APPENDIX K

TRAFFIC IMPACT ANALYSIS

Menominee Casino-Hotel Project

Traffic Impact Analysis

Updated August 1, 2005

Prepared for:

Analytical Environmental Services
2021 "N" Street
Sacramento, California

Prepared by:

LAND STRATEGIES, INC
PLANNING/TRANSPORTATION/URBAN DESIGN

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Introduction & Executive Summary

Purpose of Report and Study Objectives

Land Strategies, Inc. conducted an analysis of the traffic impacts related to the proposed Project Eagle development located in Kenosha, Wisconsin. The purpose of the study was to determine the impact that the trips generated by the proposed development will have on the adjacent roadways, and what improvements are necessary to accommodate the future traffic volumes. The traffic study was prepared according to the Wisconsin Department of Transportation Traffic Impact Analysis Guidelines. These guidelines provide the standards for intersection operation, requirements for turn-lanes, turn-lane lengths, and sight distance.

Executive Summary

The proposed Project Eagle development proposes to construct approximately 107,300 square feet of casino gaming area, two hotels, a conference area, and a water park on the existing Dairyland Greyhound Race Track. The development will generate approximately 1,750 new trips during the weekday morning peak hour and 2,815 trips during the weekday evening peak hour. Traffic will ingress the site at the existing access drive on State Highway 158 and egress at a proposed signalized access drive along 104th Avenue as well as at the existing access drive on State Highway 158. It is recommended to widen 104th Avenue, signalize the intersection of County Highway K/104th Avenue , and construct a roundabout at the intersection of State Highway 158/104th Avenue. The geometric recommendations will be able to accommodate the 2017 total traffic volumes in the area.

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Proposed Development

On-Site Development

Development Description and Site Location

According to the current site plan for the Project Eagle Center, the development will consist of casino gaming area, two hotels, a conference area, and a water park. The site is located at the existing Dairyland Greyhound Park, which is bounded by Wisconsin State Highway 158 (STH 158) to the north, 60th Street to the south, 104th Avenue to the east, and the existing Dairyland Greyhound Park access drive to the west. The site is approximately 223 acres in size and is shown in **Exhibit 2-1**.

Land Use and Intensity

The site will consist of a total of 107,300 square feet of gaming area, two hotels, a conference area, and a water park. The site plan is shown on **Exhibit 2-2**.

Development Phasing and Timing

The development will be constructed in three phases. Phase I includes 92,800 square feet of gaming area, an 86,400 square foot event hall, and 49,400 square feet of retail and is projected to be completed by June 2007; Phase II includes an additional 15,100 square feet of gaming area, a 600 room hotel, a 54,400 square foot conference room, and a 41,600 square foot spa/health club and is scheduled to be completed by June 2009; Phase III includes a 500 room hotel and a 50,000 square foot water park, but has no scheduled completion date. The site plan with the phasing schedule is shown on **Exhibit 2-3**.

Study Area

Influence Area

The majority of the trips will be generated from outside the Kenosha area as the casino is more of a regional trip generator. The remainder of the trips will be generated locally from the city of Kenosha.

Area of Significant Traffic Impact

As requested by WisDOT, the traffic study analyzed Wisconsin State Highway 158 from Interstate 94 to County Highway H and the East Frontage Road from County Highway K to Wisconsin Highway 158. Since the majority of the trips generated by the development are expected to arrive from/depart to Interstate 94, Land Strategies, Inc. is in agreement with the boundaries of the traffic study proposed by WisDOT

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SITE LOCATION

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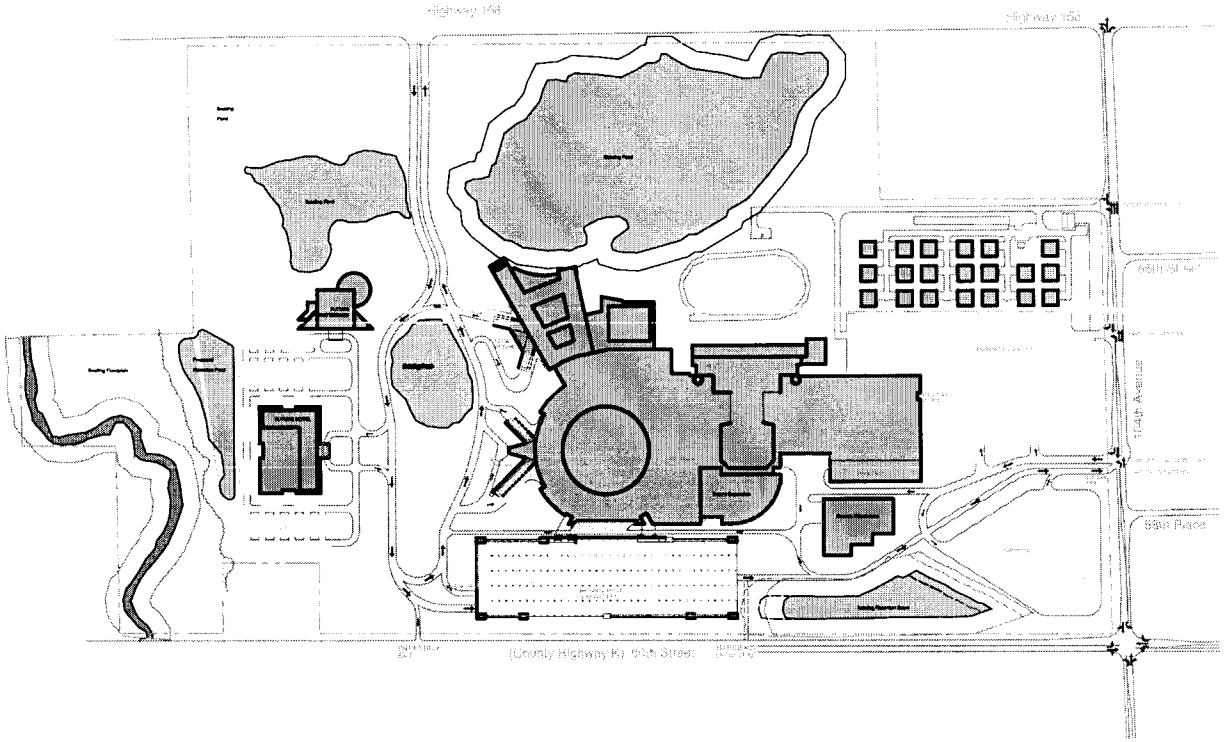
EXHIBIT 2-1

Kenosha Casino

SCALE: NOT TO SCALE
DATE: 11/11/04

N



SITE PLAN

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EXHIBIT 2-2

Menominee Casino-Hotel Project

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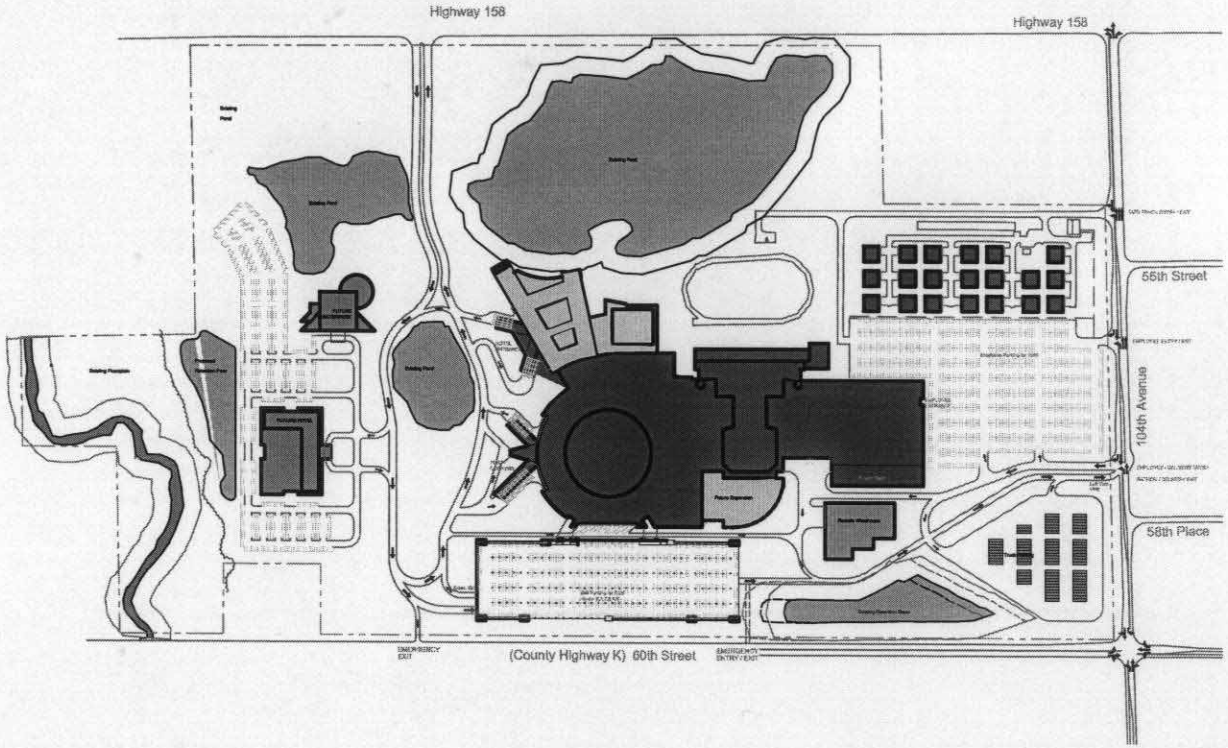

Legend:

- : Phase I Development
- : Phase II Development
- : Phase III Development

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EXHIBIT 2-3

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SITE PHASING PLAN

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Off-Site Land Use and Development

The Kenosha Regional Airport is located on the north side of Wisconsin State Highway 158, opposite the site. The Business Park of Kenosha is located to the west of 104th Avenue and has an access drive on 95th Avenue. Residential uses are located to the south of County Highway K.

Based on information provided by the Kenosha Department of City Development, the following developments are proposed in the area:

- Kilbourn Woods, 98 Single Family Homes
- Tylers Ridge, 155 Single Family Homes
- Peterson Golden Meadows, 329 Single Family Homes
- Business Park of Kenosha Phase 2 – 74.36 acres

Exhibit 2-4 shows the proposed land uses in the area.

According to WisDOT, there are plans to improve the I-94 Ramps and Frontage Road intersections with STH 158. The current functional plan, completed in 1996, calls for a diamond interchange to be built and for the frontage roads to be re-located. According to the functional plan, both the I-94 NB Ramp and the eastern frontage road are proposed to be signalized. The I-94 NB ramp is located approximately 400 feet east of the I-94 SB ramp and the eastern frontage road is approximately 350 feet east of the I-94 NB ramp.

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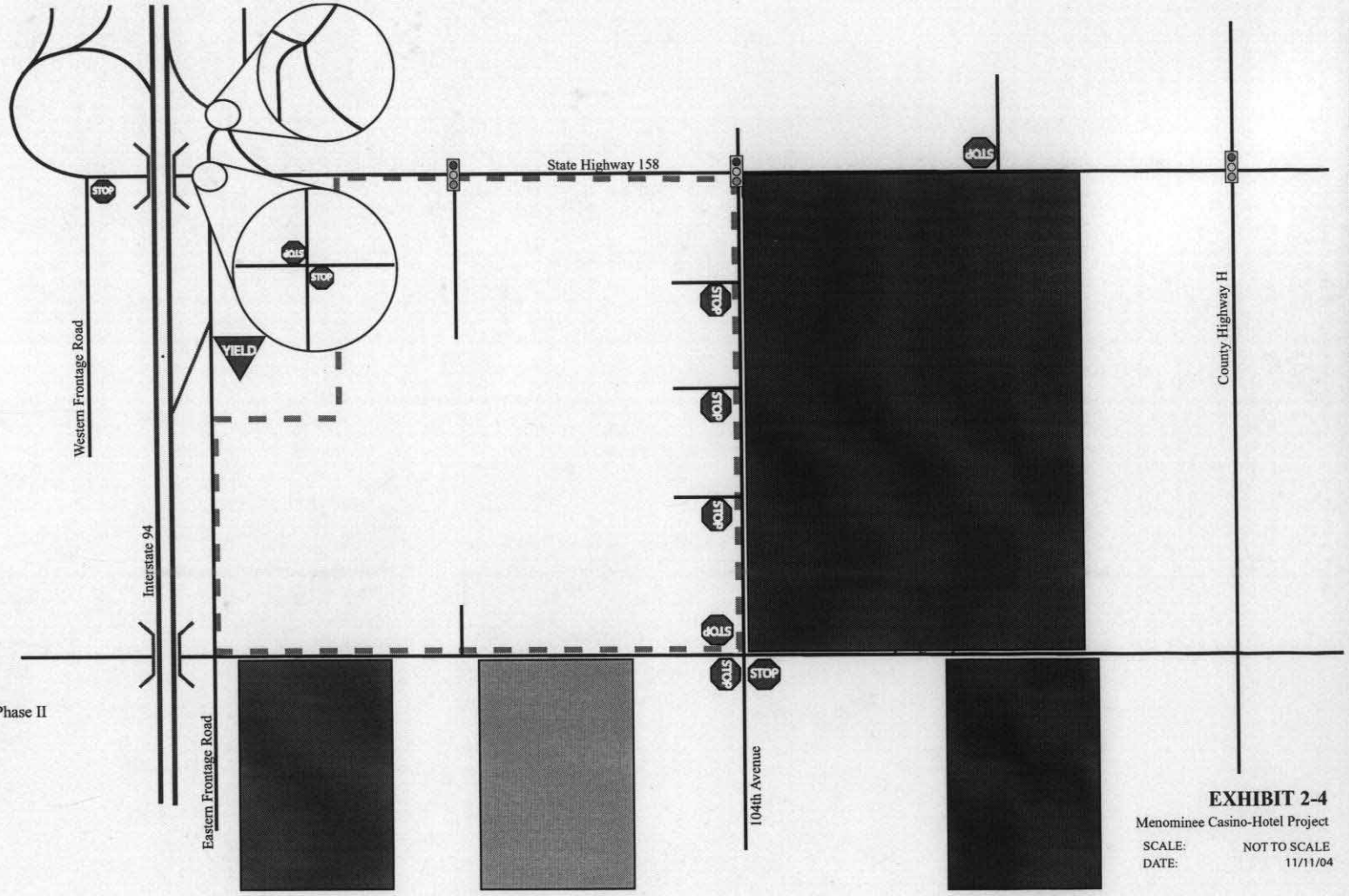

Legend:

- : Kilbourn Woods
- : Tyler's Ridge
- : Peterson Golden Meadows
- : Business Park of Kenosha Phase II
- : Signalized Intersection
- : Stop Controlled Approach

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EXHIBIT 2-4

Menominee Casino-Hotel Project

SCALE: NOT TO SCALE
DATE: 11/11/04

OTHER DEVELOPMENTS IN THE AREA

N

Analysis of Existing Conditions

Physical Characteristics

Listed below is a description of the area roadways. **Exhibit 3-1** displays the existing roadway geometrics in the area.

