoulder extending southerly from South Lake Shore Drive for a distance of about 275 feet. Access to the parking area in the southeast quadrant is unrestricted; access to the parking area in the southwest quadrant from the study segment is restricted by a fence for a distance of 50 feet from South Lake Shore Drive, but unrestricted elsewhere. The parking areas have the same effect as a series of abutting driveways and thus violate the desirable distances of 140 and 185 feet between the intersection and an upstream and a downstream driveway respectively. Analyses of the driveway spacing at the intersection of CTH BB and South Lake Shore Drive/Willow Road indicates that substandard intersection and driveway spacing exist at this location.

Based on spot speed studies conducted by the Commission Staff on CTH BB the overall 85th percentile speed was observed to be about 3.3 miles per hour above the posted 45 miles per hour speed limit. Thus, it may be concluded that there is general compliance with the speed limit on the study segment of CTH BB. However, the relatively low percentage of motorists traveling within the 10 mile per hour pace--nearly one in four vehicles was observed traveling at a speed outside the pace range of speeds--indicates considerable disparity in the travel

Figure 4

MINIMUM DESIRABLE CORNER CLEARANCES AT
SIGNALIZED AND UNSIGNALIZED INTERSECTIONS



Minimum Desirable Corner Clearances
at an Arterial and Local Street
Intersection Controlled by Stop
Signs on the Local Street

Figure Reference	Corner Clearance (Feet)
A	190
B	190
C	140
D	190
E	250

Source: Institute of Transportation Engineers

speeds on the study segment. This disparity in travel speeds increases the potential for the number and severity of accidents. Because no discernable change in speeds was observed during school dismissal times in the vicinity of Traver School, it may be concluded that motorists substantially disregard the speed limit through the school zone on the study segment during school dismissal times when children are present. Thus, it may be concluded that a speeding problem exists on the study segment.

Analyses of the four and one-half year history of traffic accidents in the study segment between Hillside Road and Brink Road indicates that 11 of the 20 accidents occurred at the intersection of CTH BB and South Lake Shore Drive/Willow Road. Of these 11 accidents 8 were right-angle collisions, and, five of the eleven accidents involved personal injuries. Because of the increasing incidence of accidents at the intersection of CTH BB and South Lake Shore Drive/Willow Road, with 2 accidents occurring in 1989, 2 in 1990, 3 in 1991 and, 4 in 1992; the pattern of the right angle collision accidents; and the number of personal injury accidents, it may be concluded that a traffic safety problem exists at this intersection.

In summary, a total of six existing traffic problems were identified on the CTH BB study segment. These included: 1) restricted stopping sight distance caused by the crest of the vertical curve on CTH BB located about 300 feet north of South Lake Shore Drive/Willow Road; 2) restricted intersection sight distance at the intersection of CTH BB and South Lake Shore Drive/Willow Road; 3) a substandard acute angle of intersection between CTH BB and South Lake Shore Drive/Willow Road; 4) substandard driveway spacing; 5) a vehicular speeding problem; and 6) a traffic accident problem at the CTH BB intersection with South Lake Shore Drive/Willow Road.

ALTERNATIVE AND RECOMMENDED TRAFFIC ENGINEERING AND ROADWAY IMPROVEMENT ACTIONS

The Commission staff considered a number of traffic engineering and other low cost roadway improvement actions to alleviate the existing and anticipated future traffic problems identified on the CTH BB study segment and at its intersection

with South Lake Shore Drive/Willow Road. Traffic engineering actions are relatively low cost, short-range improvements which be expected to alleviate existing traffic problems and which may be undertaken in the near future. Traffic engineering actions typically include pavement markings, signing, traffic control, and spot geometric improvements.

Traffic engineering actions may be expected to improve existing operating conditions. The effectiveness of such actions, however, may be expected to diminish as traffic volumes increase over time. As traffic volumes approach and exceed the roadway design capacity, operating conditions may again be expected to deteriorate, and a roadway improvement project may become necessary. Roadway improvement actions are relatively high cost, long range improvements which may be expected to alleviate both existing and probable future traffic problems.

Restricted Roadway Sight Distance

Several alternative traffic engineering actions were considered to abate the problem of restricted roadway sight distance due to the vertical curvature of the roadway on CTH BB just north of Lake Shore Drive/Willow Road. It may be noted that 73 percent of the accidents at this intersection were right-angle collisions and 46 percent of this type of accidents involved personal injuries.

The first alternative traffic engineering action considered to abate the problem of restricted roadway stopping sight distance was a reduction in the posted speed limit on CTH BB between Hillside Road and Lake Shore Drive/Willow Road from 45 to 35 miles per hour. The advantage of this alternative would be to ensure that the existing roadway stopping sight distance would be adequate to accommodate the range of typical travel speeds which may be expected based on the new speed limit. Another advantage of this alternative is that it may be implemented on a trial basis; its effectiveness evaluated; and a decision made to retain the 35 mile per hour speed limit or return to a 45 mile per hour limit. One disadvantage of this alternative is that a lack of development abutting this section of the study segment may tend to encourage higher speeds and compliance with the posted speed limit may decrease along with the percentage of motorists traveling within the 10 mile per hour range of pace speeds. Moreover, the existing roadway stopping sight distance would remain inadequate for motorists

exceeding the 85th percentile speeds. Nevertheless, because the available roadway stopping sight distance would be more adequate for the slower travel speeds which may be expected to result from the proposed speed limit reduction to 35 miles per hour, it is recommended that this alternative be implemented at an estimated cost of \$425.

One other alternative action considered to abate the problem of restricted roadway stopping sight distance on CTH BB was a spot geometric improvement to lower the existing crest of the vertical curve located about 300 feet north of South Lake Shore Drive/Willow Road by approximately two feet. The advantage of this alternative would be to eliminate the restricted roadway stopping sight distance on the study segment thereby improving traffic safety. The disadvantages of this alternative is its relatively high cost, and the time required to perform the necessary engineering design and roadway reconstruction. Because this alternative ensures that the necessary roadway stopping sight distance would be available, it is recommended for implementation at an estimated cost of \$115,000.

Restricted Intersection Sight Distance

The first alternative traffic engineering action considered to abate the problem of restricted intersection sight distance was the installation of intersection control beacons. Such 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. The advantage of this alternative is that it warns motorists that they are approaching a hazardous intersection. One disadvantage of this alternative is that it does not eliminate the intersection sight distance restriction problem. Further, such beacons tend to lose their effectiveness over time. Therefore, this alternative action is not recommended for implementation.

The second alternative traffic engineering action considered to abate the problem of restricted intersection sight distance was the installation of multi-way stop signs. This traffic engineering action requires that the warrants set forth in the Manual on Uniform Traffic Control Devices for the installation of multi-way stop signs be met. These warrants include: 1) that 5 or more traffic accidents

of a type susceptible to correction by a multi-way stop sign installation have occurred in the 12 months; 2) the average vehicular volume entering the intersection from all approaches during each of any 8 hours must average a minimum of 350 vehicles, for 85th percentile approach speed of the major street traffic over 40 miles per hour; and, 3) the average vehicular volume entering the intersection from the minor street during the same 8 hours must average a minimum of 140 vehicles, for 85th percentile approach speed of the major street traffic over 40 miles per hour.

The historic traffic accident data indicate that no more than four accidents have occurred in any 12 month period since January, 1989, and thus the accident warrant for the installation of multi-way stop signs is not met. Analysis of the vehicular volume entering the intersection of CTH BB and South Lake Shore Drive/Willow Road, is shown in Table 4, and indicates that the vehicle volumes entering this intersection are less than required to warrant the installation of multi-way stop signs. The installation of multi-way stop signs should generally not be considered at intersections where more than 60 percent of the total entering volume is on the major street approaches. The traffic volumes entering the intersection from CTH BB constitutes about 68 percent of the total volume entering the intersection. Motorists required to stop on one intersection approach when no vehicles are on the intersecting approaches tend to disrespect and may disregard the stop signs in effect creating a more dangerous situation as motorists on the minor street would expect all motorists to stop.