Wisconsin State Highway 158 (STH 158) is an east-west four-lane arterial highway with a posted speed limit of 55 miles per hour adjacent to the site. At its all-way stop-controlled intersection with the Western Frontage Road, the eastbound direction provides a through lane and a right-turn lane and the westbound direction provides a combination through/left-turn lane. At its all-way stop-controlled intersection with the Eastern Frontage Road, both the eastbound and westbound directions provide one lane of travel. At its signalized intersection with the Greyhound Dairyland Access Drive, the eastbound direction provides one through lane, a combination through/right-turn lane, and a right-turn lane and the westbound direction provides a left-turn lane, and two through lanes. At its signalized intersection with 104th Avenue, both directions provide a left-turn lane, two through lanes, and a right-turn lane. At its signalized intersection with County Highway H, both the eastbound and westbound directions provide a left-turn lane and a combination through/right-turn lane. STH 158 is under the jurisdiction of the Wisconsin Department of Transportation (WisDOT).

60th Street (CTH K) is an east-west four-lane arterial highway adjacent to the site with a posted speed limit of 45 miles per hour adjacent to the site. At its all-way stop-controlled intersection with the Eastern Frontage Road, both the eastbound and westbound directions provide a combination left-turn/through/right-turn lane. At its all-way stop-controlled intersection with 104th Avenue, the eastbound direction provides a combination left-turn/through lane and a right-turn lane and the westbound direction provides a combination left-turn/through/right-turn lane. CTH K is under the jurisdiction of the Kenosha County Highway Department.

The Western Frontage Road is a north-south two-lane roadway that runs parallel to Interstate 94. At its all-way stop-controlled intersection with STH 158, the northbound direction provides a combination left-turn/right-turn lane. The Western Frontage Road is under the jurisdiction of WisDOT.

The Eastern Frontage Road is a north-south two-lane roadway that runs parallel to Interstate 94. At its intersection with STH 158, the northbound direction provides a combination left-turn/through lane that is under stop control and two free-flow right-turn lanes. The Eastern Frontage Road is under the jurisdiction of WisDOT.

The Dailyland Greyhound Access Drive on STH 158 is the primary access drive for the Dairyland Greyhound Racing Park. At its signalized intersection with STH 158, the northbound direction provides a left-turn lane and a right-turn lane.

104th Avenue is a north-south roadway with a posted speed limit of 35 mph and serves as the site's eastern boundary. At its signalized intersection with STH 158, the northbound direction provides a combination left-turn/through lane and a right-turn lane and the southbound direction provides one lane of travel. To the south of the Dairlyland employee access, 104th Avenue is widened to provide two

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southbound through lanes. At its all-way stop-controlled intersection with CTH K, the northbound direction provides a left-turn lane, a through lane and a short channelized right-turn lane and the southbound direction provides a combination left-turn/through lane and a channelized right-turn lane. 104th Avenue is under the jurisdiction of the City of Kenosha.

88th Avenue (CTH H) is a two-lane north-south roadway with a posted speed limit of 35 mph. At its signalized intersection with STH 158, both the northbound and southbound directions provide a combination left-turn/through/right-turn lane. CTH H is under the jurisdiction of the Kenosha County Highway Department.

Existing Traffic Volumes

Weekday morning (7:00 AM to 9:00 AM) and afternoon (4:00 PM to 6:00 PM) peak hour manual traffic counts were obtained from the WisDOT. Additional traffic counts were conducted to supplement the traffic counts provided by WisDOT. The existing traffic volumes are shown in **Exhibit 3-2**. Copies of the traffic counts are included with the Appendix.

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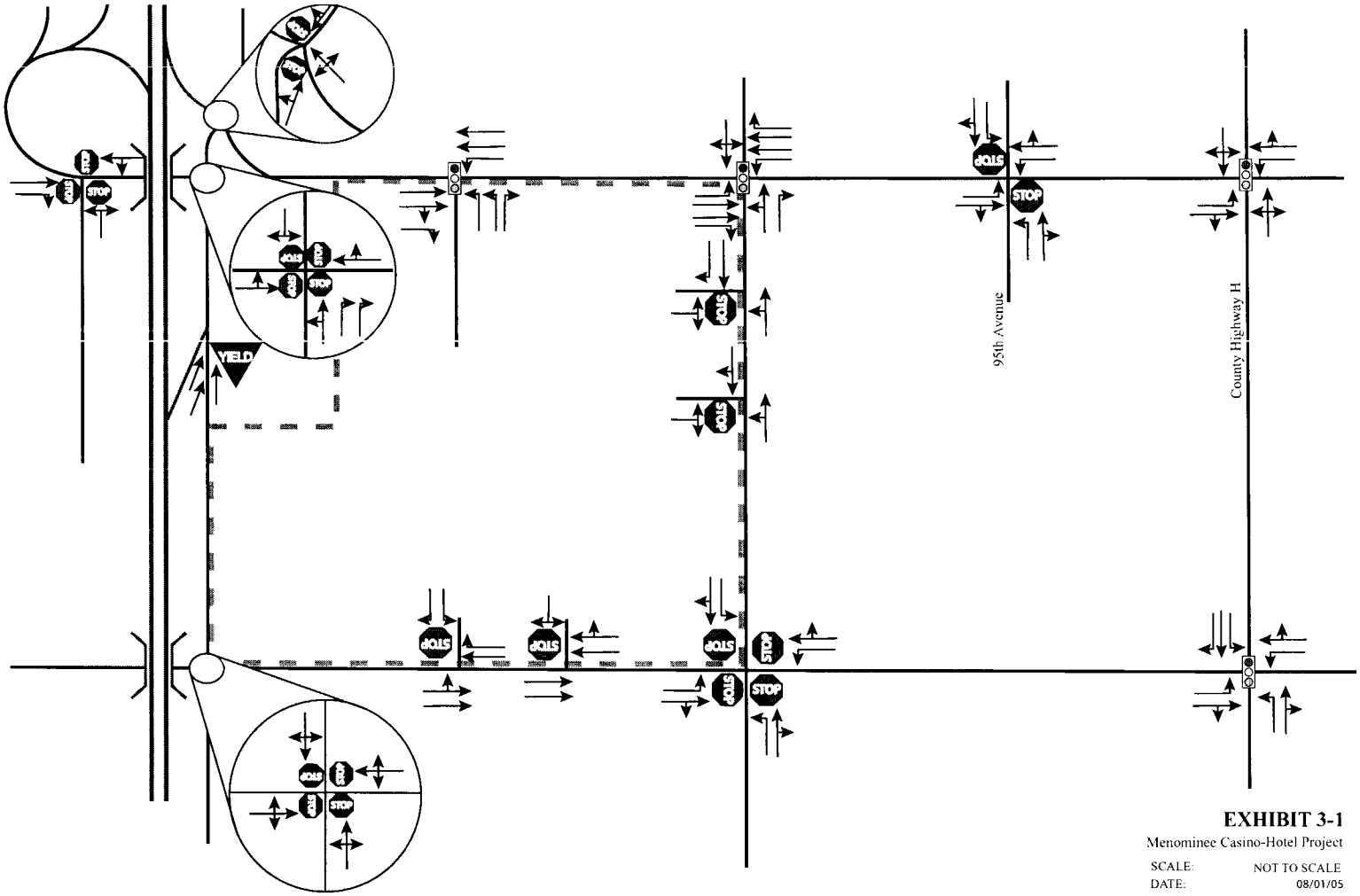

Legend:

→ : Existing Lane

: Signalized Intersection

STOP : Stop Controlled Approach

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EXHIBIT 3-1

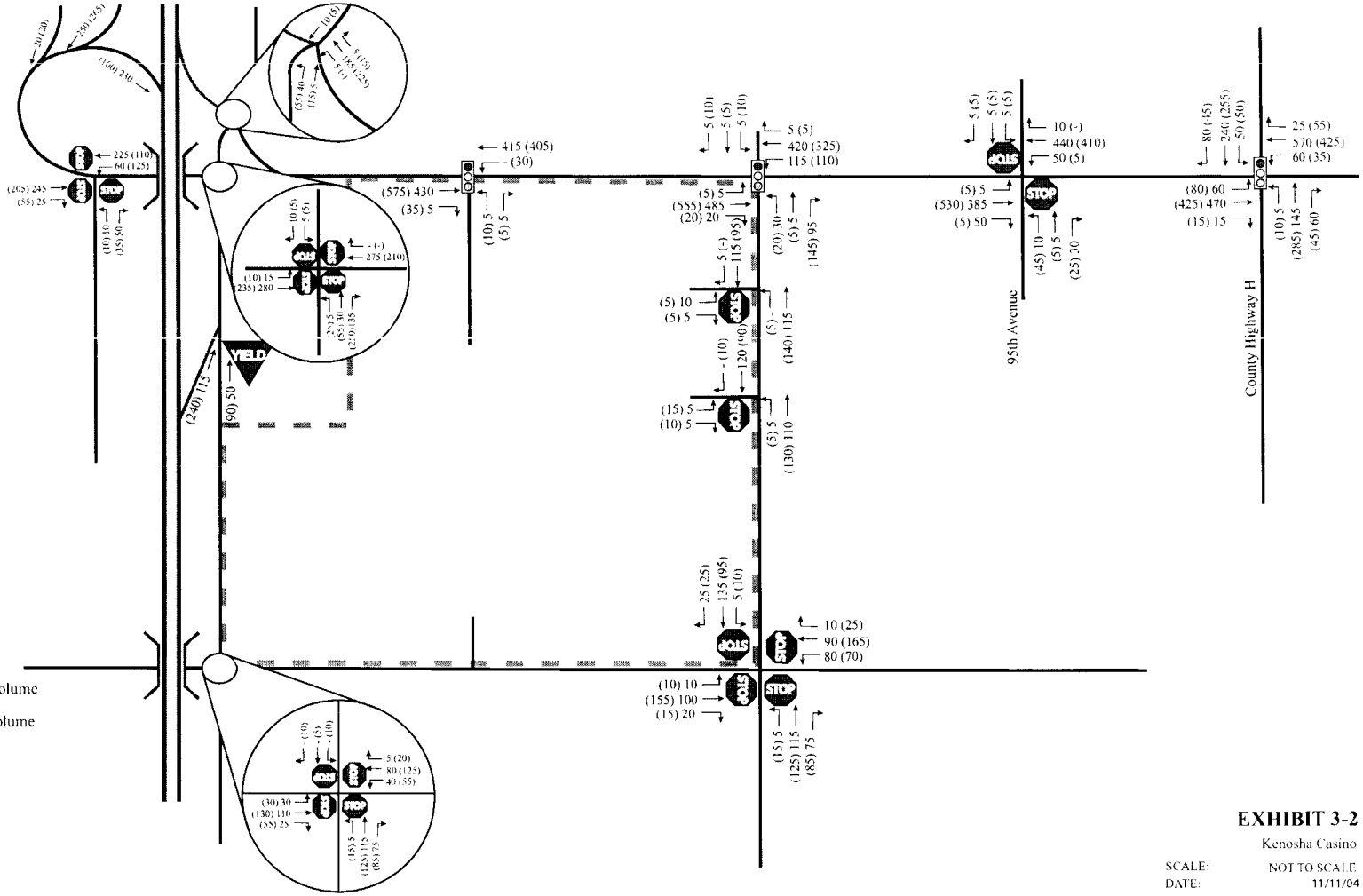
Menominee Casino-Hotel Project

SCALE: NOT TO SCALE

DATE: 08/01/05

EXISTING GEOMETRICS

N



Legend:

XX : Weekday AM Peak Hour Volume

(XX) : Weekday PM Peak Hour Volume

: Signalized Intersection

: Stop Controlled Approach

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EXISTING TRAFFIC

EXHIBIT 3-2

Kenosha Casino

SCALE: NOT TO SCALE
DATE: 11/11/04

N

Capacity/Level of Service

In order to quantify the operations of the study intersections, Highway Capacity Software (HCS) was utilized. HCS is an analysis tool used to define the capacity and delay of an intersection during the peak hours. Based on engineering standards and the available capacity, a level of service (LOS) grade is determined. The level of service ranges from LOS A to LOS F, with A being the best and F the worst. **Exhibit 3-3** shows the existing level of service results for the study intersections.

Sources of Data

The majority of the traffic counts were obtained from WisDOT. Additional traffic counts were obtained from previous counts conducted by Metro Transportation. The individual traffic counts are shown in the Appendix.

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Exhibit 3-3
Existing Level of Service

Intersection	Intersection Control	Weekday AM Peak Hour	Weekday PM Peak Hour
STH 158/CTH H	Signalized Intersection	EBL - B EBTR - C WBL - B WBTR - C NBA - C SBA - D **OVERALL - B**	EBL - B EBTR - D WBL - B WBTR - C NBA - C SBA - C **OVERALL - C**
STH 158/Dairlyland Access	Signalized Intersection	EBTR - B EBR - A WBL - A WBT - A NBL - C NBR - B **OVERALL - A**	EBTR - B EBR - B WBL - A WBT - A NBL - C NBR - B **OVERALL - B**
STH 158/Western Frontage Road	All-way Stop Control	EBT - A EBR - A WBTL - A NBLR - A **OVERALL - A**	EBT - A EBR - A WBTL - A NBLR - A **OVERALL - A**
STH 158/Eastern Frontage Road	All-way Stop Control	EBLT - A WBTR - A NBL - A SBLR - A **OVERALL - A**	EBLT - A WBTR - A NBL - A SBLR - A **OVERALL - A**
STH 158/104th Avenue	North-South Movements Under Stop Control	NBLTR - C SBLTR – C	NBLTR - B SBLTR - C
60th Street/Eastern Frontage Road	All-way Stop Control	EBLTR - A WBLTR - A NBLTR - A SBLTR - A **OVERALL - A**	EBLTR - A WBLTR - A NBLTR - A SBLTR - A **OVERALL - A**
60th Street/104th Avenue	All-way Stop Control	EBLT - A EBR - A WBLTR - B NBL - A NBTR - B SBLT - A SBR - A **OVERALL - A**	EBLT - B EBR - A WBLTR - B NBL - A NBTR - B SBLT - B SBR - A **OVERALL - B**

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Projected Traffic

Non-Site Traffic Forecasting (Background Volumes)

WisDOT staff prepared projections of the 2007 and 2017 traffic. These projections were strictly on growth rates from the existing traffic volumes. The projections provided by WisDOT are displayed in **Exhibit 4-1a** and **Exhibit 4-1b** and will be referred to as the background traffic.

Site Traffic Forecasting

Trip Generation

As stated earlier, the development will be built on in three phases. Phase I includes 92,800 square feet of gaming area, an 86,400 square foot event hall, and 49,400 square feet of retail; Phase II includes an additional 15,100 square feet of gaming area, a 600 room hotel, a 54,400 square foot conference room, and a 41,600 square foot spa/health club; Phase III includes a 500 room hotel and a 50,000 square foot water park.

In order to establish trips from the development, Land Strategies, Inc. based the number of trips generated by Phase I and Phase II on rates provided in the article "Calibration of Trip Generation Model for Las Vegas Hotel/Casinos", by Curtis D. Rowe, Mohamed S. Kaseko, and Kenneth W. Ackeret. The rates are based on casino gaming area and include all of the gaming, entertainment, food and beverage, and the hotel land uses to be built in Phase I and Phase II. The trips for the hotel in Phase III was based on trip generation rates contained in Trip Generation, 7th Edition, by the Institute of Transportation Engineers (ITE), 2003. The trip generation rates for the water park land use in the ITE publication are based on one survey and are not considered very accurate. The water park is providing 40 employee parking spaces and 150 visitor parking spaces. To estimate the number of trips generated by the water park land use, we conservatively assumed that all forty of the vehicles occupying the employees parking spaces would enter the park in the morning peak hour, and all 150 visitor parking spaces would empty during the evening peak hour. Applying the appropriate trip rate to the land use establishes the number of project generated peak hour trips as shown in **Exhibit 4-2**.