The installation of stop signs, while expected to reduce certain collision types such as right angle collisions, may increase other accident types such as rear end collisions. This potential for rear end accidents may be increased due to the crest of the hill located about 300 feet north of the intersection which obstructs the southbound motorists sight distance as they approach the intersection. Thus, this alternative is not recommended for implementation.

A third traffic engineering action considered to abate the problem of restricted intersection sight distance was the prohibition of parking on the paved shoulders in the southeast and southwest intersection quadrants. The advantage of this

Table 4

**MULTI-WAY STOP SIGN INSTALLATION WARRANT ANALYSIS OF
VEHICULAR VOLUME ENTERING THE INTERSECTION OF CTH BB
AND SOUTH LAKE SHORE DRIVE/WILLOW ROAD: 1993**

	Volume Observed By Hour During Highest Eight Hours								Average Volume Observed	Volume Required To Meet Warrant
	1	2	3	4	5	6	7	8		
Total vehicular volume entering the intersection from all approaches	378	367	320	295	276	271	261	257	303	500
Vehicular volume entering the intersection from the cross street	124	124	111	95	95	92	99	75	102	200

Source: SEWRPC

alternative would be to reduce the potential for parked vehicles to restrict sight distance to the south.

One disadvantage of this alternative is that the roadway shoulder is not readily discernable because owners of abutting properties have paved parking areas contiguous with the shoulders. Another disadvantage is that parking for the business in the southeast quadrant would be severely limited as this business provides limited parking off the public right-of-way. Because of its potential to eliminate sight restrictions due to parked vehicles, it is recommended that parking be prohibited on the paved roadway shoulders in the southeast and southwest quadrants. Implementation would require that pavement markings be applied to delineate the shoulders and that no parking signs be installed. The estimated cost of implementing this alternative is \$2,200.

One action considered to abate the problem of restricted intersection sight distance was to clear the obstructions at the intersection of CTH BB and South Lake Shore Drive/Willow Road, through the enforcement of Section 5.1 of The Zoning Ordinance, Walworth County, Wisconsin. This section of the Ordinance prohibits obstructions such as structures, parking, or vegetation above the height of two and one-half (2 1/2) feet within a triangle defined by the intersecting street right-of-way lines and a line joining points on such lines located fifty (50) feet from point of intersection.

The advantage of this action would be to ensure that sufficient intersection sight distance would be available for motorists on the minor street approaches to cross CTH BB without causing CTH BB traffic to reduce speed below the average running speed. The disadvantage of this alternative is an attendant loss of both on-street and off-street parking in the southwest quadrant of the intersection, and the loss of on-street parking in the southeast quadrant. The cost to implement this action would be borne by the property owner. It is recommended that the provisions of Section 5.1 of The Zoning Ordinance, Walworth County, Wisconsin, be enforced.

Substandard Driveway Spacing

The first action considered to mitigate the problem of substandard driveway

spacing at the intersection of CTH BB and South Lake Shore Drive/Willow Road was to seek the voluntary cooperation of current property owners whose parking is paved contiguous with the CTH BB shoulder to restrict the access to a single, clearly defined driveway. The advantage of providing a single, clearly defined driveway rather than permitting ingress or egress from any point is that motorists traveling on the study segment need then monitor only a single access point rather than having to monitor the entire length of the contiguously paved parking lot, thereby reducing the complexity of the driving task and improving traffic safety.

The disadvantage of providing a clearly defined driveway is that such retrofitting requires the voluntary cooperation of the owner of the affected property. It may be noted, however, that such changes in access may be required of the property owner as a condition of the necessary public approval when a change in the use of the parcel is requested by the property owner. Because of the potential to improve traffic safety and improve the operation of the intersection, it is recommended that Walworth County seek voluntary cooperation to provide clearly defined driveways to the parking areas which abut the CTH BB shoulders in the southeast and southwest quadrants of the CTH BB intersection with South Lake Shore Drive/Willow Road.

The second action considered to mitigate the problem of substandard driveway spacing at the intersection of CTH BB and South Lake Shore Drive/Willow Road intersection was to seek the voluntary cooperation of the current owners of abutting property to relocate driveway openings along CTH BB in conformance with the appropriate corner clearances set forth in Figure 4. This could impact the properties in all intersection quadrants except the northeast quadrant where there currently are no driveways. Consideration should be given to denying access on the major street if access to and from a parcel can be provided on the minor street. This action would be utilized in the southwest quadrant. The advantage of locating the driveways appropriate distances from the intersection reduces the potential for driveway traffic to interfere with traffic in the adjacent intersection thereby improving traffic safety. Restricting access to the intersecting minor street eliminates one conflict point which must be monitored by motorists on the major street.

The disadvantage of relocating existing driveways is that it requires the voluntary cooperation of the property owner. It may be noted, however, that such changes in access may be required as a condition of the necessary public approval when a change in the use of a parcel is requested by the property owner. Because of the potential to improve traffic safety and improve the operation of the intersection, it is recommended that Walworth County seek the voluntary cooperation to relocate existing driveways in the vicinity of the CTH BB intersection with South Lake Shore Drive/Willow Road to conform with the corner clearances set forth in Figure 4.

Thus, specific access recommendations at the CTH BB intersection with South Lake Shore Drive/Willow Road include seeking voluntary owner compliance to: 1) limit access to the property in the southwest quadrant to South Lake Shore Drive; 2) limit access to the property in the southeast quadrant of the intersection to a single driveway located a minimum of 140 feet southwest of Willow Road; and, 3) relocate the driveway in the northwest quadrant of the intersection to a point a minimum of 140 feet northeast of South Lake Shore Drive. It is further recommended that said access recommendations be required as a condition of approval should a request be made for change in the existing use of the impacted parcels.

Vehicular Speeding Problem

The first traffic engineering action considered to abate the modest speeding problem identified on the CTH BB study segment was to lengthen the existing 45 mile per hour speed zone by relocating the existing warning reduced speed ahead and regulatory speed signs about 500 feet to the southwest of their present location. The advantage of this alternative is to provide additional time for motorists traveling northeast on the study segment to reduce travel speeds in advance of the study segment and in particular Traver School, to the posted speed limit. Further, motorists traveling southwest on the study segment would not begin to accelerate until after they were southwest of the study segment. Another advantage of this alternative is that the percentage of motorists traveling within the 10 mile per hour pace range of speeds may be expected to modestly increase particularly in the Traver School area as motorists would not be transitioning from one speed zone to another in the immediate vicinity of the

school. Another advantage of this alternative may be implemented on a trial basis; its effectiveness evaluated; and a decision made to retain the 45 mile per hour speed limit or return to 55 miles per hour.

There are no disadvantages to implementing this alternative. Therefore, it is recommended that the reduced speed zone be extended southwest along the study segment for a distance of 500 feet. The estimated cost to implement this alternative is \$600.

The second traffic engineering action considered to abate the problem of vehicular speeding was to reduce the speed limit from 45 to 35 miles per hour. The primary advantage of this alternative is to reduce travel speeds on the study segment south of the South Lake Shore Drive/Willow Road intersection and in particular in the Traver School vicinity with an attendant potential to improve traffic safety. Another advantage is that the proposed speed limit is the same as proposed for the study segment between South Lake Shore Drive/Willow Road and Hillside Road resulting in a uniform speed limit over the entire study segment. Another advantage is that the percentage of motorists traveling within the 10 mile per hour pace range of speeds may be expected to modestly increase. Yet another advantage is that this alternative may be implemented on a trial basis; its effectiveness evaluated; and a decision made to retain the 35 mile per hour speed limit or return to 45 miles per hour.

The disadvantage of this alternative is that the 15 percent of motorists currently disregarding the posted speed limit may be expected to continue to disregard the posted speed limit. Unless these motorists also correspondingly reduce their travel speeds in response to the reduced speed limit, the disparity in travel speeds between the fastest vehicles on the study segment and the general traffic stream would increase. This has the potential to increase the severity of traffic accidents.

Another disadvantage of this alternative is that the existing posted speed limit on CTH BB northeast of the study segment--between Hillside Road and Loramoor Drive--is 45 miles per hour. Between Loramoor Drive and STH 120 the posted speed limit is 35 miles per hour. Thus, the posted speed limit would vary from 55

miles per hour southwest of the study segment to 35 miles per hour through the study segment to 45 miles per hour for a distance of 0.66 miles northeast of the study segment before dropping again to 35 miles per hour. Therefore, it is recommended that the posted speed limit on the CTH BB study segment and that portion of CTH BB northeast of the study segment from Hillside Road to Loramoor Drive be reduced from 45 to 35 miles per hour. The estimated cost to implement this alternative is \$1,000.

The final action considered to abate the modest speeding problem identified on the CTH BB study segment was an increase in directed law enforcement activity to enforce the posted speed limit on a random basis. Compliance with posted speed limits may be expected to substantially improve when law enforcement officials are present. This activity may in particular be utilized to increase compliance with the 15 mile per hour speed limit in force in the designated school zone at Traver School when children are present. The disadvantage of this alternative is that compliance with posted speed limits decreases in the absence of law enforcement officials. It is recommended that random directed enforcement activity be undertaken on the study segment between the hours of 6:00 a.m. and 6:00 p.m. at a rate of ten hours per month. It is estimated that the cost to implement this alternative is \$3,000 annually.³

Vehicular Accidents

The final problem identified on the study segment was a vehicular accident problem both with respect to the observed annual increase in the incidence of vehicular accidents and the concentration of accidents at the CTH BB intersection with South Lake Shore Drive/Willow Road. A number of the alternative traffic engineering or other low-cost short range alternative actions which have already been recommended to specifically address other problems identified on the study segment may also be expected to reduce the trend in the annual increase in the incidence of traffic accidents. The actions already recommended which may be expected to abate the vehicular accident problem on the study segment include:

³This cost reflects only the time directly spent in directed enforcement activities and does not include any attendant costs which may result such as time for court appearances.

1) lowering the crest of the vertical curve located about 300 feet north of the CTH BB intersection with South Lake Shore Drive/Willow Road; 2) improving vision triangles at the CTH BB intersection with South Lake Shore Drive/Willow Road; 3) prohibiting parking on the shoulders near the CTH BB intersection with South Lake Shore Drive/Willow Road; 4) access restrictions in the vicinity of the South Lake Shore Drive/Willow Road intersection with CTH BB; 5) reducing the speed limit on the study segment from 45 to 35 miles per hour; and, 6) directed enforcement activity to enforce the posted speed limits.

Because of the concentration of accidents at the CTH BB intersection with South Lake Shore Drive/Willow Road, the Commission staff also reconsidered a number of traffic engineering actions which had previously been considered but rejected. These included the installation of multi-way stop signs and the installation of a hazardous location beacon. Neither of these actions are recommended at this time.

Another traffic engineering action considered to abate the accident problem at the CTH BB intersection with South Lake Shore Drive/Willow Road was the addition of an advisory plate to the existing "Cross Road" warning signs to indicate the distance from the sign to the intersection. The advantage of this alternative is that the motorist is presented with information about the location of the intersection.

The disadvantage of this alternative is that an advisory speed plate is currently mounted on the same post as the "Cross Road" warning sign. The addition of a second advisory plate may present more information than the motorist can readily assimilate. Because the "Cross Road" warning sign is a readily and easily understood pictograph and because both the advisory speed and distance plates have brief messages, this alternative is recommended for implementation. The estimated cost to implement this action is \$400.

Two other actions to abate the vehicular accident problem at the CTH BB intersection with South Lake Shore Drive/Willow Road intersection were considered but rejected. The first action was the installation of rumble strips on the CTH BB intersection approaches. Rumble strips are intended to alert motorists to

unusual traffic conditions. Because appropriate signing already warns motorists of the intersection and because the noise attendant to the rumble strips would be considered annoying by adjacent property owners and may carry as far as Traver School, this action was rejected.

The other action considered was the construction of an exclusive left turn lane on the eastbound intersection approach. The advantage of this action is that overall delay on this approach would be reduced. The pattern of right angle collisions may indicate that delay on this approach has reached the level at which motorists accept shorter and shorter gaps in the traffic stream on CTH BB to attempt to enter or cross the CTH BB and are occasionally trying to utilize a gap which is too short and an accident results. The disadvantage of this alternative is that vehicles side by side in adjacent lanes would block the vision of the motorist in the adjacent vehicle which may increase the accident potential at this intersection. Further, only 220 vehicles per average weekday, or about 21 percent of the total 1,095 vehicles on this approach, do not turn left. This volume does not warrant construction of an exclusive lane. Thus, this action was rejected.

Substandard Acute Angle of Intersection

No traffic engineering action may be expected to eliminate the problem of the substandard acute angle of intersection at the CTH BB intersection with South Lake Shore Drive/Willow Road. There are, however, traffic engineering actions and other actions which may be expected to reduce the potential for accidents.

The following actions were considered and recommended: 1) a reduction in the speed limit on CTH BB from 45 miles per hour to 35 miles per hour between Hillside Road and South Lake Shore Drive/Willow Road; 2) a spot geometric improvement to lower the crest of the vertical curve located about 300 feet north of South Lake Shore Drive/Willow Road; 3) the prohibition of parking on the paved shoulders in the southeast and southwest quadrants of the CTH BB intersection with South Lake Shore Drive/Willow Road; and, 4) enforcement of Section 5.1 of the Shoreland Zoning Ordinance for Walworth County to provide improved sight triangles on all intersection approaches. Also considered but rejected were: 1) the installation of an intersection control beacon; and 2) the installation

of multi-way stop-sign control at the CTH BB intersection with South Lake Shore Drive/Willow Road.

Summary of Short-Range Low-Cost Actions

A number of short-range, low-cost actions are recommended to abate the traffic problems identified on the CTH BB study segment. These actions are listed in Table 5. Although certain actions were specifically recommended to abate one problem, these actions may be expected to help abate other problems as well. The recommendation to prohibit on-street parking may be expected to improve traffic safety as well as providing unrestricted sight distance at selected intersections. An increase in directed law enforcement activity may be expected to improve traffic safety in addition to abating the problem of vehicular speeding on the study segment. Thus, implementation of the recommended actions may be expected to promote a general improvement in the traffic operating conditions experienced under existing average weekday traffic volumes.

ALTERNATIVE ROADWAY IMPROVEMENT ACTIONS

LONG-RANGE PLAN

Three long-range alternative roadway improvement actions described herein also were considered to abate the substandard acute angle of intersection problem. These actions may be considered long range because of the time required for design, potential environmental impact assessments, right-of-way acquisition, budgeting and programming, and construction. They may, as well, abate other existing identified problems related to access, and intersection and roadway sight distance.

It may be noted that the addition of Willow Road between CTH BB and STH 120 to the arterial street and highway system as a county trunk highway; and the transfer of CTH BB between Willow Road and STH 120 from the county arterial system to the local arterial system has long been recommended to the Town of Linn. These transfers were first proposed during the preparation of a jurisdictional highway system plan for Walworth County which was adopted in 1972. These proposed transfers were reaffirmed in 1978 with the adoption of the second-generation regional transportation system plan; and again in 1991 during a