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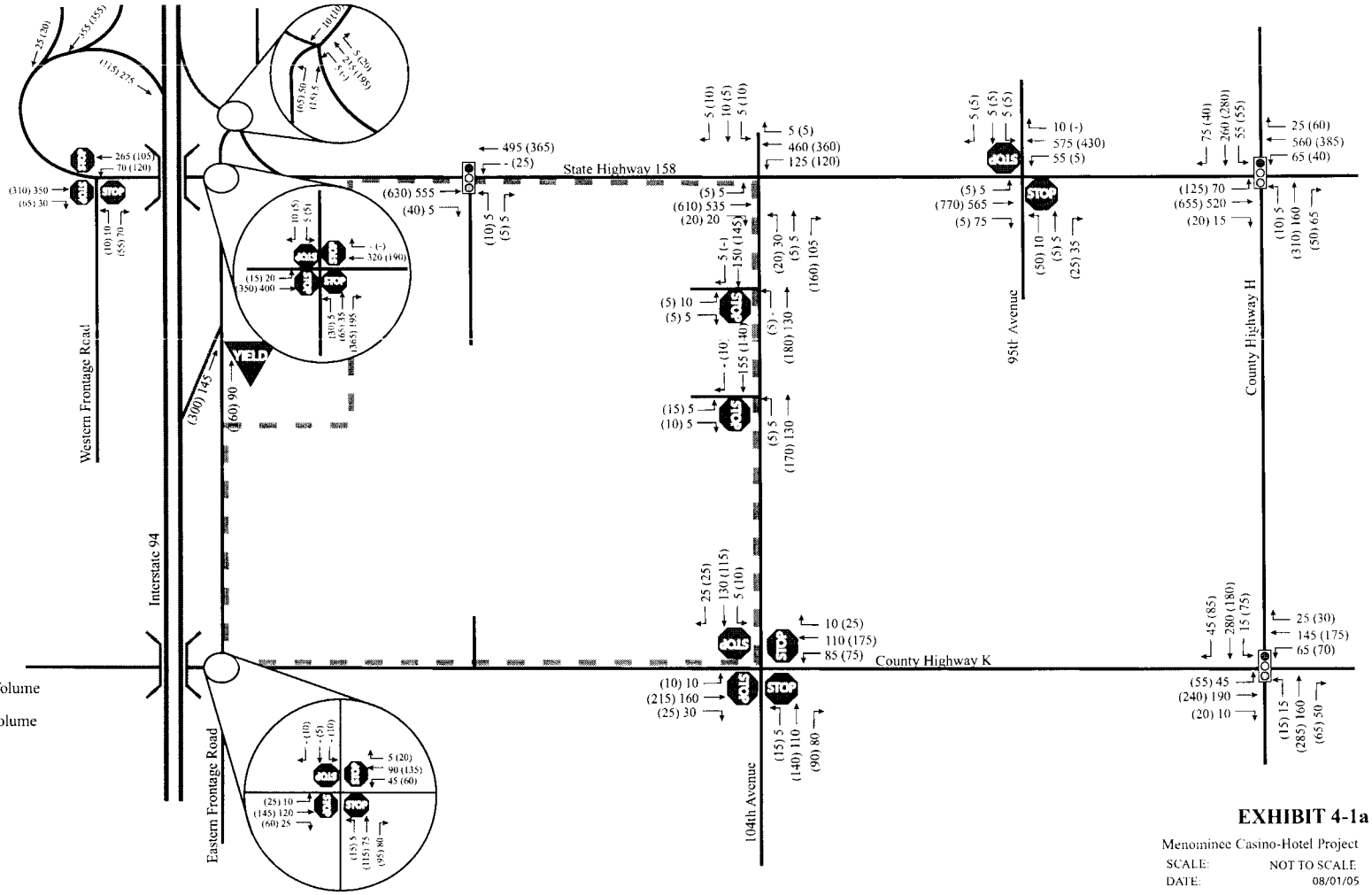

Legend:

XX : Weekday AM Peak Hour Volume

(XX) : Weekday PM Peak Hour Volume

: Signalized Intersection

: Stop Controlled Approach

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EXHIBIT 4-1a

Menominee Casino-Hotel Project

SCALE: NOT TO SCALE

DATE: 08/01/05

2007 BACKGROUND TRAFFIC

N

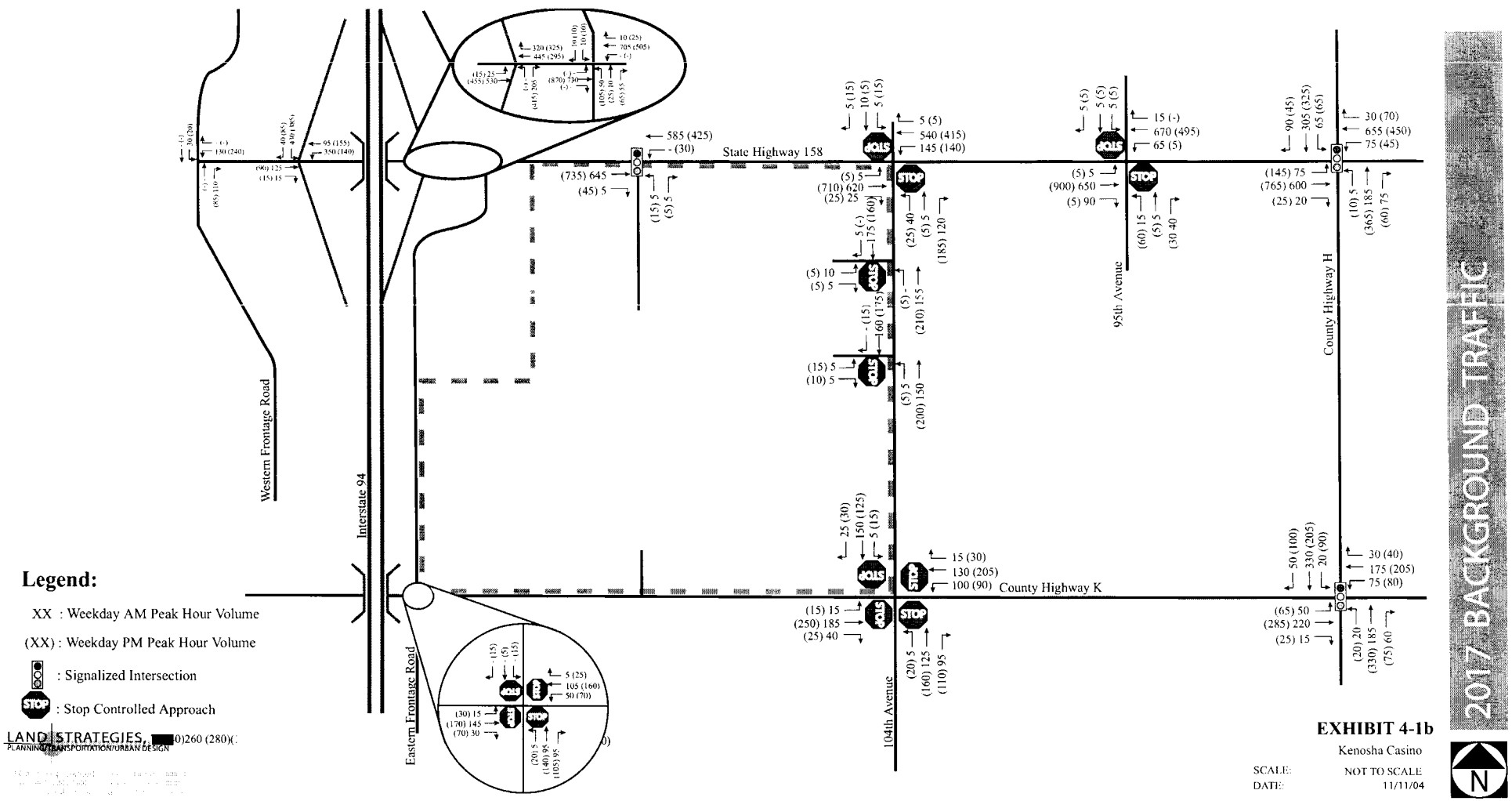
2017 BACKGROUND TRAFFIC
State Highway 158
County Highway K
County Highway H
95th Avenue
104th Avenue
Western Frontage Road
Eastern Frontage Road
Interstate 94
Legend:
XX : Weekday AM Peak Hour Volume
(XX) : Weekday PM Peak Hour Volume
: Signalized Intersection
: Stop Controlled Approach
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EXHIBIT 4-1b
Kenosha Casino
SCALE: NOT TO SCALE
DATE: 11/11/04
N

Exhibit 4-2
Kenosha Casino
Trip Generation

Phase	Land Use	Size	Weekday AM Peak Hour Trips			Weekday PM Peak Hour Trips		
			In	Out	Total	In	Out	Total
Phase I	Casino Gaming	92,200 sf	740	560	1300	1070	990	2060
Phase II	Casino Gaming	15,100 sf	125	90	215	175	160	335
Phase III	Water Park	150 Visitor Parking Spaces, 40 Employee Parking Spaces	40	20	60	40	150	190
	Hotel	500 Rooms	115	45	160	90	115	205
	RV Park	60 Spaces	5	10	15	15	10	25
	Total Phase III Trips		*160*	*75*	*235*	*145*	*275*	*420*
TOTAL SITE TRIPS			**1025**	**725**	**1750**	**1390**	**1425**	**2815**

Mode Split

Though there may be some pedestrians and bicycle trips to the development, these trips will be minimal. The mode split was considered to be 100% vehicles.

Determination of Pass-By and Multi (linked) – Trip Traffic

No pass-by or multi-linked trips were included in the traffic generations. The land uses of the proposed development are strictly destination uses.

Trip Distribution

The trip distribution for the development was based on the market area of the patrons of the future development. The casino is going to be a regional trip generator and the majority of the trips will come from/depart to Interstate 94. The trip distribution for the site is shown on **Exhibit 4-3**.

Trip Assignment

The trips generated for the development, shown in Exhibit 4-2, were distributed to the area roadways. **Exhibits 4-4a, 4-4b,** and **4-4c** display the trip assignment for each phase of the development. **Exhibit 4-4d** shows the total site trip assignment.

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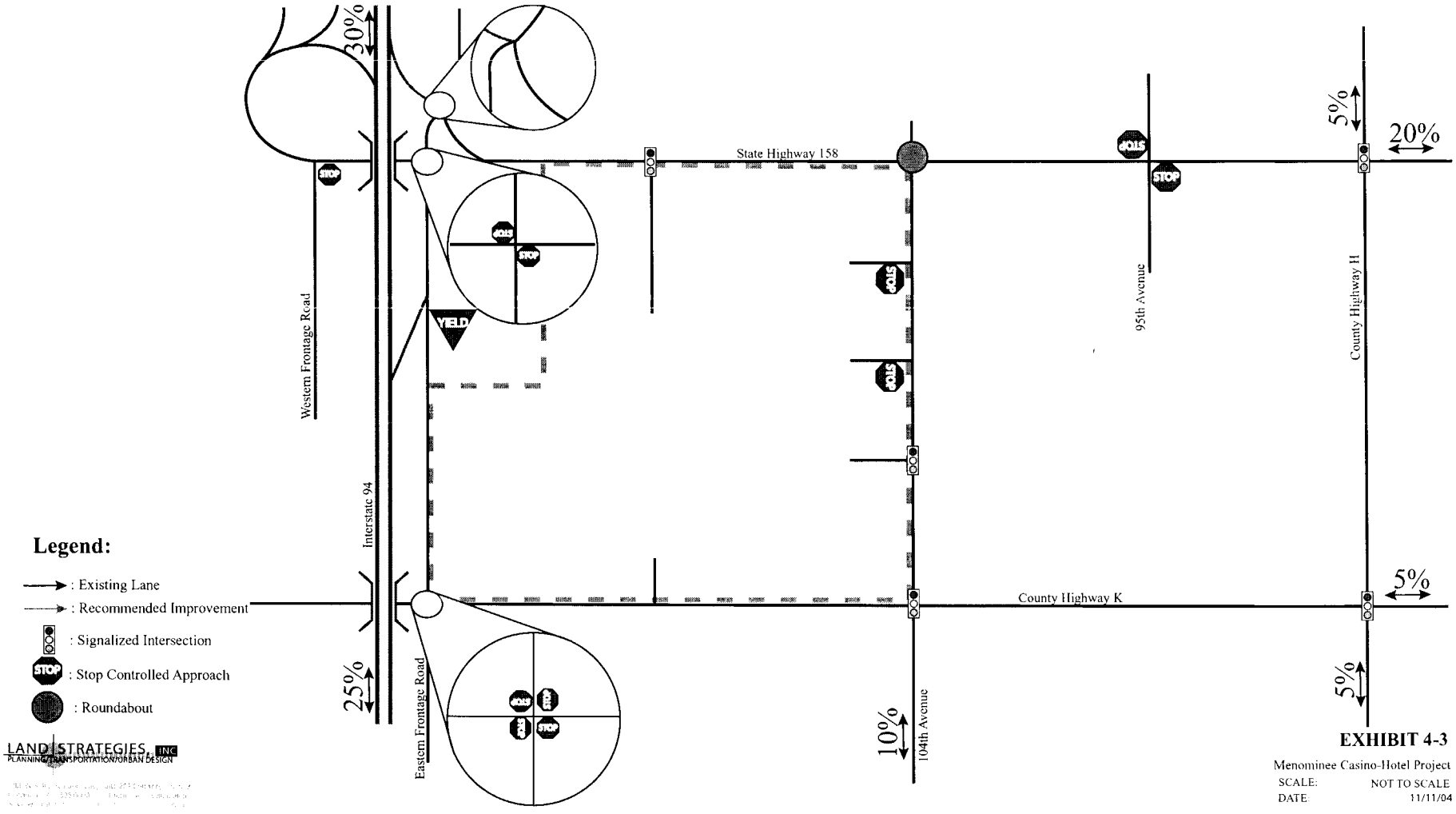
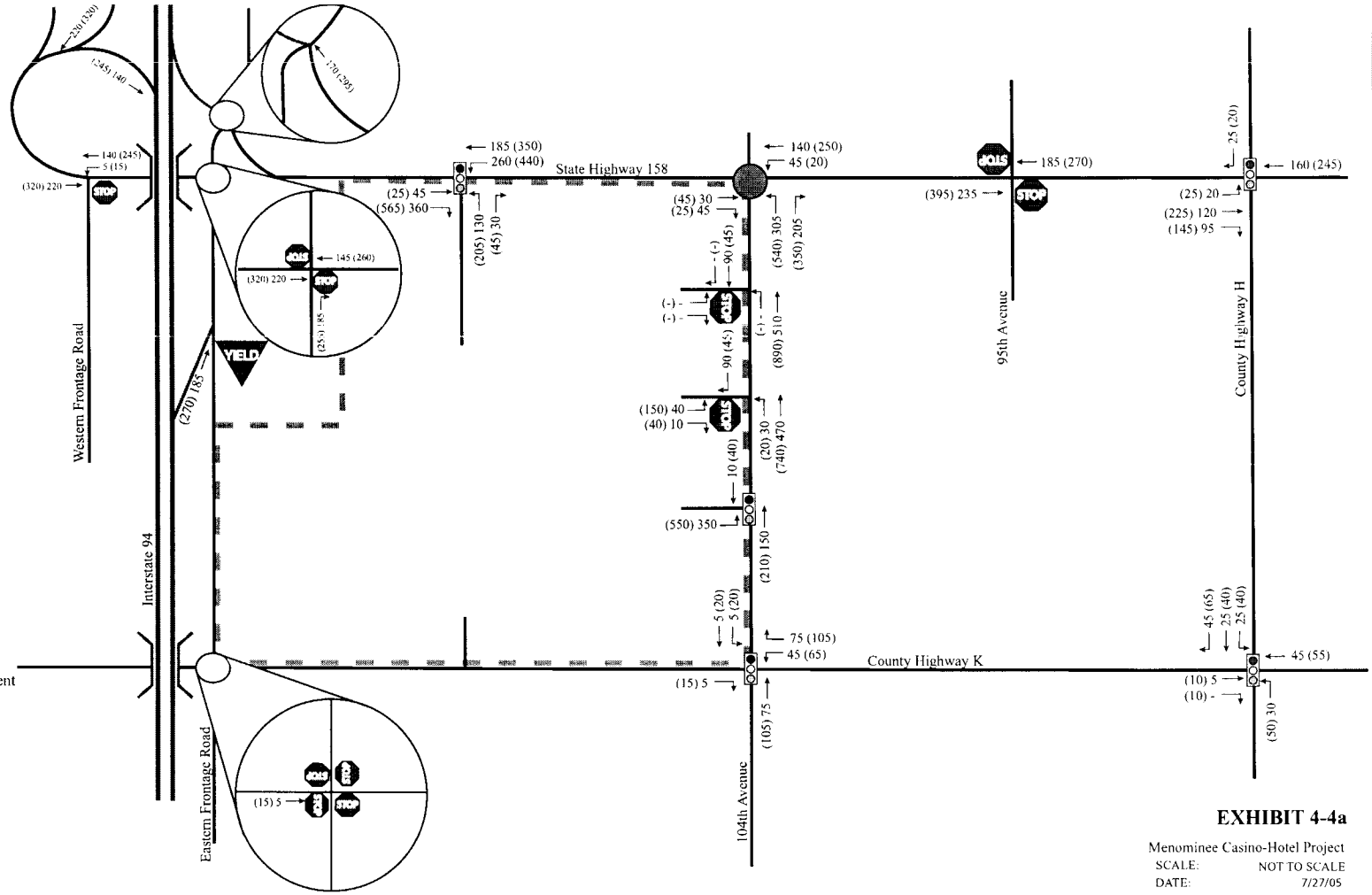


EXHIBIT 4-3

Menominee Casino-Hotel Project

SCALE: NOT TO SCALE

DATE: 11/11/04



Legend:

- : Existing Lane
- : Recommended Improvement
- : Signalized Intersection
- : Stop Controlled Approach
- : Roundabout

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PHASE I SITE TRAFFIC

EXHIBIT 4-4a

Menominee Casino-Hotel Project
SCALE: NOT TO SCALE
DATE: 7/27/05

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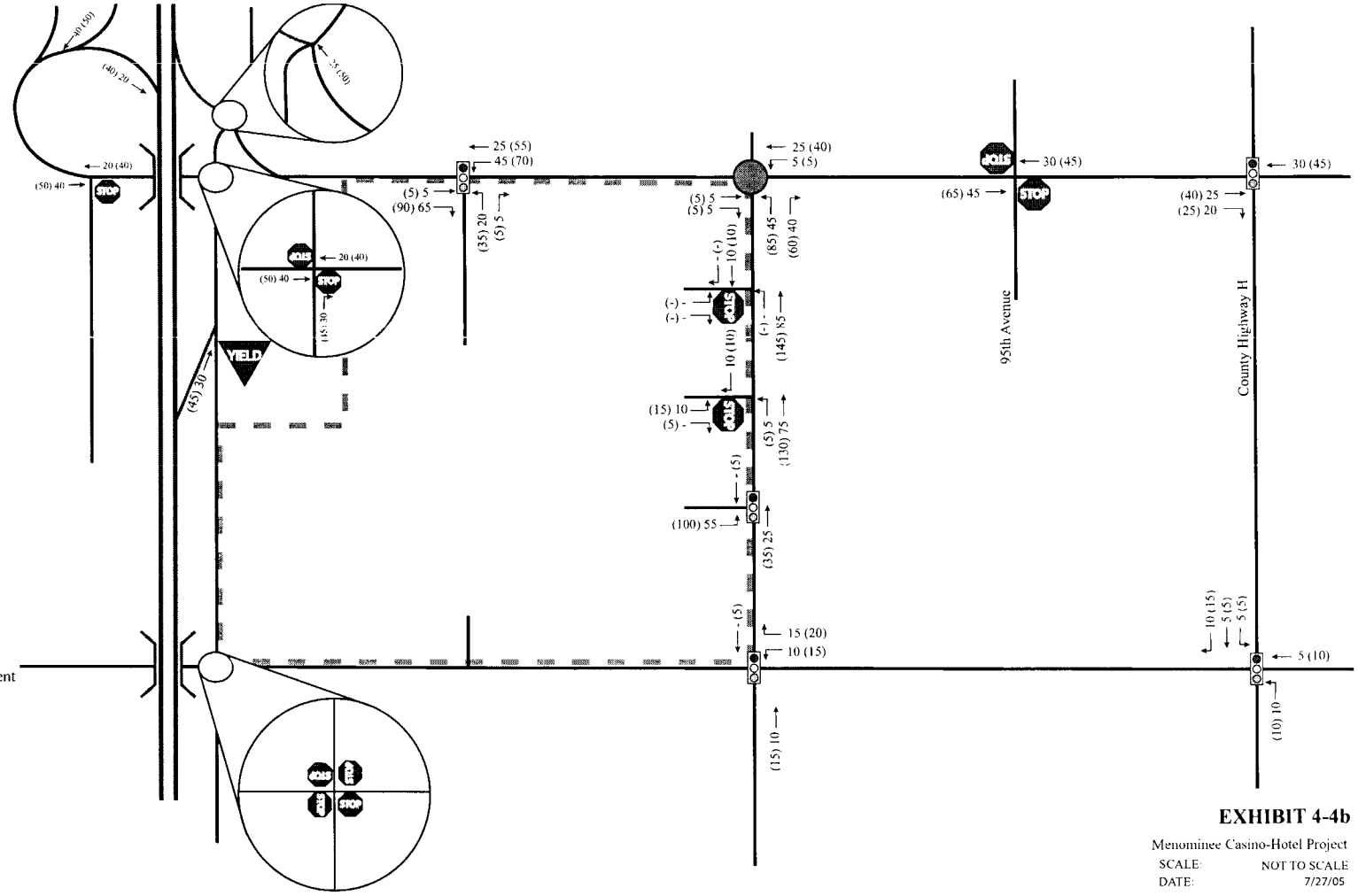

Legend:

- : Existing Lane
- : Recommended Improvement
- : Signalized Intersection
- : Stop Controlled Approach
- : Roundabout

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EXHIBIT 4-4b

Menominee Casino-Hotel Project

SCALE: NOT TO SCALE

DATE: 7/27/05

PHASE II SITE TRAFFIC

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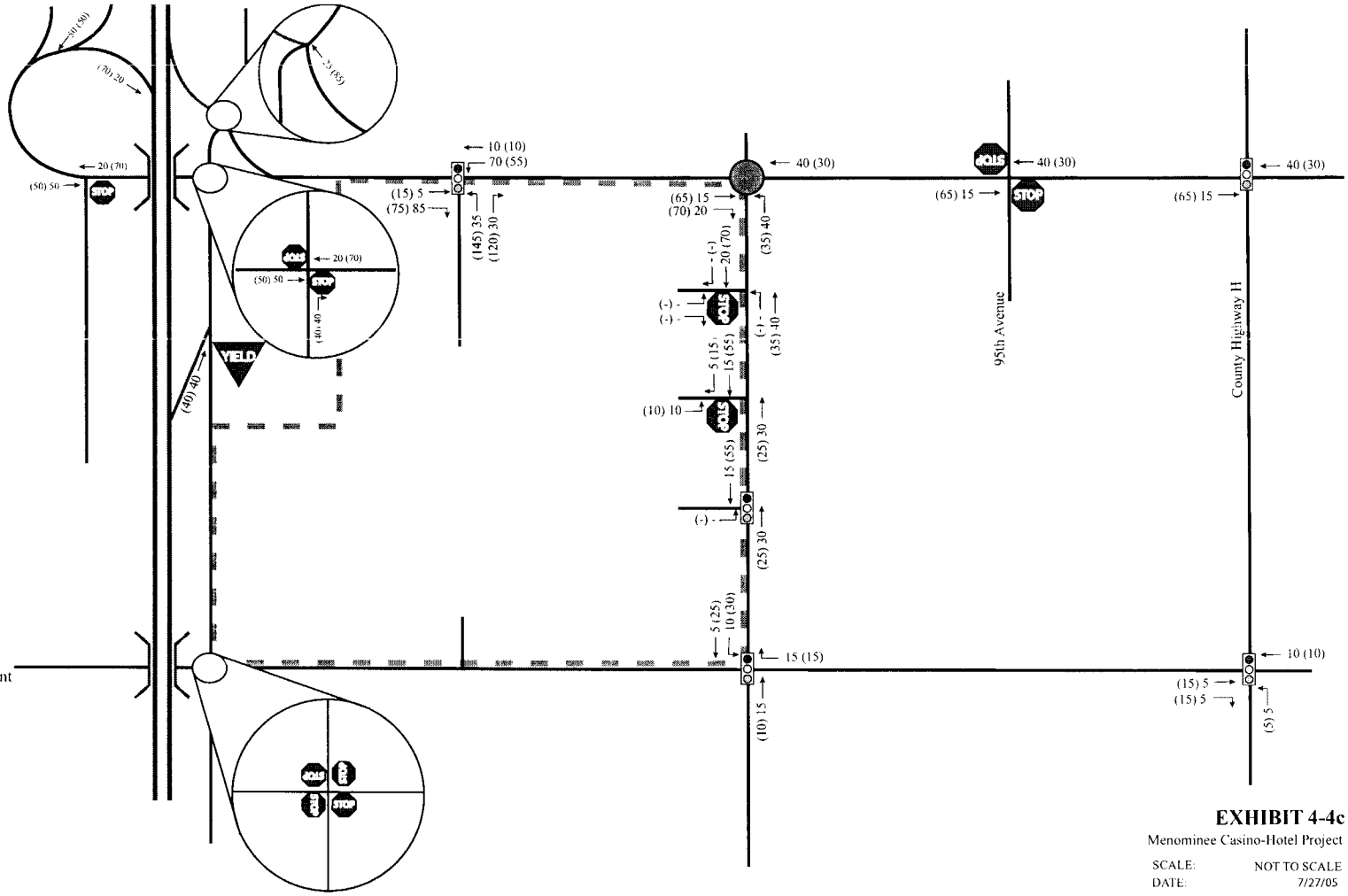

EXHIBIT 4-4c

Menominee Casino-Hotel Project

SCALE: NOT TO SCALE

DATE: 7/27/05

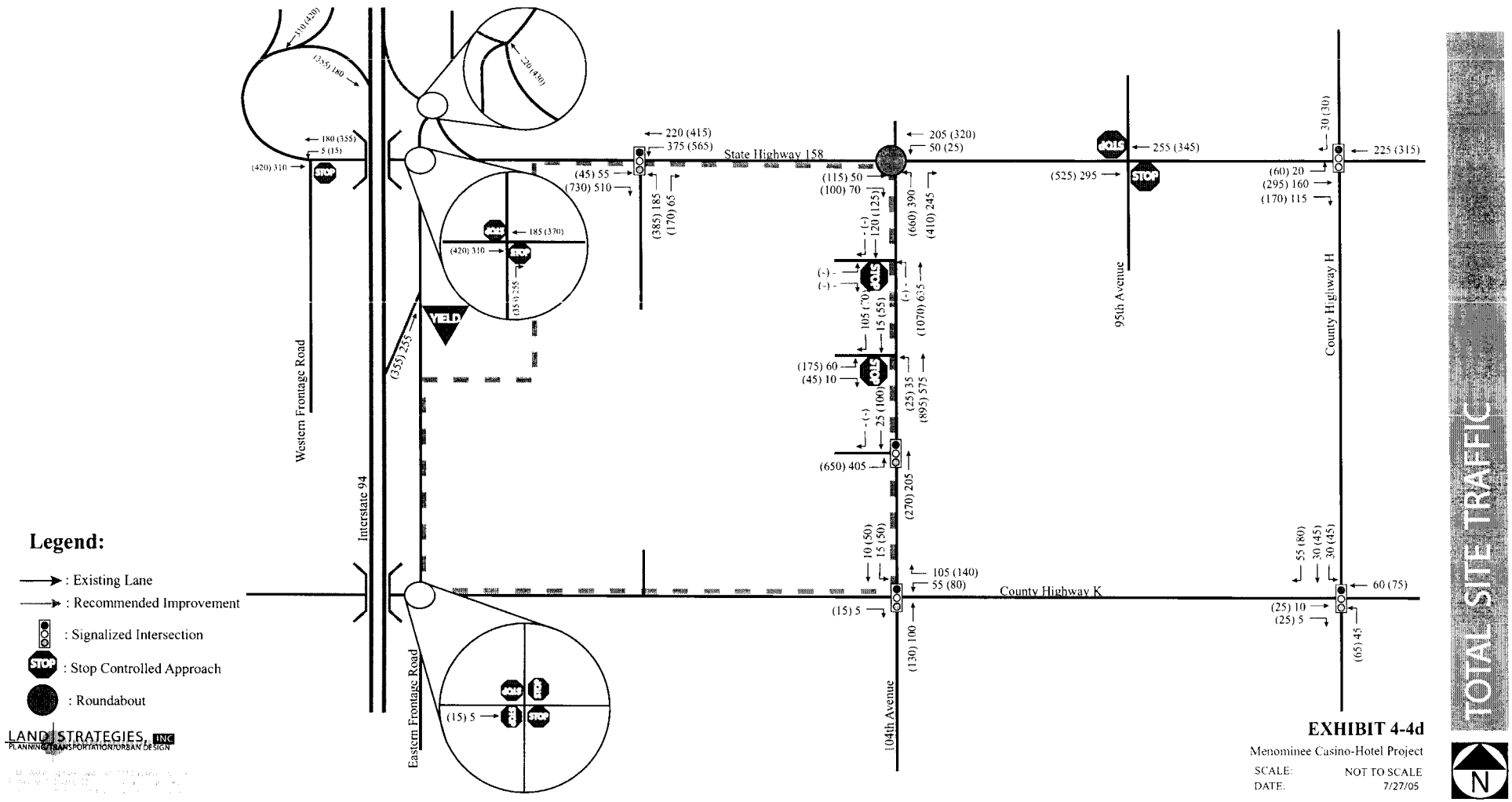

EXHIBIT 4-4d

Menominee Casino-Hotel Project

SCALE: NOT TO SCALE

DATE: 7/27/05

Total Traffic

The trips generated by the proposed Project Eagle development were added to the background traffic (traffic projections for the years 2007 and 2017 provided by WisDOT). The resulting total traffic volumes for the year 2007 are shown in **Exhibit 4-5a** and the volumes for 2017 are shown in **Exhibit 4-5b**.