Table 5

RECOMMENDED SHORT-RANGE, LOW-COST ACTIONS TO ALLEVIATE
TRAFFIC PROBLEMS IDENTIFIED ON THE CTH BB STUDY SEGMENT

Traffic Problem	Recommended Action	Implementing Agency	Estimated Cost
Restricted roadway sight distance	Reduce speed limit from 45 to 35 miles per hour between this intersection and Hillside Road	Walworth County	\$ 125
	Lower the crest of the vertical curve located about 300 feet north of the CTH BB intersection with South Lake Shore Drive/Willow Road.	Walworth County	\$115,000
Restricted intersection sight distance at South Lake Shore Drive/Willow Road	Prohibit parking on the paved shoulders in the southeast and southwest intersection quadrants.	Walworth County	\$ 2,200
	The creation or improvement of vision triangles at the intersections as required in Section 5.1 of The Shoreland Zoning Ordinance for Walworth County.	Walworth County Town of Linn	--
Substandard driveway spacing	Seek voluntary owner compliance to: 1) limit access to the property in the southwest quadrant of the CTH BB intersection with South Lake Shore Drive/Willow Road to South Lake Shore Drive; 2) limit access to the property in the southeast quadrant of the CTH BB intersection with South Lake Shore Drive/Willow Road to a single driveway located a minimum of 140 feet southwest of Willow Road; and, 3) relocate the driveway in the northwest quadrant of the CTH BB intersection with South Lake Shore Drive/Willow Road to a point a minimum of 140 feet northeast of South Lake Shore Drive	Walworth County	--
	Require as a condition of approval, the access changes identified above should a request be made for a change in the existing use of the impacted parcels.	Walworth County/ Town of Linn	--
Modest vehicular speeding	Lengthen the existing 45 mile per hour speed zone by extending it for a distance of about 500 feet southwest of its current terminus at Brink Road.	Walworth County	\$ 600
	Reduce the speed limit from 45 to 35 miles per hour from a point about 500 feet southwest of Brink Road to South Lake Shore Drive/Willow Road and from Hillside Road to Loramoor Drive.	Walworth County	\$ 1,000
	Provide 10 manhours monthly of directed enforcement activity on a random basis between the hours 6:00 a.m. and 6:00 p.m.	Walworth County	\$ 3,000 ^a Annually

Table 5 (continued)

RECOMMENDED SHORT-RANGE, LOW-COST ACTIONS TO ALLEVIATE
TRAFFIC PROBLEMS IDENTIFIED ON THE CTH BB STUDY SEGMENT

Traffic Problem	Recommended Action	Implementing Agency	Estimated Cost
Vehicular Accidents	Post a distance advisory plate on the "Cross Road" warning signs informing motorists of the South Lake Shore Drive/Willow Road intersection.	Walworth County	\$ 400
	Other actions which have been specifically identified to abate the other problems on the study segment may also be expected to help alleviate the vehicular accident problem. These include: 1) lowering the crest of the vertical curve; 2) improving the vision triangles at the South Lake Shore Drive/Willow Road intersection; 3) prohibition of parking on the shoulders near the South Lake Shore Drive/Willow Road intersection; 5) reducing the speed limit on the study segment from 45 to 35 miles per hour; and, 6) directed enforcement activity.	Walworth County Town of Linn	
Substandard acute angle of intersection	Although no traffic engineering or other low cost action will abate this problem, other actions which have been specifically identified to abate the other problems on the study segment may also be expected to help alleviate the vehicular accident problem. These include: 1) lowering the crest of the vertical curve; 2) improving the vision triangles at the South Lake Shore Drive/Willow Road intersection; 3) prohibition of parking on the shoulders near the South Lake Shore Drive/Willow Road intersection; 5) reducing the speed limit on the study segment from 45 to 35 miles per hour; and, 6) directed enforcement activity.	Walworth County Town of Linn	

^aThis cost reflects only the time spent in directed enforcement activities and does not include any attendant costs which may result such as time for court appearances.

Source: SEWRPC.

Walworth County jurisdictional highway system plan reevaluation. Thus, any long range action taken should not preclude implementation of these transfers but should advance the transfers.

The first long-range, roadway improvement considered to abate the problem of the substandard acute angle of intersection between CTH BB and South Lake Shore Drive/Willow Road was to relocate the intersection of these two facilities to improve the angle of intersection between them. Two subalternatives were considered. The first subalternative--subalternative A--is shown on Map 2 and would create two new intersections approximately 600 feet apart. The legs of South Lake Shore Drive and Willow Road would be realigned at CTH BB resulting in an angle of intersection of approximately 90 degrees with the existing legs removed. The primary advantage of subalternative A is that the acute angle of intersection is increased from the existing 41 degrees to about 90 degrees. This angle is the optimal angle of intersection between two facilities, and, thus the time of exposure for motorists crossing CTH BB is minimized and the need to look back over the shoulder for oncoming traffic is eliminated. The driveway in the northwest quadrant of the intersection could be realigned directly across from relocated Willow Road. The driveway in the southeast quadrant of the existing intersection could be realigned directly across CTH BB from the South Lake Shore Drive leg. Finally, lowering the crest of the hill located about 300 feet north of the existing intersection should be done at the same time thereby eliminating the roadway sight distance problem.

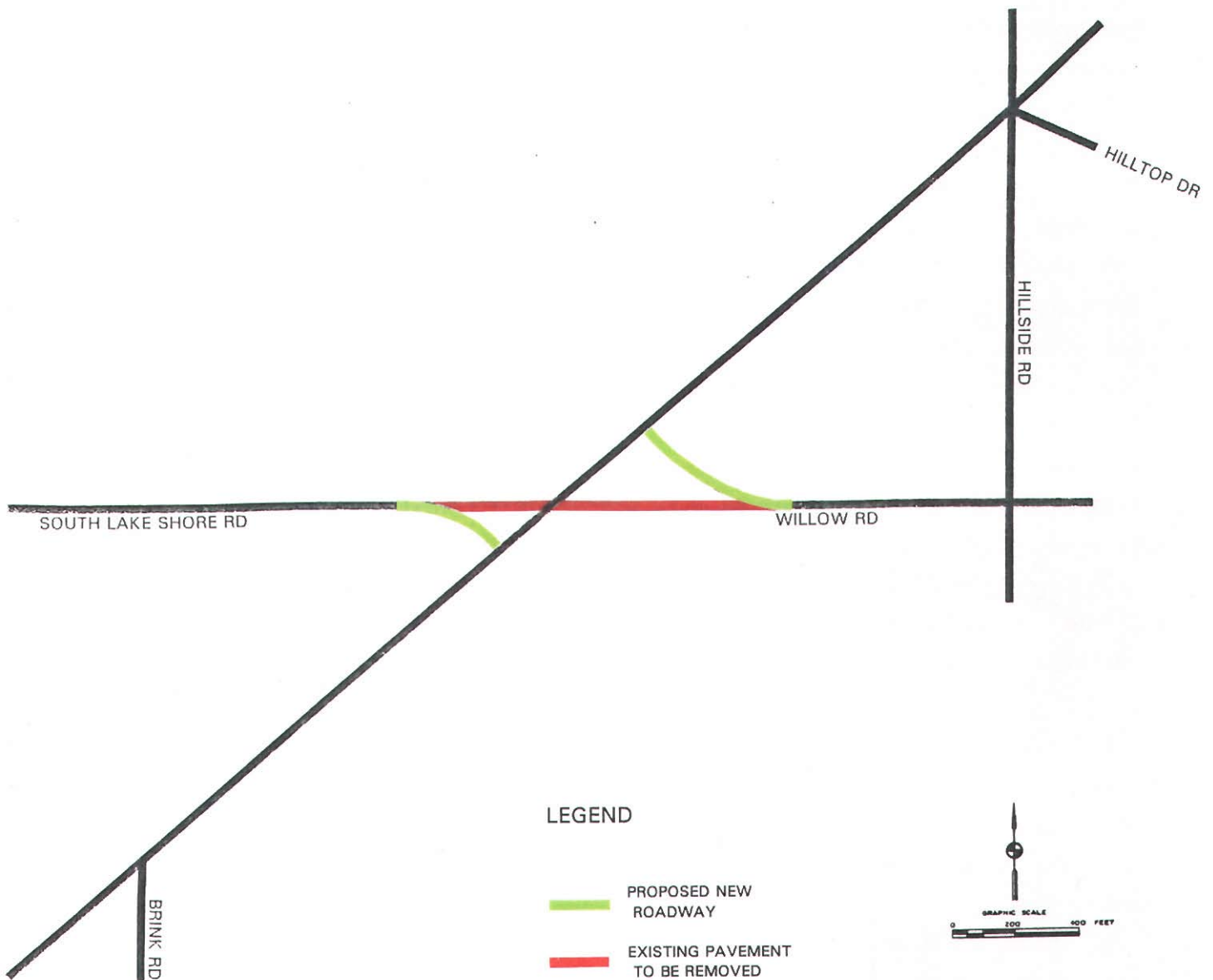
The disadvantages of this alternative roadway improvement include: 1) the creation of two intersections in place of the existing single intersection; and, 2) the need to acquire and displace the business in the southwest quadrant of the existing CTH BB intersection with South Lake Shore Drive/Willow Road. It may be noted that the creation of two intersections results in turning movements for all vehicles on the South Lake Shore Drive/Willow Road intersection legs, even for motorists who may currently proceed directly across CTH BB from one leg to the other.

Another disadvantage of this subalternative is that the through movement on CTH BB would continue to be emphasized. While this does not preclude implementation

Map 2

LONG-RANGE ROADWAY IMPROVMENT ALTERNATIVE ONE
CONSIDERED TO ABATE THE SUBSTANDARD ACUTE ANGLE OF INTERSECTION AT
THE CTH BB INTERSECTION WITH SOUTH LAKE SHORE DRIVE/WILLOW ROAD

Subalternative A



Source: SEWRPC.

of the long recommended jurisdictional transfers described at the beginning of this section of the report, neither does it serve to advance their implementation.

The estimated cost to implement this subalternative is approximately \$880,000 including right-of-way. Because implementation of this alternative results in two intersections and because one business would be displaced, and because it does not serve to advance implementation of the long proposed jurisdictional transfers, this subalternative is not recommended for implementation.

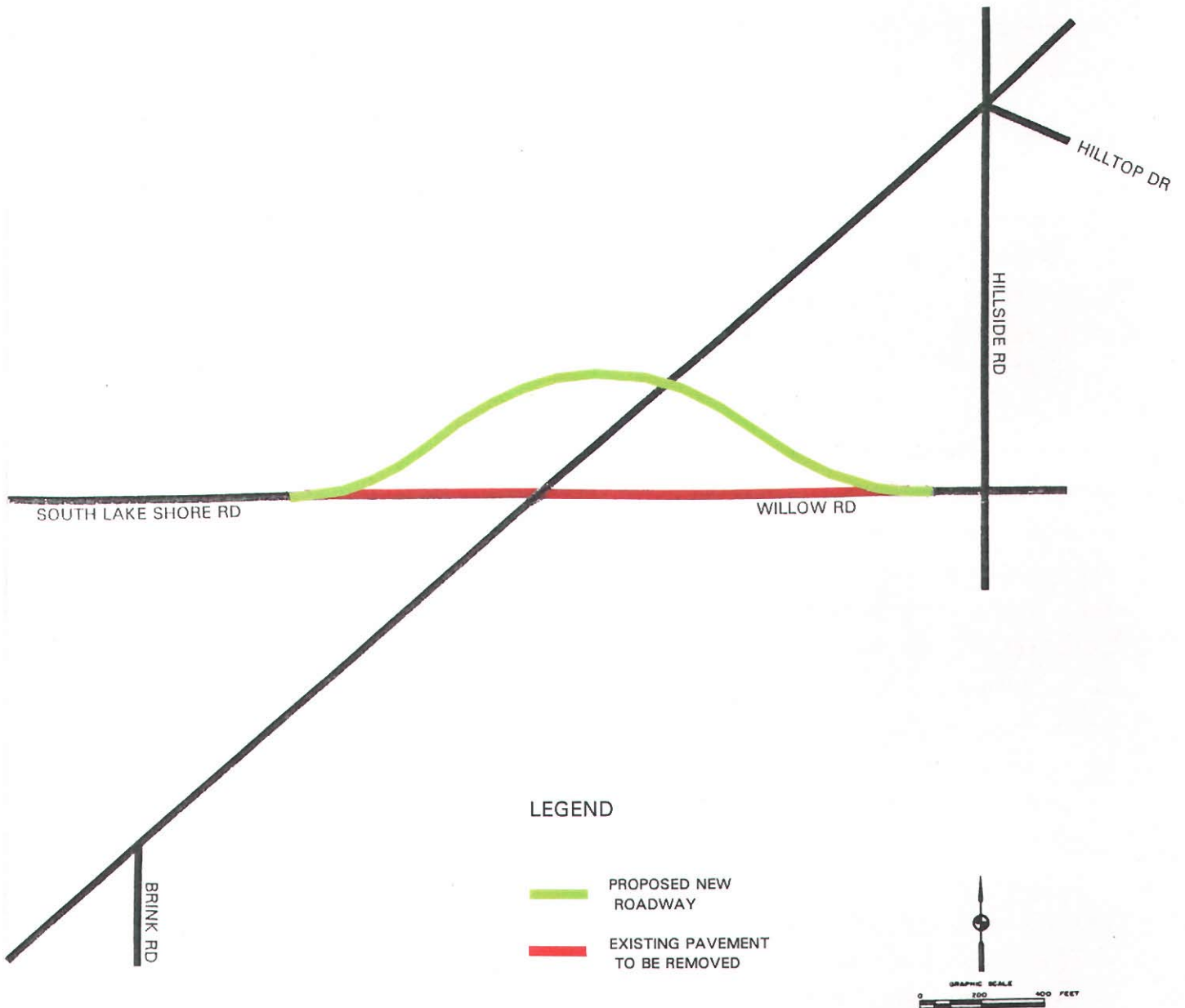
The second subalternative considered--subalternative B--is also shown on Map 2. This subalternative would result in a new intersection approximately 500 feet north of the existing intersection and would have an angle of intersection about 65 degrees. The existing South Lake Shore Drive and Willow Road legs would be removed.

The primary advantage of subalternative B is that the acute angle of intersection is increased from the existing 41 degrees to about 65 degrees. This angle is greater than the minimum desirable angle of intersection of 60 degrees, and, thus the time of exposure for motorists crossing CTH BB is reduced and the need to look back over their shoulder for oncoming traffic is eliminated. Traffic safety is therefore improved. All substandard driveway corner clearance problems would be eliminated under this subalternative. Another advantage of this subalternative is that disruption to abutting development is minimized as no businesses or residences are displaced. Finally, the crest of the hill located about 300 feet north of the existing intersection may be lowered at the same time thereby eliminating the roadway sight distance problem.

The disadvantages of this subalternative roadway improvement include: 1) the need to acquire approximately 5.5 acres of right-of-way; 2) the optimum angle of intersection between CTH BB and the intersecting roadways is not achieved; and, 3) the new roadway would be on a horizontal curve through the intersection. Ideally, a tangent section would be carried through the intersection.

Map 2 (Continued)

Subalternative B



Source: SEWRPC.