As discussed earlier in the report, there are a few other developments in the area that are proposed. LSI estimated the traffic from the following developments:

- Kibourn Woods subdivision, 98 single family homes, located on 60th Street east of the Eastern Frontage Road
- Tyler's Ridge subdivision, 155 single family homes, located on 60th Street east of the Eastern Frontage Road
- Peterson Golden Meadows subdivision, 329 single family homes, located on 60th Street east of 104th Avenue
- Business Park of Kenosha Phase II – 74.36 Acres

The trip generation estimates and the traffic assignments for the future developments is shown in the Appendix.

The trips generated by these additional developments were added to the total traffic volumes to determine the overall traffic volumes in the area. **Exhibits 4-6a** and **4-6b** display the overall traffic volumes for the years 2007 and 2017, respectively.

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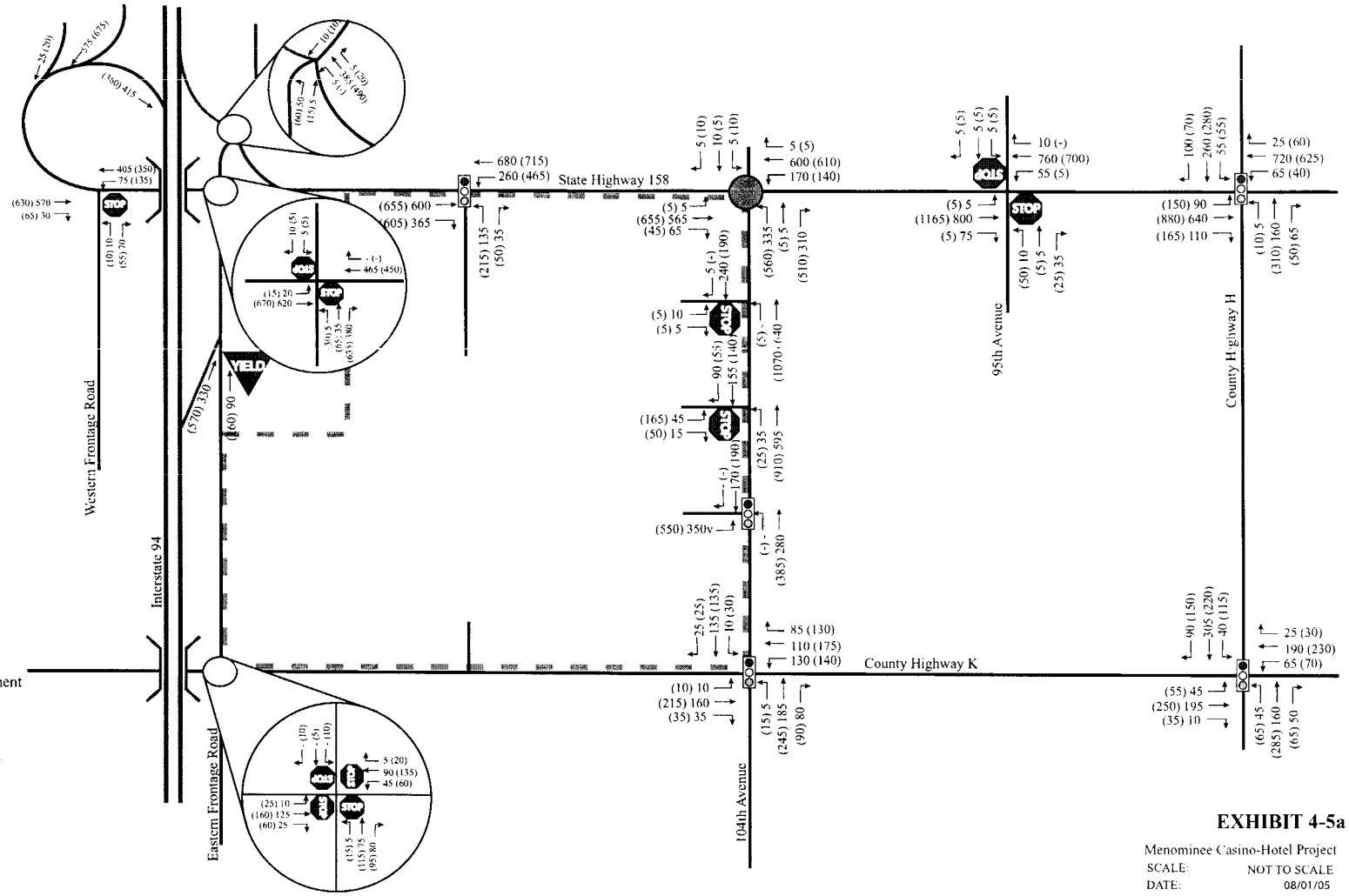

Legend:

- : Existing Lane
- : Recommended Improvement
- : Signalized Intersection
- : Stop Controlled Approach
- : Roundabout

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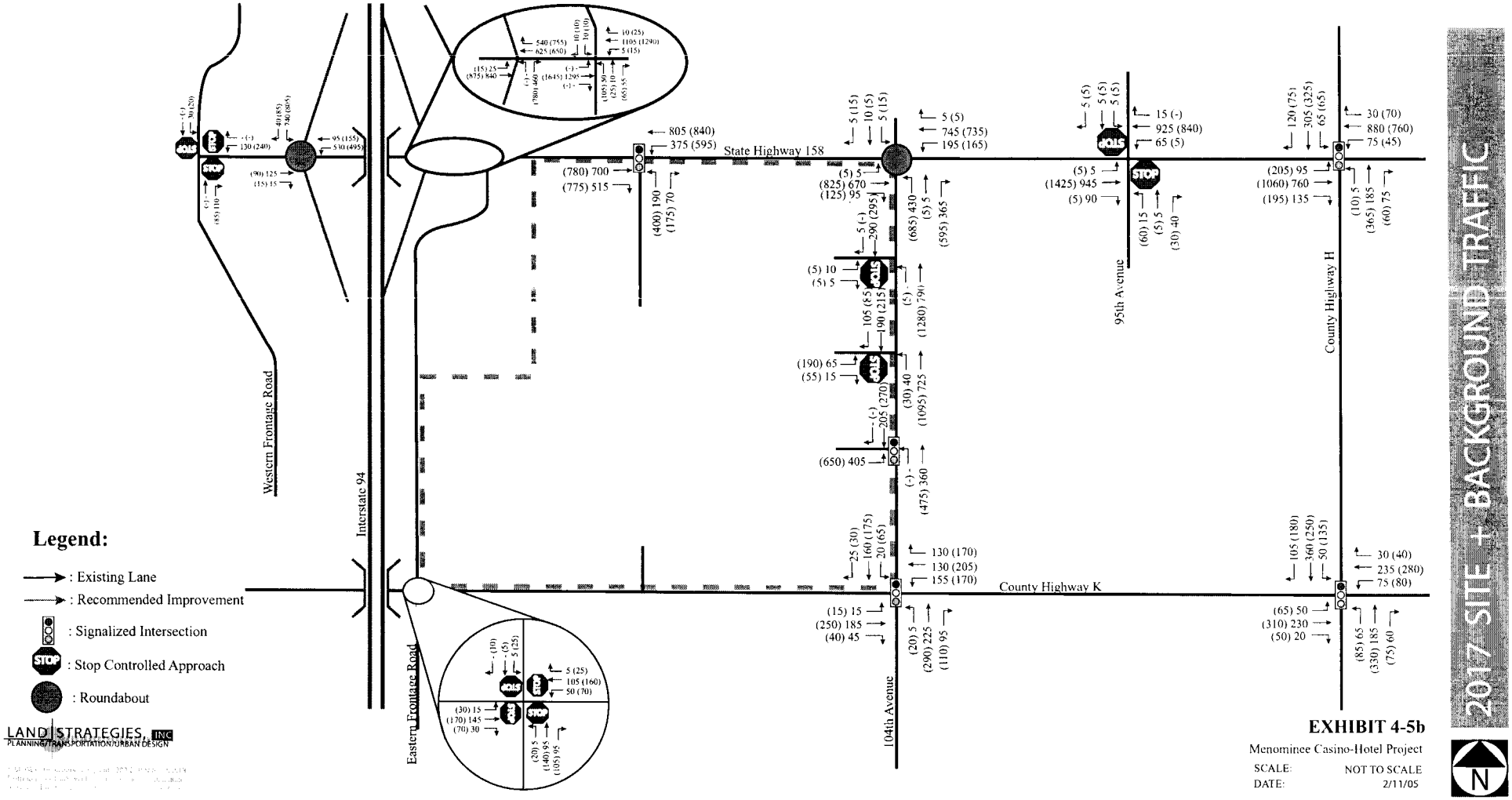
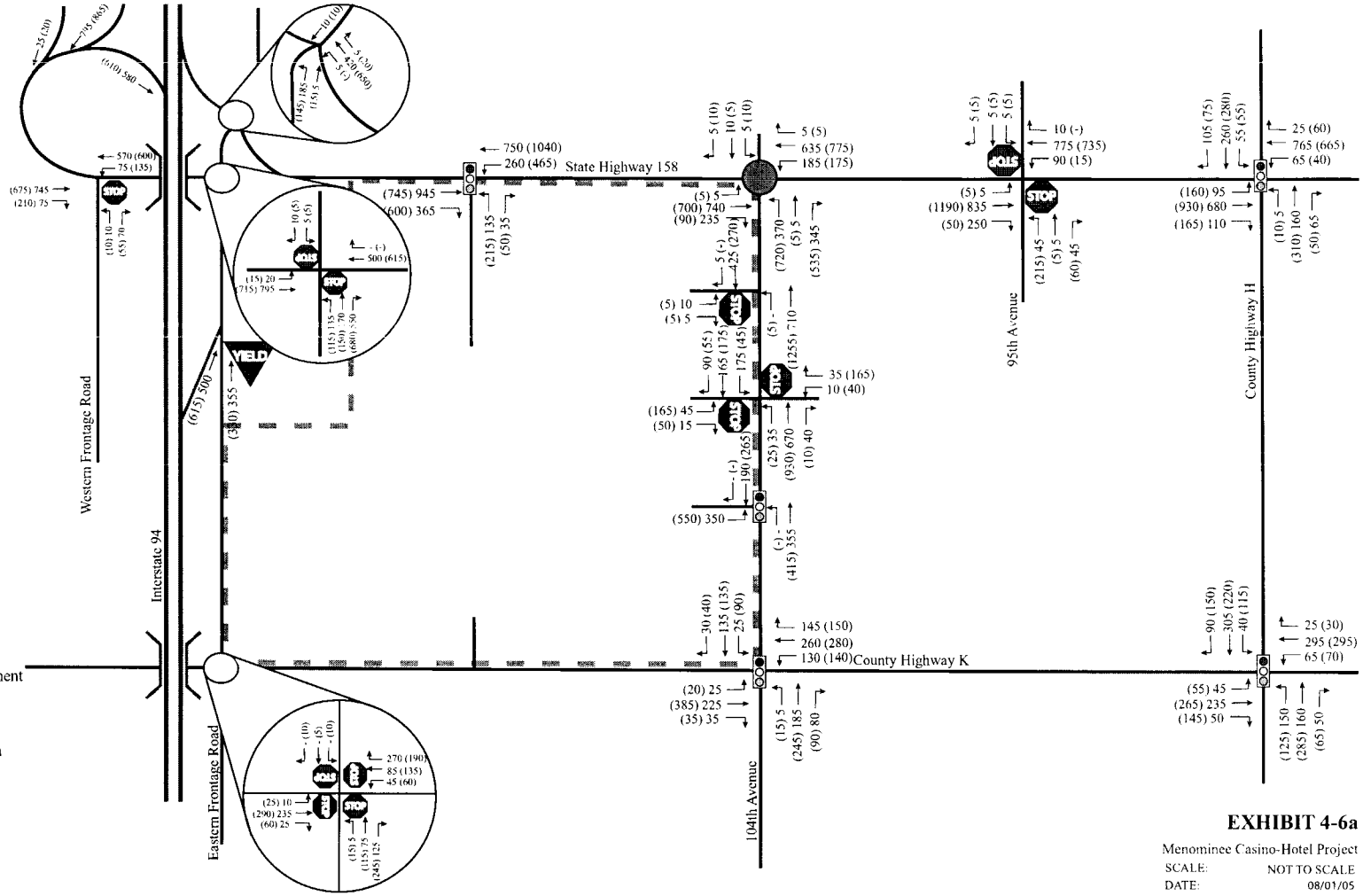
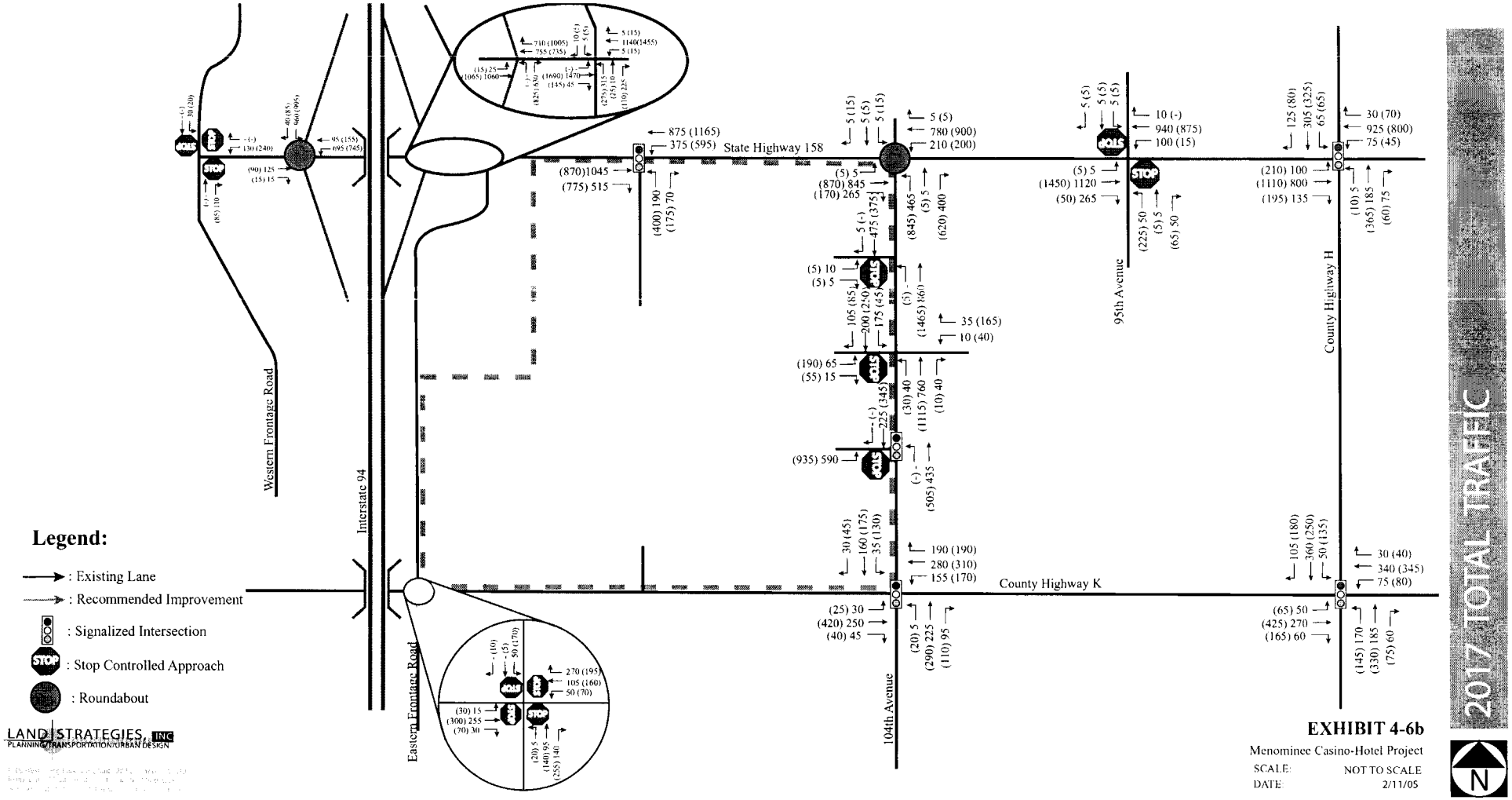
EXHIBIT 4-5a

Menominee Casino-Hotel Project
SCALE: NOT TO SCALE
DATE: 08/01/05

2007 SITE + BACKGROUND TRAFFIC


2017 SITE + BACKGROUND TRAFFIC
State Highway 158
County Highway K
County Highway H
95th Avenue
104th Avenue
Interstate 94
Western Frontage Road
Eastern Frontage Road
Legend:
: Existing Lane
: Recommended Improvement
: Signalized Intersection
: Stop Controlled Approach
: Roundabout
LAND STRATEGIES, INC
PLANNING/TRANSPORTATION/URBAN DESIGN
EXHIBIT 4-5b
Menominee Casino-Hotel Project
SCALE: NOT TO SCALE
DATE: 2/11/05
N


2007 TOTAL TRAFFIC
State Highway 158
County Highway K
County Highway H
95th Avenue
104th Avenue
Interstate 94
Western Frontage Road
Eastern Frontage Road
750 (1040)
260 (465)
(745) 945
(600) 365
(215) 135
(50) 35
5 (10)
10 (5)
5 (10)
5 (5)
635 (775)
185 (175)
(5) 5
(700) 740
(90) 235
(720) 370
(5) 5
(535) 345
5 (-)
425 (270)
(5) 10
(5) 5
(5) -
(1255) 710
35 (165)
10 (40)
90 (55)
65 (175)
175 (45)
(165) 45
(50) 15
(25) 35
(930) 670
(10) 40
- (-)
190 (265)
(550) 350
(-) -
(415) 355
30 (40)
135 (135)
25 (90)
145 (150)
260 (280)
130 (140)
(20) 25
(385) 225
(35) 35
(15) 5
(245) 185
(90) 80
5 (5)
5 (5)
5 (5)
10 (-)
775 (735)
90 (15)
(5) 5
(1190) 835
(50) 250
(215) 45
(5) 5
(60) 45
105 (75)
260 (280)
55 (55)
25 (60)
765 (665)
65 (40)
(160) 95
(930) 680
(165) 110
(10) 5
(310) 160
(50) 65
90 (150)
305 (220)
40 (115)
25 (30)
295 (295)
65 (70)
(55) 45
(265) 235
(145) 50
(125) 150
(285) 160
(65) 50
570 (600)
75 (135)
(675) 745
(210) 75
(10) 10
(55) 70
25 (20)
795 (865)
(610) 580
(615) 500
(380) 355
10 (10)
5 (20)
420 (650)
5 (-)
(145) 185
(15) 5
10 (5)
5 (5)
- (-)
500 (615)
(15) 20
(715) 795
(115) 115
(150) 70
(680) 550
- (10)
- (5)
- (10)
270 (190)
85 (135)
45 (60)
(25) 10
(290) 235
(60) 25
(15) 5
(115) 75
(245) 125
YIELD
STOP
Legend:
: Existing Lane
: Recommended Improvement
: Signalized Intersection
: Stop Controlled Approach
: Roundabout
LAND STRATEGIES, INC
PLANNING/TRANSPORTATION/URBAN DESIGN
EXHIBIT 4-6a
Menominee Casino-Hotel Project
SCALE: NOT TO SCALE
DATE: 08/01/05
N


2017 TOTAL TRAFFIC
Western Frontage Road
Interstate 94
Eastern Frontage Road
State Highway 158
County Highway K
County Highway H
95th Avenue
104th Avenue
Legend:
: Existing Lane
: Recommended Improvement
: Signalized Intersection
: Stop Controlled Approach
: Roundabout
LAND STRATEGIES, INC
PLANNING/TRANSPORTATION/URBAN DESIGN
EXHIBIT 4-6b
Menominee Casino-Hotel Project
SCALE: NOT TO SCALE
DATE: 2/11/05
N

Traffic and Improvement Analysis

Site Access

Access will be provided for the site at five locations: the existing access location on STH 158, the two existing access drives on 104th Avenue, an additional access drive on 104th Avenue, and the existing access drive on County Highway K. Each access drive is described below.

Access Drive/STH 158: This access drive will serve as the main ingress point for all visitors as well as an egress point for some visitors, cabs, buses, and limousines. Phase III of the site will use this access drive as their main egress point.

Northern Access Drive/104th Avenue: This access drive will serve the operations of the dog track. It will be only used by employees.

Central Access Drive/104th Avenue: This access drive will serve as the main point of ingress and egress for all of the employees of the site.

Southern Access Drive/104th Avenue: Visitors from the casino will egress the site at this location. There will be minimal ingress traffic at this location, just some service vehicles, the RVs as part of Phase III, and some employees.

Access Drive/County Highway K: This drive will be gated and be used only for service and emergency vehicles.

Signal Warrant Analysis

A peak hour signal warrant analysis was conducted at the following locations, based on the 2017 traffic volumes:

- State Highway 158/104th Avenue
- State Highway 158/I-94 SB Ramp (2017 Traffic Conditions)
- State Highway 158/I-94 NB Ramp (2017 Traffic Conditions)
- State Highway 158/Eastern Frontage Road.

The results of this analysis are shown in **Exhibit 5-1**. The volumes that meet the peak hour warrant requirements are shown in bold.

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Exhibit 5-1
Peak Hour Signal Warrant Analysis

Intersection	2017 Site+Background				2017 Total Traffic Volumes			
	AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour	
	Major Street Volumes	Minor Street Volumes	Major Street Volumes	Minor Street Volumes	Major Street Volumes	Minor Street Volumes	Major Street Volumes	Minor Street Volumes
State Highway 158/104th Avenue	**1700**	**580**	**1835**	**920**	**2095**	**615**	**2125**	**1080**
State Highway 158/I-94 SB Ramp (2017 Traffic Conditions)	**785**	**780**	**795**	**890**	**1065**	**1000**	**1115**	**1080**
State Highway 158/I-94 NB Ramp (2017 Traffic Conditions)	**1495**	**460**	**1545**	**780**	**1975**	**630**	**1925**	**825**
State Highway 158/Eastern Frontage Road.	2415	115	2975	195	**2665**	**550**	**3320**	**410**

As can be seen in Exhibit 5-1, all of the study intersections warrant a traffic signal based on the peak hour volume warrant.

Capacity/Level of Service

Capacity analyses were again conducted at the study intersections, this time based on the future traffic volumes. Three scenarios were analyzed:

- The no-build traffic volumes, which are projections provided by Wis-DOT, with the existing transportation system and the proposed improvements.
- The total traffic volumes, both with and without the traffic volumes from the other proposed developments in the area, with the existing transportation system.
- The total traffic volumes, both with and without the traffic volumes from the other proposed developments in the area, with the transportation system improvements as recommended later in this report.

Exhibit 5-2 displays the results of the capacity analyses for the year 2007 and **Exhibit 5-3** shows the results for 2017.

All of the capacity analyses for the year 2017 assumed that the improvements would have been constructed at the Interstate 94 interchange with STH 158, regardless of whether the proposed development was built or not. As can be seen from Exhibit 5-1 and 5-2, the 2007 and 2017 total traffic volumes can be accommodated with the proposed improvements at the study intersections.

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Exhibit 5-1
2007 Levels of Service

Intersection	Background				Site + Background				Total Traffic			
	AM		PM		AM		PM		AM		PM	
	With Improvements	Without Improvements	With Improvements	Without Improvements	With Improvements	Without Improvements	With Improvements	Without Improvements	With Improvements	Without Improvements	With Improvements	Without Improvements
STH 158/CTH H	EBL - B EBTR -C WBL - B WBTR - C NBA - C SBLT -C SBR - C **OVERALL - C**	EBL - B EBTR - C WBL - B WBTR - C NBA - C SBA - D **OVERALL - B**	EBL - B EBTR -C WBL - B WBTR - C NBA - C SBLT -C SBR - C **OVERALL - C**	EBL - B EBTR - D WBL - B WBTR - C NBA - C SBA - C **OVERALL - C**	EBL - B EBT -C EBR - B WBL - B WBT - C WBR - A NBL - B NBTR - C SBL -B SBTR - D **OVERALL - C**	EBL - C EBTR - E WBL - B WBTR - D NBA - C SBA - D **OVERALL - D**	EBL - C EBT - D EBR - C WBL - B WBT - C WBR - B NBL - B NBTR - C SBL -B SBTR - C **OVERALL - C**	EBL - D EBTR - F WBL - B WBTR - C NBA - C SBA - F **OVERALL - F**	EBL - B EBT -C EBR - B WBL - B WBT - C WBR - B NBL - B NBTR - C SBL -B SBTR - D **OVERALL - C**	EBL - C EBTR - E WBL - B WBTR - E NBA - C SBA - D **OVERALL - E**	EBL - C EBT -D EBR - C WBL - B WBT - C WBR - B NBL - B NBTR - C SBL -B SBTR - C **OVERALL - C**	EBL - D EBTR - F WBL - B WBTR - D NBA - C SBA - F **OVERALL - F**
STH 158/104th	EBL - C EBT - C EBR - C WBL - B WBTR - C NBL - C NBLT - C NBR - C SBL - D SBTR -B **OVERALL - C**	NBA - C SBA - D	EBL - B EBT - C EBR - C WBL - C WBTR - C NBL - C NBLT - C NBR - B SBL - D SBTR - D **OVERALL - C**	NBA - C SBA - C	EBL - D EBT - D EBR - A WBL - D WBT - C WBR - B NBL - D NBLT - C SBL - C SBTR -D **OVERALL - C**	NBA - F SBA - E	EBL - C EBT - D EBR - C WBL - D WBT - C WBR - B NBL - C NBLT - C SBL - D SBTR -D **OVERALL - C**	NBA - F SBA - F	EBL - D EBT - D EBR - A WBL - D WBT - C WBR - B NBL - C NBLT - C SBL - D SBTR -D **OVERALL - C**	NBA - F SBA - F	EBL - D EBT - D EBR - C WBL - D WBT - C WBR - B NBL - C NBLT - C SBL - D SBTR -D **OVERALL - D**	NBA - F SBA - F
STH 158/Greyhound Access	EBT - B WBL - A WBT - A NBL - C NBR - B **OVERALL - A**	EBTR - B EBR - A WBL - A WBT - A NBL - C NBR - B **OVERALL - A**	EBT - B WBL - A WBT - A NBL - C NBR - B **OVERALL - A**	EBTR - B EBR - B WBL - A WBT - A NBL - C NBR - B **OVERALL - B**	EBT - B WBL - C WBT - A NBL - C NBR - B **OVERALL - A**	EBTR - B EBR - B WBL - C WBT - A NBL - C NBR - B **OVERALL - B**	EBT - B WBL - C WBT - A NBL - C NBR - B **OVERALL - B**	EBTR - B EBR - C WBL - B WBT - A NBL - D NBR - B **OVERALL - B**	EBT - B WBL - C WBT - A NBL - D NBR - B **OVERALL - B**	EBTR - B EBR - B WBL - A WBT - A NBL - D NBR - B **OVERALL - D**	EBT - B WBL - C WBT - A NBL - D NBR - B **OVERALL - B**	EBTR - B EBR - C WBL - B WBT - A NBL - D NBR - B **OVERALL - B**
STH 158/Ramp/Frontage Road	NBLT - C SBLR - B	EBA - B WBA - B NBA - A SBA - A **OVERALL - B**	NBLT - C SBLR - B	EBA - B WBA - A NBA - A SBA - A **OVERALL - B**	NBLT - D SBLR - C	EBA - D WBA - C NBA - A SBA - A **OVERALL - C**	NBLT - E SBLR - C	EBA - E WBA - C NBA - B SBA - A **OVERALL - D**	NBLT - F SBLR - F	EBA - F WBA - E NBA - C SBA - B **OVERALL - F**	NBLT - F SBLR - F	EBA - F WBA - F NBA - C SBA - B **OVERALL - F**
STH 158/Western Frontage Road	NBLR - B	EBT - B EBR - A WBA - A NBLT - A **OVERALL - B**	NBLR - B	EBT - B EBR - A WBA - A NBLT - A **OVERALL - A**	NBLR - B	EBT - D EBR - A WBA - C NBLT - A **OVERALL - C**	NBLR - C	EBT - E EBR - A WBA - C NBLT - A **OVERALL - D**	NBLR - D	EBT - F EBR - A WBA - E NBLT - B **OVERALL - F**	NBLR - D	EBT - F EBR - A WBA - F NBLT - B **OVERALL - F**
CTH K/104th	EBL - B EBTR - C WBL - B WBTR - C NBL - B NBTR - C SBL - B SBTR - C **OVERALL - C**	EBLT- B EBR - A WBA - B NBL - A NBTR - B SBLT - B SBR - A **OVERALL - B**	EBL - B EBTR - C WBL - B WBTR - C NBL - B NBTR - C SBL - B SBTR - B **OVERALL - C**	EBLT- B EBR - A WBA - B NBL - A NBTR - B SBLT - B SBR - A **OVERALL - B**	EBL - B EBTR - C WBL - C WBT - C WBR - B NBL - B NBTR - C SBL - B SBTR - C **OVERALL - C**	EBLT- B EBR - A WBA - C NBL - A NBTR - B SBLT - B SBR - A **OVERALL - B**	EBL - B EBTR - C WBL - C WBT - C WBR - B NBL - B NBTR - C SBL - B SBTR - C **OVERALL - C**	EBLT- C EBR - B WBA - E NBL - B NBTR - C SBLT - C SBR - B **OVERALL - D**	EBL - B EBTR - C WBL - B WBT - C WBR - B NBL - B NBTR - C SBL - B SBTR - C **OVERALL - C**	EBL - C EBTR - A WBA - F NBL - B NBTR - C SBL - C SBTR - B **OVERALL - E**	EBL - B EBTR - C WBL - B WBT - C WBR - B NBL - B NBTR - C SBL - B SBTR - C **OVERALL - C**	EBL - F EBTR - B WBA - F NBL - B NBTR - E SBL - D SBTR - B **OVERALL - F**
CTH K/Eastern Frontage Road	EBA - A WBA - A NBA - A SBA - A **OVERALL - A**	EBA - A WBA - A NBA - A SBA - A **OVERALL - A**	EBA - A WBA - A NBA - A SBA - A **OVERALL - A**	EBA - A WBA - A NBA - A SBA - A **OVERALL - A**	EBA - A WBA - A NBA - A SBA - A **OVERALL - A**	EBA - A WBA - A NBA - A SBA - A **OVERALL - A**	EBA - A WBA - A NBA - A SBA - A **OVERALL - A**	EBA - A WBA - A NBA - A SBA - A **OVERALL - A**	EBA - B WBA - B NBA - B SBA - A **OVERALL - B**	EBA - B WBA - B NBA - B SBA - A **OVERALL - B**	EBA - C WBA - C NBA - C SBA - B **OVERALL - C**	EBA - C WBA - C NBA - C SBA - B **OVERALL - C**
104th/Southern Access	N/A	N/A	N/A	N/A	EBL - C NBL - B NBT - B SBT - B SBR - A **OVERALL - B**	N/A	EBL - C NBL - B NBT - B SBT - B SBR - A **OVERALL - B**	N/A	EBL - C NBL - B NBT - B SBT - B SBR - A **OVERALL - B**	N/A	EBL - C NBL - B NBT - B SBT - B SBR - A **OVERALL - B**	N/A