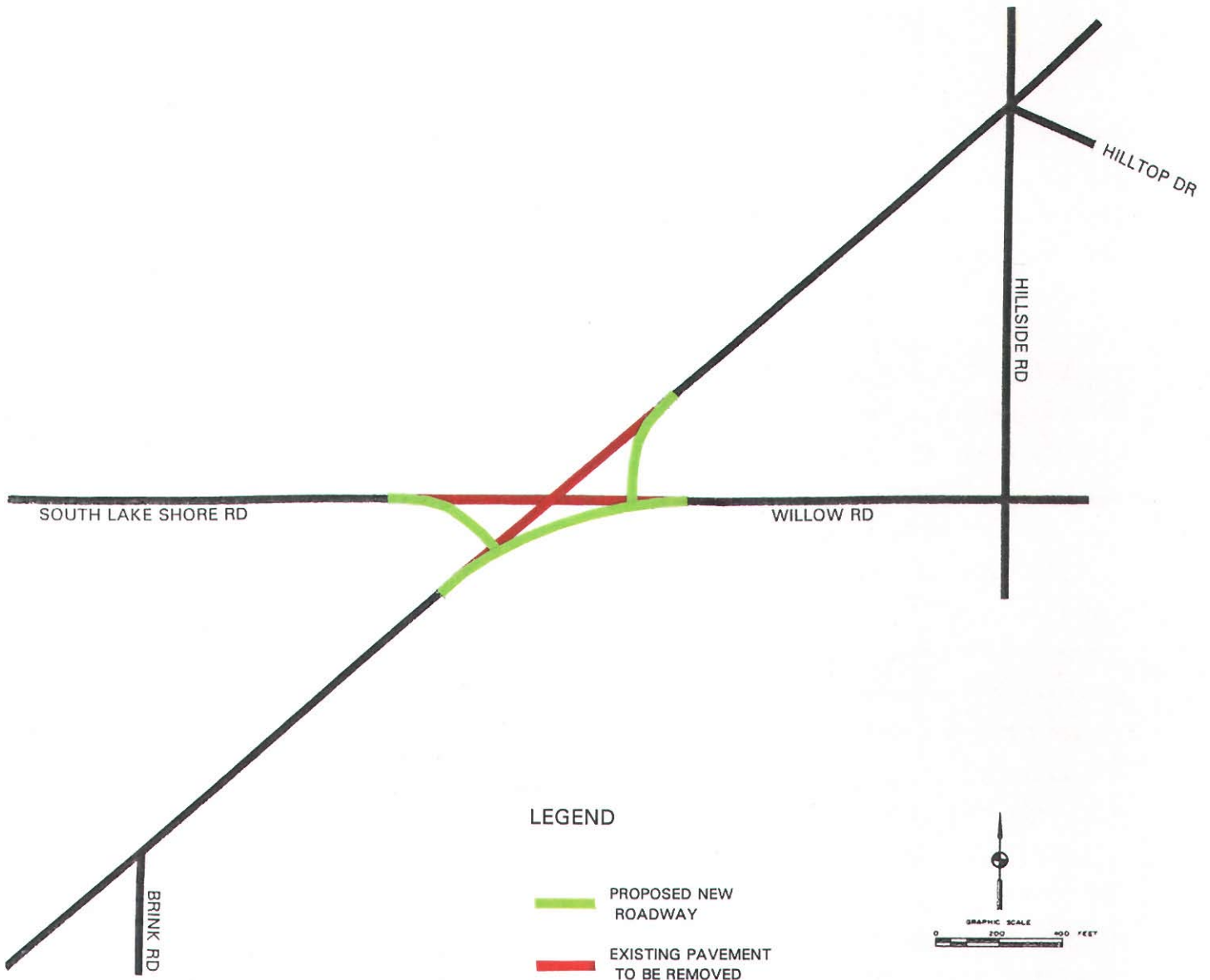
Another disadvantage of this subalternative is that without physical reconstruction to emphasize travel between CTH BB and Willow Road, the through movement on CTH BB would continue to be emphasized. While this does not preclude implementation of the long recommended jurisdictional transfers described at the beginning of this section of the report, neither does it serve to advance their implementation.

The estimated cost to implement this subalternative is approximately \$1.1 million. Because this subalternative does not achieve the optimal angle of intersection between intersecting roadways and because it does not serve to advance implementation of the long recommended jurisdictional transfers, this subalternative is not recommended for implementation.

The second long-range, roadway improvement alternative considered to abate the problem of the substandard acute angle of the intersection identified on the study segment of CTH BB was to reconstruct the existing intersection of CTH BB and South Lake Shore Drive/Willow Road to physically encourage travel between CTH BB south of the intersection and Willow Road as shown in Map 3. As shown on Map 3, the South Lake Shore Drive leg and the CTH BB leg north of the intersection would also be reconstructed. The advantages of this alternative roadway improvement include: 1) the acute angle of intersection is increased from the existing 41 degrees to about 90 degrees, the optimal angle of intersection between two facilities; 2) traffic safety is improved as the time of exposure for motorists crossing CTH BB is minimized and the need for motorists to look back over their shoulder for oncoming traffic is eliminated; 3) the two new intersections are located approximately 500 feet apart, a sufficient distance to eliminate the potential for operational interference from the adjacent intersection; 4) reconstruction of the intersection would be expected to eliminate the substandard corner clearance and unrestricted access problems identified at the intersection, as well as the restricted roadway sight distance problem identified on the study segment; and, 5) implementation of the long recommended jurisdictional transfers described at the beginning of this section of the report would be advanced.

Map 3

LONG-RANGE ROADWAY IMPROVEMENT ALTERNATIVE TWO
CONSIDERED TO ABATE THE SUBSTANDARD ACUTE ANGLE OF INTERSECTION AT
THE CTH BB INTERSECTION WITH SOUTH LAKE SHORE DRIVE/WILLOW ROAD



The primary disadvantage of this alternative is that it may be expected to displace one residence and three businesses. Other disadvantages of this alternative are: 1) the single existing intersection would be replaced with two intersections; and, 2) the modest vehicular speeding problem identified on the study segment would not be eliminated.

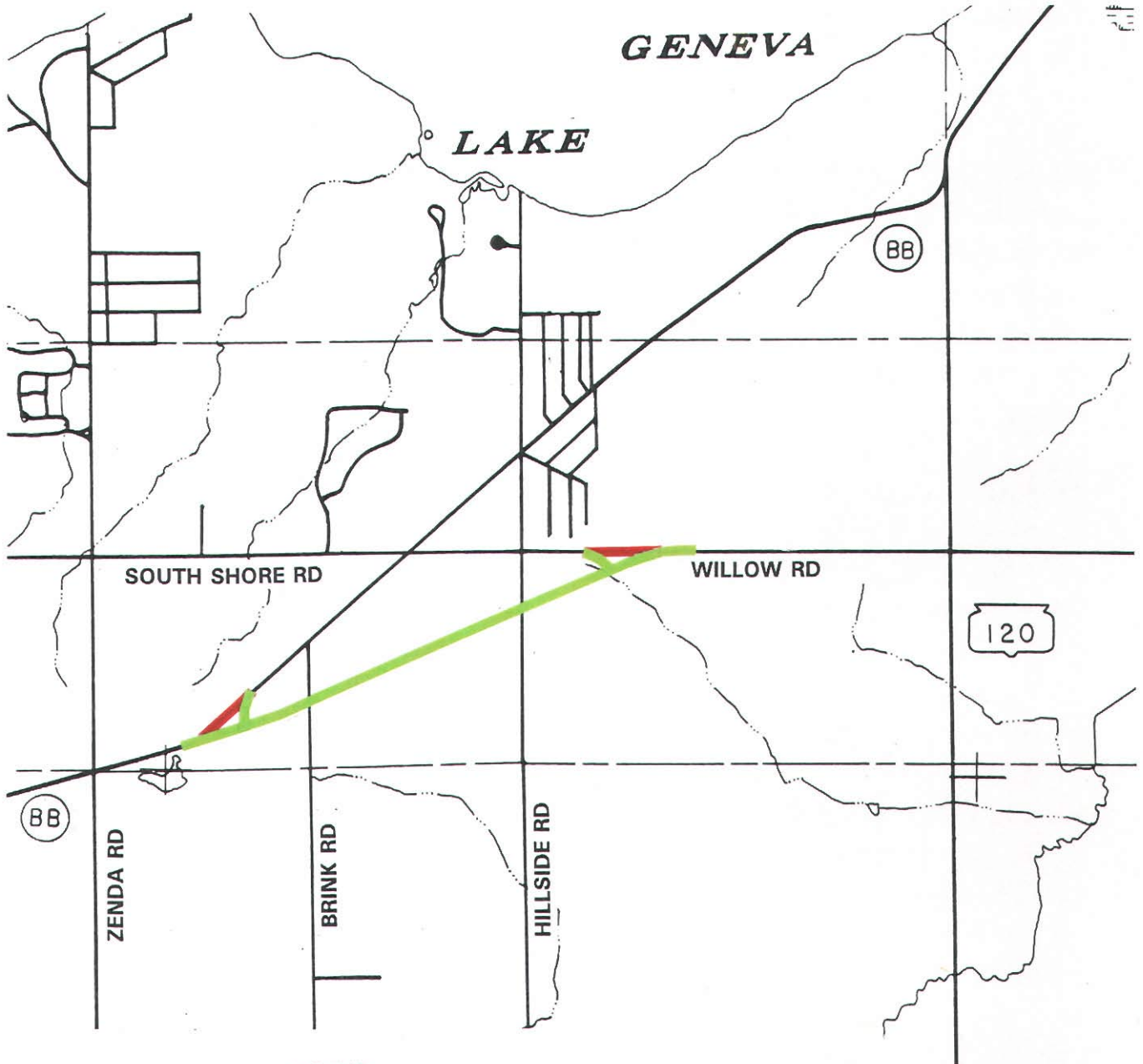
The estimated cost to implement this alternative roadway improvement is approximately \$3.2 million including right-of-way. This estimated cost includes an estimate of the cost to reconstruct approximately 1.2 miles of Willow Road to a high standard facility including two 12 foot wide travel lanes and ten foot wide shoulders. Because this alternative eliminated the substandard acute angle of intersection; improves traffic safety; and serves to advance the recommended jurisdictional transfers, it is recommended for implementation.

The third long-range roadway improvement alternative--shown on Map 4--considered to abate the problem of a substandard acute angle of intersection between CTH BB and South Lake Shore Drive/Willow Road was to relocate CTH BB on new alignment by projecting the tangent of the existing horizontal curve located approximately 0.36 miles south of Brink Road on CTH BB to Willow Road east of Hillside Road.

The advantages of this alternative are 1) the traffic volume entering the CTH BB intersection with South Lake Shore Drive/Willow Road may be expected to be reduced by about 1,890 vehicles per average weekday; and, 2) it would serve to advance the long recommended jurisdictional transfers described at the beginning of this section of the report.

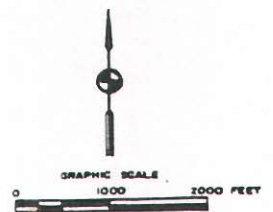
The disadvantages of this alternative include: 1) while the traffic safety problems may be expected to be corrected for the motorists traveling on re-routed CTH BB, the problems of restricted roadway sight distance, restricted sight distance due to angle of intersection, and obstructed vision corner at the existing CTH BB intersection with South Lake Shore Drive/Willow Road would not be abated; and, 2) approximately 20.0 acres of right-of-way would have to be acquired.

LONG-RANGE ROADWAY IMPROVEMENT ALTERNATIVE THREE
CONSIDERED TO ABATE THE SUBSTANDARD ACUTE ANGLE OF INTERSECTION AT
THE CTH BB INTERSECTION WITH SOUTH LAKE SHORE DRIVE/WILLOW ROAD



LEGEND

- PROPOSED NEW ROADWAY
- EXISTING PAVEMENT TO BE REMOVED



The estimated cost to implement this alternative roadway improvement is approximately \$4.25 million including right-of-way. This cost estimate includes an estimate of the cost to reconstruct approximately 0.64 miles of Willow Road to STH 120 to a high standard arterial including two 12 foot wide travel lanes with ten foot shoulders. Because of its cost and because it is not expected to abate any of the problems identified on the study segment, this alternative is not recommended for implementation.

SUMMARY

On March 16, 1993 the Walworth County Highway Commissioner requested that the Regional Planning Commission conduct a traffic safety study on the CTH BB between Brink Road and Hillside road in the Town of Linn, focusing particularly on its intersection with South Lake Shore Drive/Willow Road.

The Commission conducted a number of fiscal and operational inventories on the CTH BB study segment. With respect to the physical characteristics of the study segment, data were collected regarding pavement width, the horizontal and vertical alignment, the location of intersecting public streets and driveways, and the location of existing traffic control signs.

Based on these inventories, it may be noted that the study segment of CTH BB is constructed as a rural type cross-section with a 22 foot wide pavement and 5 foot wide shoulders. The study segment is intersected by public streets at three locations and driveways at 15 locations. The horizontal alignment of the study segment consists of a single tangent section. The vertical alignment consists of a series of gradients connected by two vertical curves; one is a "sag" vertical curve and one is a "crest" vertical curve. The low point of the "sag" vertical curve is located approximately at the intersection of the study segment with South Shore Lake Drive/Willow Road, and the high point of the "crest" vertical curve is located approximately 300 feet northeast of the intersection.

With respect to the operational characteristics of the study segment, 24 hour traffic volumes, operating speeds, and vehicular traffic accidents along the study segment were collected. A 14 hour manual turning movement count was also

conducted at the intersection of the study segment with South Lake Shore Drive/Willow Road. Approximately 3,550 vehicles per average weekday were observed on the study segment north of South Lake Shore Drive/Willow Road and about 2,150 vehicles per average weekday were observed south of South Lake Shore Drive/Willow Road. Based on the manual turning movement count data collected, approximately 46 percent of all vehicles entering the intersection of CTH BB with South Lake Shore Drive/Willow Road were observed engaging in a turning movement. The most substantial turning movement at the intersection was between the South Lake Shore Drive leg and the CTH BB leg north of the intersection.

A four and one-half year history of motor vehicle accident data were collected. A total of 20 accidents were reported along the study segment, none of which involved a fatality. A total of 9 of the accidents involved personal injuries and 11 accidents were property damage only. Of the 20 total accidents, 11 occurred at the intersection of CTH BB with South Lake Shore Drive/Willow Road. Eight of those 11 accidents were right angle collisions.

The spot speed study indicated that the 85th percentile speed was approximately 3.3 miles per hour over the posted 45 mile per hour speed limit. The 10 mile per hour pace range of speeds was between 39 and 48 miles per hour and included 70 percent of all motorists. The highest observed speed was 61 miles per hour.

The inventory data were compared to generally accepted traffic engineering standards to determine if any traffic problems exist on the study segment. Based on that comparison, a total of six existing traffic problems were identified on the CTH BB study segment. These included: 1) restricted stopping sight distance caused by the crest of the vertical curve on CTH BB about 300 feet north of South Lake Shore Drive/Willow Road; 2) restricted intersection sight distance at the intersection of CTH BB and South Lake Shore Drive/Willow Road; 3) a substandard acute of intersection between CTH BB and South Lake Shore Drive/Willow Road; 4) substandard driveway spacing; 5) the modest vehicular speeding problem; and, 6) a traffic accident problem at the CTH BB intersection with South Lake Shore Drive/Willow Road.

The Commission staff considered a number of traffic engineering and other low cost roadway improvement actions to alleviate the existing traffic problems identified on the CTH BB study segment. The actions recommended for implementation are set forth in Table 5.

Because none of the traffic engineering or other low cost roadway improvement actions recommended may be expected to eliminate the problem of the substandard acute angle of intersection between the CTH BB study segment and South Lake Shore Drive/Willow Road, and to advance the long recommended transfer of Willow Road between the CTH BB study segment and STH 120 to the County trunk arterial system, and the transfer of the existing segment of CTH BB between South Lake Shore Drive/Willow Road and STH 120 to the Town of Linn, three long range roadway improvements were also considered. The recommended long range roadway improvement proposes reconstruction of the existing CTH BB intersection with South Lake Shore Drive/Willow Road to physically encourage the movement between the CTH BB leg south of that intersection and Willow Road. A number of traffic engineering and other low cost roadway actions were considered but were not recommended for implementation. These include the installation of a hazard identification beacon, the installation of multi-way stop signs both at the intersection of CTH BB and South Lake Shore Drive/Willow Road. Finally, the installation of rumble strips on the CTH BB approaches to its intersection with South Lake Shore Drive/Willow Road was considered but rejected.

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APPENDIX

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INTERSECTION **CTH BB and Brink Rd.**
PERIOD **Four years** From **01-01-89** To **12-31-92**
MUNICIPALITY **Walworth Co./Town of Linn** Prepared by _____ Sheet _____



CTH BB

BRINK RD.