Exhibit 5-2
2017 Levels of Service

Intersection	Background				Site + Background				Total Traffic			
	AM		PM		AM		PM		AM		PM	
	With Improvements	Without Improvements	With Improvements	Without Improvements	With Improvements	Without Improvements	With Improvements	Without Improvements	With Improvements	Without Improvements	With Improvements	Without Improvements
STH 158/CTH H	EBL - B EBTR -C WBL - B WBTR - C NBA - C SBLT -C SBR - B **OVERALL - C**	EBL - C EBTR - D WBL - B WBTR - D NBA - C SBA - D **OVERALL - D**	EBL - B EBTR -C WBL - C WBTR - C NBA - D SBLT -D SBR - A **OVERALL - C**	EBL - B EBTR - F WBL - B WBTR - C NBA - C SBA - E **OVERALL - D**	EBL - C EBT -C EBR - C WBL - B WBT - C WBR - B NBL - C NBTR - C SBL -B SBTR - C **OVERALL - C**	EBL - C EBTR - F WBL - B WBTR - F NBA - C SBA - F **OVERALL - F**	EBL - D EBT - D EBR - B WBL - C WBT - D WBR - C NBL - C NBTR - C SBL - C SBTR - C **OVERALL - D**	EBL - F EBTR - F WBL - B WBTR - E NBA - D SBA - F **OVERALL - F**	EBL - C EBT - C EBR - C WBL - B WBT - C WBR - B NBL - C NBTR - C SBL - B SBTR - C **OVERALL - C**	EBL - C EBTR - F WBL - B WBTR - F NBA - C SBA - F **OVERALL - F**	EBL - D EBT - D EBR - B WBL - C WBT - D WBR - B NBL - C NBTR - D SBL - C SBTR - D **OVERALL - D**	EBL - F EBTR - F WBL - B WBTR - F NBA - D SBA - F **OVERALL - F**
STH 158/104th	EBL - C EBT - C EBR - C WBL - C WBTR - C NBL - C NBLT - C NBR - C SBL - D SBTR -D **OVERALL - C**	NBA - D SBA - E	EBL - C EBT - D EBR - C WBL - C WBTR - C NBL - C NBLT - C NBR - B SBL - D SBTR -D **OVERALL - C**	NBA - C SBA - D	EBL - D EBT - D EBR - A WBL - D WBR - C WBR - B NBL - C NBLT - C SBL - D SBTR -D **OVERALL - C**	NBA - F SBA - F	EBL - D EBT - D EBR - A WBL - D WBR - C WBR - B NBL - D NBLT - D SBL - D SBTR -D **OVERALL - D**	NBA - F SBA - F	EBL - D EBT - D EBR - C WBL - D WBR - C WBR - B NBL - D NBLT - D SBL - D SBTR - D **OVERALL - C**	NBA - F SBA - F	EBL - D EBT - D EBR - A WBL - D WBR - C WBR - B NBL - D NBLT - D SBL - D SBTR - D **OVERALL - D**	NBA - F SBA - F
STH 158/Greyhound Access	EBT - B WBL - A WBT - A NBL - C NBR - B **OVERALL - B**	EBTR - B EBR - A WBL - A WBT - A NBL - C NBR - B **OVERALL - B**	EBT - C WBL - A WBT - A NBL - D NBR - B **OVERALL - B**	EBTR - C EBR - A WBL - A WBT - A NBL - D NBR - B **OVERALL - B**	EBT - B WBL - D WBT - A NBL - D NBR - B **OVERALL - B**	EBTR - B EBR - C WBL - B WBT - A NBL - D NBR - B **OVERALL - B**	EBT - D WBL - D WBT - A NBL - D NBR - A **OVERALL - C**	EBTR - D EBR - C WBL - D WBT - A NBL - D NBR - B **OVERALL - C**	EBT - C WBL - D WBT - A NBL - C NBR - B **OVERALL - C**	EBTR - C EBR - A WBL - D WBT - A NBL - D NBR - B **OVERALL - B**	EBT - D WBL - C WBT - A NBL - D NBR - B **OVERALL - C**	EBTR - D EBR - D WBL - D WBT - A NBL - D NBR - B **OVERALL - C**
STH 158/Eastern Frontage Road	NBL - E SBL - D	NBL - E SBL - D	NBL - F SBL - D	NBL - F SBL - D	NBL - F SBL - F	NBL - F SBL - F	NBL - F SBL - F	NBL - F SBL - F	NBL - F SBL - F	NBL - F SBL - F	NBL - F SBL - F	NBL - F SBL - F
STH 158/NB Ramp	NBLT - C	NBLT - C	NBLT - C	NBLT - C	NBLT - E	NBLT - E	NBLT - F	NBLT - F	NBLT - E	NBLT - E	NBLT - F	NBLT - F
STH 158/SB Ramp	EBT - D EBR - D WBL - B WBT - B SBL - C SBLTR - C **OVERALL - C**	EBT - D EBR - D WBL - B WBT - B SBL - C SBLTR - C **OVERALL - C**	EBT - D EBR - D WBL - B WBT - B SBL - C SBLTR - C **OVERALL - C**	EBT - D EBR - D WBL - B WBT - B SBL - C SBLTR - C **OVERALL - C**	EBT - D EBR - D WBL - C WBT - B SBL - C SBLTR - C **OVERALL - C**	EBT - D EBR - D WBL - C WBT - B SBL - C SBLTR - C **OVERALL - C**	EBT - D EBR - D WBL - C WBT - B SBL - C SBLTR - C **OVERALL - C**	EBT - D EBR - D WBL - C WBT - B SBL - C SBLTR - C **OVERALL - C**	EBT - D EBR - D WBL - D WBT - B SBL - D SBLTR - D **OVERALL - D**	EBT - D EBR - D WBL - D WBT - B SBL - D SBLTR - D **OVERALL - D**	EBT - D EBR - D WBL - C WBT - B SBL - D SBLTR - D **OVERALL - D**	EBT - D EBR - D WBL - C WBT - B SBL - D SBLTR - D **OVERALL - D**
STH 158/Western Frontage Road	WBLR - A NBTR - A SBLT - A **OVERALL - A**	WBLR - A NBTR - A SBLT - A **OVERALL - A**	WBLR - A NBTR - A SBLT - A **OVERALL - A**	WBLR - A NBTR - A SBLT - A **OVERALL - A**	WBLR - A NBTR - A SBLT - A **OVERALL - A**	WBLR - A NBTR - A SBLT - A **OVERALL - A**	WBLR - A NBTR - A SBLT - A **OVERALL - A**	WBLR - A NBTR - A SBLT - A **OVERALL - A**	WBLR - A NBTR - A SBLT - A **OVERALL - A**	WBLR - A NBTR - A SBLT - A **OVERALL - A**	WBLR - A NBTR - A SBLT - A **OVERALL - A**	WBLR - A NBTR - A SBLT - A **OVERALL - A**
CTH K/104th	EBL - B EBTR - C WBL - B WBTR - C NBL - B NBTR - C SBL - B SBTR - C **OVERALL - C**	EBLT- B EBR - A WBA - B NBL - A NBTR - B SBLT - B SBR - A **OVERALL - B**	EBL - B EBTR - C WBL - B WBTR - C NBL - B NBTR - C SBL - B SBTR - C **OVERALL - C**	EBLT- C EBR - A WBA - C NBL - B NBTR - C SBLT - B SBR - A **OVERALL - C**	EBL - B EBTR - C WBL - B WBT - C WBR - C NBL - B NBTR - C SBL - B SBTR - C **OVERALL - C**	EBLT- B EBR - A WBA - D NBL - B NBTR - C SBLT - B SBR - A **OVERALL - C**	EBL - B EBTR - C WBL - C WBT - C WBR - C NBL - B NBTR - C SBL - C SBTR - C **OVERALL - C**	EBLT- D EBR - B WBA - F NBL - B NBTR - F SBLT - D SBR - B **OVERALL - F**	EBL - B EBTR - C WBL - B WBT - C WBR - C NBL - B NBTR - C SBL - B SBTR - C **OVERALL - C**	EBLT- C EBR - A WBA - F NBL - B NBTR - C SBLT - C SBR - B **OVERALL - E**	EBL - B EBTR - D WBL - D WBT - C WBR - C NBL - B NBTR - D SBL - C SBTR - C **OVERALL - C**	EBLT- F EBR - B WBA - F NBL - B NBTR - E SBLT - D SBR - B **OVERALL - F**
CTH K/Eastern Frontage Road	EBA - A WBA - A NBA - A SBA - A **OVERALL - A**	EBA - A WBA - A NBA - A SBA - A **OVERALL - A**	EBA - B WBA - B NBA - B SBA - B **OVERALL - B**	EBA - B WBA - B NBA - B SBA - B **OVERALL - B**	EBA - A WBA - A NBA - A SBA - A **OVERALL - A**	EBA - A WBA - A NBA - A SBA - A **OVERALL - A**	EBA - B WBA - B NBA - B SBA - B **OVERALL - B**	EBA - B WBA - B NBA - B SBA - A **OVERALL - B**	EBA - B WBA - B NBA - B SBA - A **OVERALL - B**	EBA - B WBA - B NBA - B SBA - A **OVERALL - B**	EBA - C WBA - C NBA - C SBA - B **OVERALL - C**	EBA - C WBA - C NBA - C SBA - B **OVERALL - C**
104th/Southern Access	NA	NA	NA	NA	EBL - C NBL - B NBT - B SBT - C SBR - A **OVERALL - B**	N/A	EBL - C NBL - B NBT - C SBT - C SBR - A **OVERALL - C**	N/A	EBL - C NBL - B NBT - B SBT - C SBR - A **OVERALL - C**	N/A	EBL - C NBL - B NBT - C SBT - C SBR - A **OVERALL - C**	N/A

Roundabout Analysis

As per the Wisconsin Department of Transportation's Facilities Development Manual, all intersections that warrant a traffic signal on Wisconsin State Highway 158 must also be analyzed to determine if a roundabout is a better traffic control alternative. In order to analyze the level of service operations of these intersections with roundabouts, Land Strategies utilized the RODEL software program. The RODEL program is based on empirical models that develop relationships between the geometric design of the roundabout and capacity and delay of the intersection. **Exhibit 5-4** displays the results of RODEL software analysis using the 2017 total traffic volumes. The RODEL printouts are included with the appendix.

Exhibit 5-4
Roundabout RODEL Analysis – 2017 Total Traffic Volumes

Intersection	Level of Service	
	AM Peak Hour	PM Peak Hour
STH 158/I-94 NB Ramp	A	A
STH 158/I-94 NB Ramp	A	A
STH 158/Eastern Frontage Road	A	A
STH 158/104th Avenue	B	C

As can be seen from Exhibit 5-4, all four intersections operate at good levels of service as roundabouts. Based on the proximity of the I-94 NB Ramp to the Eastern Frontage Road and I-94 as well as the Kilbourn ditch, constructing roundabouts at these intersections is not an option. Roundabouts should strongly be considered at the intersections of STH 158/I-94 SB Ramp and STH 158/104th Avenue.

Signal Progression Analysis

The 1996 WisDOT Functional Plan for the STH 158 interchange improvement project proposed traffic signals at the I-94 NB Ramp/STH 158 and STH 158/Eastern Frontage Road. The distance between these two intersections is approximately 350 feet. If traffic signals are installed at both of these intersections, the two traffic signals will essentially operate as one traffic signal. A progression analysis was conducted on STH 158 at the intersections of I-94 NB Ramp/STH 158, STH 158/Eastern Frontage Road, and STH 158/Main Access Drive using the Transyt 7-F software program. The results of this analysis are shown in the Appendix.

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Conclusions and Recommendations

Recommended Improvements

Recommendations for the proposed development were made based on traffic engineering standards and the criteria stated in the WisDOT Traffic Impact Analysis Guidelines.

2007 (Phase I)

The 2007 improvements are designed to accommodate the 2007 total traffic volumes and are shown on **Exhibit 6-1**. It should be noted that the need for these improvements is a result of not only the traffic to be generated by the proposed casino, but also because of the growth in the existing traffic in the area as well as other developments in the area. It is recommended that a cost sharing model be developed so that each development pays for its fair share of the recommended improvements.

STH 158/Western Frontage Road

The east-west movements on STH 158 should operate freely. Only the northbound direction should operate under stop control.

STH 158/Eastern Frontage Road

The east-west movements on STH 158 should operate freely. The northbound and southbound directions should continue to operate under stop control.

STH 158/Access Drive

The eastbound direction should be re-configured to provide two through lanes and a free-flow right-turn lane. The northbound direction should provide dual left-turn lanes and a right-turn lane. A left-turn lane should be added in the westbound direction to provide dual left-turn lanes into the site.

STH 158/104th Avenue

The intersection of STH 158 and 104th Avenue should be converted to a roundabout. Based on the initial analysis, the eastbound, westbound, and northbound directions should provide two entry lanes into the roundabout and the southbound direction should provide one entry lane. The exact geometrics of the intersection will be completed during the design phase.

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STH 158/County Highway H

The only improvement at the intersection that is a direct result of the traffic generated by the proposed Project Eagle development is the eastbound right-turn lane on State Highway 158. The other improvements required at this intersection are a result of growth in existing traffic volumes, the other developments in the area, as well as the Project Eagle development. These improvements include an additional through lane in both the eastbound and westbound direction, and a left-turn lane in the northbound and southbound directions on County Highway H and a westbound right-turn lane on State Highway 158. These improvements will allow the intersection to operate above the acceptable level of service in both the year 2007 and 2017. The cost of these improvements should be distributed appropriately.

STH 158/95th Avenue

As the traffic in the area increases, STH 158 should be widened at this intersection to provide an additional through lane and a right-turn lane in the westbound direction. The widening on STH 158 at this intersection is also a result of the growth in existing traffic and the additional traffic generated by all of the proposed development in the area.