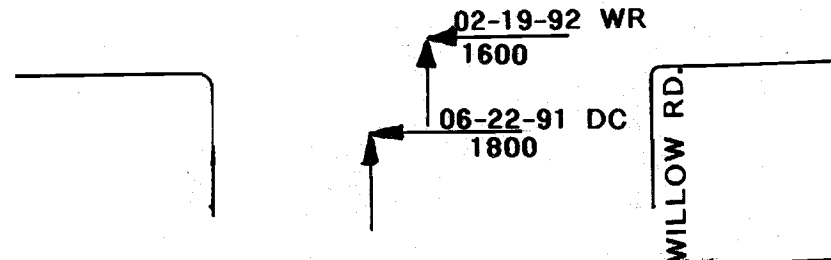
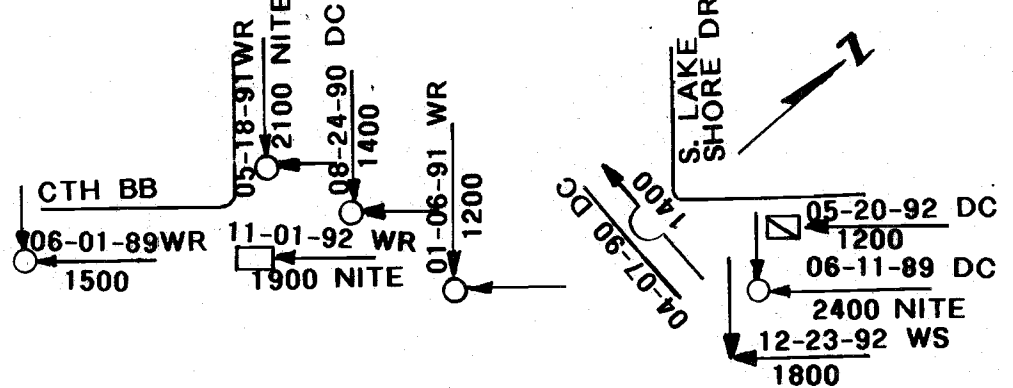
12-11-90 DC
1500 NITE

12-31-89 WS
0700 NITE

SHOW FOR EACH ACCIDENT	LEGEND		SUMMARY			
	SYMBOLS	TYPES OF COLLISION	TYPE	DAY	NIGHT	TOTAL
1. TIME, DAY, AND DATE.	← MOVING VEHICLE	↔ REAR END	FATAL	0	0	0
2. WEATHER: D = DRY; I = ICY; W = WET.	↔ BACKING VEHICLE	↔ HEAD ON	PEDESTRIAN INJURY	0	0	0
3. PAVEMENT: C = CLEAR; F = FOG; R = RAIN; SL = SLEET; S = SNOW.	← NONINVOLVED VEHICLE	↔ SIDESWIPE	OTHER INJURY	0	0	0
4. NITE - IF BETWEEN DUSK AND DAWN.	X --- PEDESTRIAN	↔ OUT-OF-CONTROL	PROPERTY DAMAGE ONLY	0	2	2
	☐ PARKED VEHICLE	↔ LEFT TURN	TOTAL	0	2	2
	☐ FIXED OBJECT	↔ RIGHT ANGLE				
	● FATAL ACCIDENT					
	○ INJURY ACCIDENT					

Source: SEWRPC.

INTERSECTION **CTH BB and S. Lake Shore Dr./Willow Rd.**
PERIOD **4 years** From **01-01-89** To **12-31-92**
MUNICIPALITY **Walworth Co./Town of Linn** Prepared by _____ Sheet _____



SHOW FOR EACH ACCIDENT	LEGEND		SUMMARY			
	SYMBOLS	TYPES OF COLLISION	TYPE	DAY	NIGHT	TOTAL
1. TIME, DAY, AND DATE.	← MOVING VEHICLE	↔ REAR END	FATAL	0	0	0
2. WEATHER: D = DRY; I = ICY; W = WET.	↔ BACKING VEHICLE	↔ HEAD ON	PEDESTRIAN INJURY	0	0	0
3. PAVEMENT: C = CLEAR; F = FOG; R = RAIN; SL = SLEET; S = SNOW.	← NONINVOLVED VEHICLE	↔ SIDESWIPE	OTHER INJURY	3	2	5
4. NITE - IF BETWEEN DUSK AND DAWN.	X --- PEDESTRIAN	↔ OUT-OF-CONTROL	PROPERTY DAMAGE ONLY	5	1	6
	☐ PARKED VEHICLE	↔ LEFT TURN	TOTAL	8	3	11
	☐ FIXED OBJECT	↔ RIGHT ANGLE				
	● FATAL ACCIDENT					
	○ INJURY ACCIDENT					

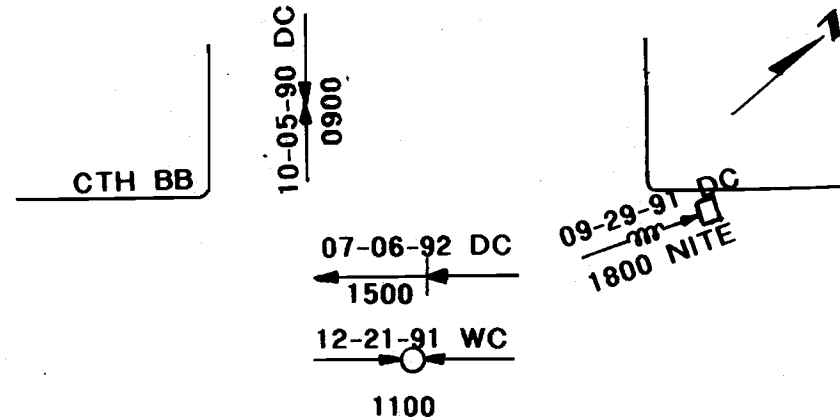
Source: SEWRPC.

COLLISION DIAGRAM
Southeastern Wisconsin Regional Planning Commission

INTERSECTION _____
 PERIOD _____ From _____ To _____
 MUNICIPALITY _____ Prepared by _____ Sheet _____

COLLISION DIAGRAM
Southeastern Wisconsin Regional Planning Commission

INTERSECTION CTH BB and Hillside Rd.
 PERIOD Four years From 01-01-89 To 12-31-92
 MUNICIPALITY Walworth Co./Town of Linn Prepared by _____ Sheet _____



SHOW FOR EACH ACCIDENT	LEGEND		SUMMARY			
	SYMBOLS	TYPES OF COLLISION	TYPE	DAY	NIGHT	TOTAL
1. TIME, DAY, AND DATE.			FATAL			
2. WEATHER: D = DRY; I = ICY; W = WET.	← MOVING VEHICLE	↔ REAR END	PEDESTRIAN INJURY			
	↔ BACKING VEHICLE	↔ HEAD ON	OTHER INJURY			
	← NONINVOLVED VEHICLE	↔ SIDESWIPE	PROPERTY DAMAGE ONLY			
	↔ OUT-OF-CONTROL	↔ LEFT TURN	TOTAL			
3. PAVEMENT: C = CLEAR; F = FOG; R = RAIN; SL = SLEET; S = SNOW.	X PEDESTRIAN	↔ RIGHT ANGLE				
	☐ PARKED VEHICLE					
	☐ FIXED OBJECT					
	● FATAL ACCIDENT					
4. NITE - IF BETWEEN DUSK AND DAWN.	○ INJURY ACCIDENT					

Source: SEWRPC.

SHOW FOR EACH ACCIDENT	LEGEND		SUMMARY			
	SYMBOLS	TYPES OF COLLISION	TYPE	DAY	NIGHT	TOTAL
1. TIME, DAY, AND DATE.			FATAL	0	0	0
2. WEATHER: D = DRY; I = ICY; W = WET.	← MOVING VEHICLE	↔ REAR END	PEDESTRIAN INJURY	0	0	0
	↔ BACKING VEHICLE	↔ HEAD ON	OTHER INJURY	2	1	3
	← NONINVOLVED VEHICLE	↔ SIDESWIPE	PROPERTY DAMAGE ONLY	2	0	2
	↔ OUT-OF-CONTROL	↔ LEFT TURN	TOTAL	4	1	5
	↔ RIGHT ANGLE					
3. PAVEMENT: C = CLEAR; F = FOG; R = RAIN; SL = SLEET; S = SNOW.	X PEDESTRIAN					
	☐ PARKED VEHICLE					
	☐ FIXED OBJECT					
	● FATAL ACCIDENT					
4. NITE - IF BETWEEN DUSK AND DAWN.	○ INJURY ACCIDENT					

Source: SEWRPC.