104th Avenue

104th Avenue should be widened to provide two northbound through lanes in the area bounded by the development's southern access drive on the south and STH 158 to the north. A center left-turn lane should also be provided along 104th Avenue.

104th Avenue/Northern Access Drive

A northbound left-turn lane should be provided on 104th Avenue the access drive location.

104th Avenue/Central Access Drive

A northbound left-turn lane and a southbound right-turn lane should be provided on 104th Avenue at the access drive location. The access drive should provide one inbound lane and two outbound lanes, a left-turn lane and a right-turn lane. The outbound movements should remain under stop control.

104th Avenue/Southern Access Drive

The intersection should be signalized. The access drive should provide dual left-turn lanes and right-turn lane. A northbound left-turn lane and a southbound right-turn lane should be provided on 104th Avenue at the access drive location.

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104th Avenue/County Highway K

The intersection should be signalized. On CTH K, the eastbound direction should provide a left-turn lane and a combination through/right-turn lane, the westbound direction should provide a left-turn lane, a through lane, and a right-turn lane. On 104th Avenue, both the northbound and southbound directions should provide a left-turn lane and a combination through/right-turn lane.

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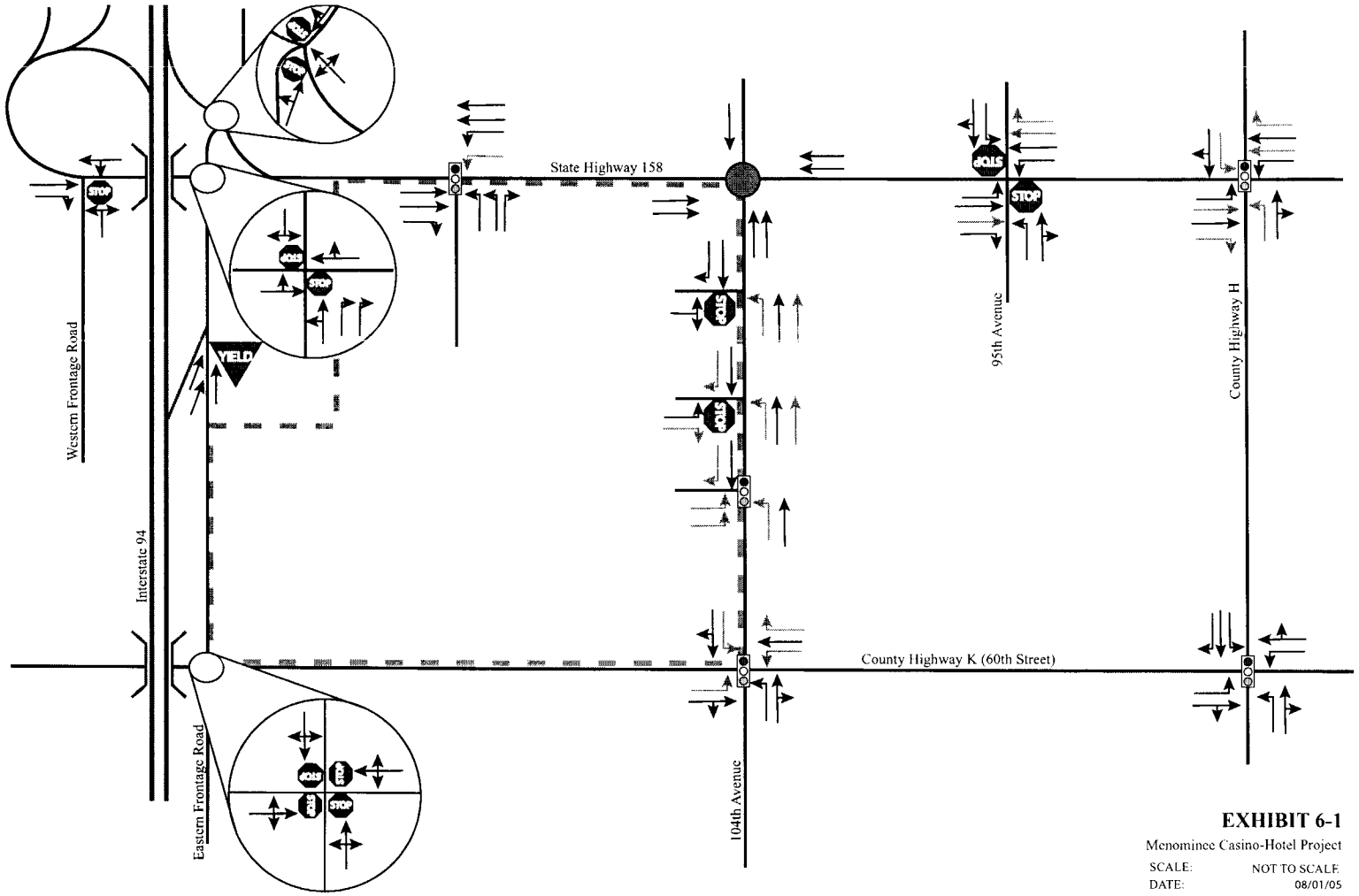

Legend:

- : Existing Lane
- : Recommended Improvement
- : Signalized Intersection
- : Stop Controlled Approach
- : Roundabout

LAND STRATEGIES, INC
PLANNING/TRANSPORTATION/URBAN DESIGN

EXHIBIT 6-1

Menominee Casino-Hotel Project

SCALE: NOT TO SCALE
DATE: 08/01/05

2007 PROPOSED GEOMETRICS

N

2017 (Full Buildout)

No additional off-site improvements are required to accommodate the 2017 traffic volumes. This section discussed the proposed intersection geometry at the Interstate 94 interchange at STH 158 and any additional improvements that are necessary. **Exhibit 6-2** displays the proposed geometrics for the year 2017.

STH 158/Western Frontage Road

The improvements in the I-94 corridor study at this intersection included a left-turn lane and a through lane in the southbound direction, a through lane and a right-turn lane in the northbound direction, and a left-turn lane and a right-turn lane in the westbound direction. Land Strategies agrees with these improvements and no additional improvements are necessary to accommodate the 2017 total traffic volumes.

STH 158/I-94 Southbound Ramp

As discussed earlier, a roundabout should be considered at this intersection. Two entry lanes should be provided in the eastbound, westbound, and southbound directions.

STH 158/I-94 Northbound Ramp

The intersection should be signalized. Along STH 158, the eastbound direction should provide a left-turn lane and two through lanes and the westbound direction should provide two through lanes and a right-turn lane. The I-94 off ramp should provide a combination left-turn/through lane and a free-flow right-turn lane.

STH 158/Eastern Frontage Road

As discussed in the signal progression analysis, the spacing between the proposed signalized intersections of I-94 NB Ramp/STH 158 and STH 158/Eastern Frontage Road is approximately 350 feet which is well below the typical spacing between signalized intersections. Consideration should be given to installing a traffic signal only at the intersection of I-94 NB Ramp/STH 158 and placing signs at the intersection of County Highway K/Eastern Frontage Road directing vehicles to access I-94 from the west, utilizing the Western Frontage Road. The intersection of STH 158/Western Frontage Road can accommodate the additional traffic and this would improve the operations of STH 158.

If a traffic signal is to be installed at this intersection, the eastbound direction of STH 158 should provide a left-turn lane, two through lanes, and a combination through/right-turn lane and the westbound direction of STH 158 should provide a left-turn lane, two through lanes, and a right-turn lane. The frontage road should provide a left-turn lane and a combination through/right-turn lane in both the northbound and southbound directions.

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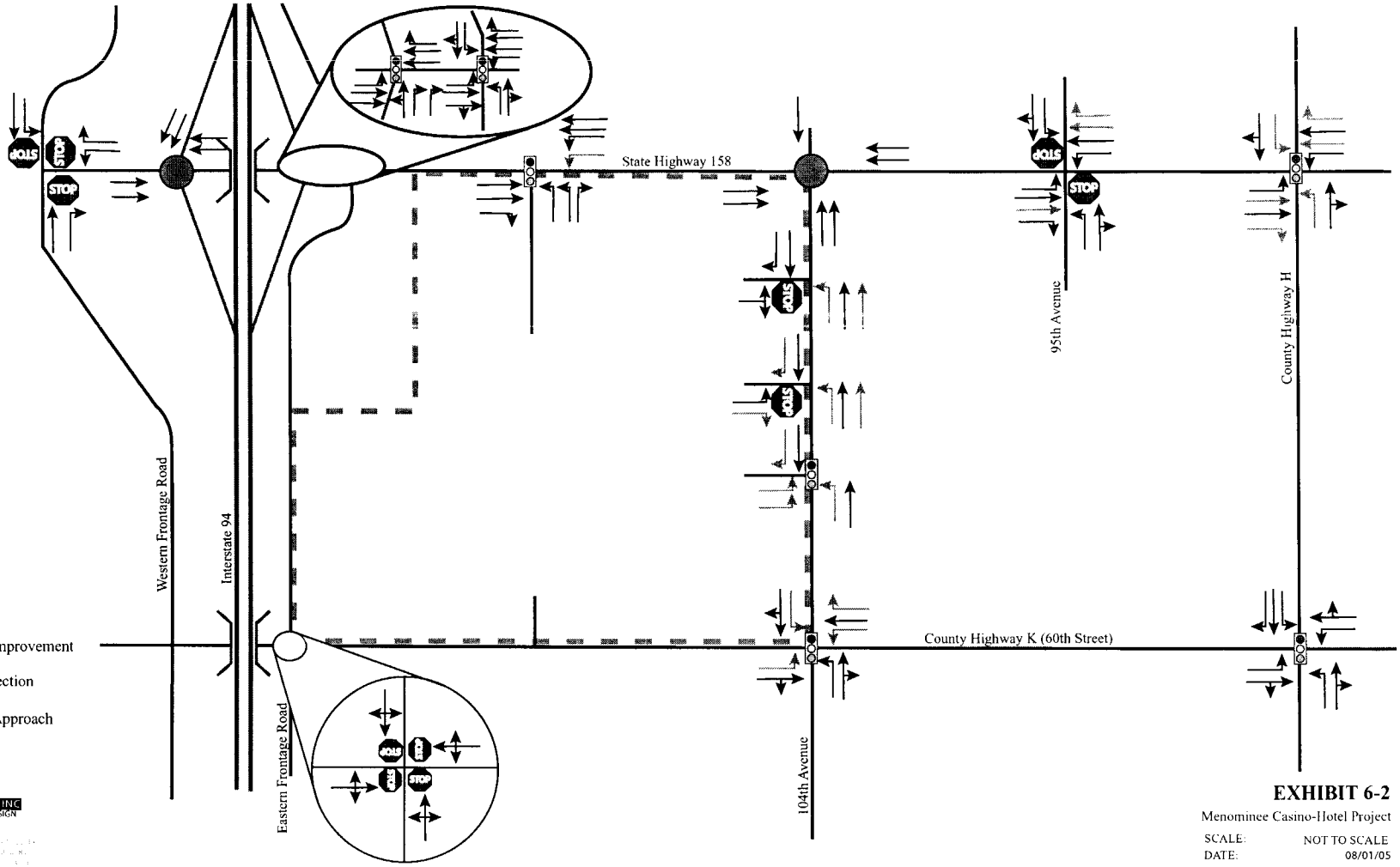

Legend:

- : Existing Lane
- : Recommended Improvement
- : Signalized Intersection
- : Stop Controlled Approach
- : Roundabout

LAND STRATEGIES, INC
PLANNING/TRANSPORTATION/URBAN DESIGN

2017 PROPOSED GEOMETRICS

N

EXHIBIT 6-2

Menominee Casino-Hotel Project

SCALE: NOT TO SCALE
DATE: 08/01/05

Summary

The proposed Project Eagle development on the existing Dairyland Greyhound site will include casino gaming area, hotels, and a water park. The existing access points on STH 158 and 104th Avenue will remain and an additional access drive is proposed on 104th Avenue. The existing access drive on CTH K will become an emergency only access drive.

- A roundabout should be constructed at the intersection of STH 158/104th Avenue.
- The new access drive on 104th Avenue will serve as the main egress point and should be signalized.
- The intersection of CTH K/104th Avenue should be signalized and the traffic signal should be coordinated with the new traffic signal at the development's southern access drive on 104th Avenue.

The 2017 total traffic volumes can be accommodated by the recommended improvements to the existing street system.

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APPENDIX

EXISTING TRAFFIC COUNTS

:OT District 2 Traffic Count

ALL VEHICLES & U-TURNS

EXPANSION FACTORS

HOURLY EXP. = 0.0000
MONTHLY EXP. = 0.0000

:OCATION:STH 156 and Dairyland Greyhound Park
' & DATE:Tues 07/01/03(pm); Wed 07/02/03(am)
WEATHER:Pt Cloudy;Sunny

TRUCKS : X
BUSES : X
SCHOOL BUSES : X
PASSENGER VEHICLES: X

OBSERVER NAME :Greg Hansen
PROCESSER NAME :Lisa Abraham

et NM :	From North				Dairyland Greyhound From South				STH 158 From East				STH 158 From West				Totals			U-Turns				
e I	L	A	R	TOTAL	L	A	R	TOTAL	L	A	R	TOTAL	L	A	R	TOTAL	N-S	E-W	ALL	N	S	E	W	TOTAL
7	0	0	0	0	0	0	0	0	0	479	0	479	0	353	0	353	0	832	832	0	0	0	0	0
8	0	0	0	0	1	0	0	1	0	417	0	417	0	431	1	432	1	849	850	0	0	0	0	0
9	0	0	0	0	2	0	1	3	1	345	0	346	0	329	3	332	3	678	681	0	0	0	2	2
					0	0	0		0	420	0		0	430	0									
0	0	0	0	0	3	0	0	3	0	270	0	270	0	277	3	280	3	550	553	0	0	1	0	1
1	0	0	0	0	2	0	4	6	4	259	0	263	0	315	19	334	6	597	603	0	0	0	0	0
2	0	0	0	0	11	0	3	14	22	303	0	325	0	295	94	389	14	714	728	0	0	0	5	5
3	0	0	0	0	8	0	9	17	63	397	0	460	0	344	188	532	17	992	1009	0	0	0	1	1
4	0	0	0	0	13	0	8	21	20	360	0	380	0	345	35	380	21	760	781	0	0	0	1	1
5	0	0	0	0	10	0	3	13	0	439	0	439	0	367	14	381	13	820	833	0	0	0	2	2
6	0	0	0	0	7	0	4	11	1	479	0	480	0	459	8	467	11	947	958	0	0	0	1	1
7	0	0	0	0	3	0	2	5	1	496	0	497	0	466	10	476	5	973	978	0	0	0	1	1
8	0	0	0	0	10	0	2	12	29	406	0	435	0	576	37	613	12	1048	1060	0	0	0	0	0
					5	0	0		0	495	0		0	575	35									
TL	0	0	0	0	70	0	36	106	141	4650	0	4791	0	4557	412	4969	106	9760	9866	0	0	1	13	14
ARTING FROM				0				553				4594				4733	553	9327	9880					

EXPANDED TO 24 HOURS

VL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RUCKS				0.00				0.00				0.00				0.00	0.00	0.00	0.00					
T'G				0				0				0				0	0	0	0					
RUCKS				0.00				0.00				0.00				0.00	0.00	0.00	0.00					

ILE NAME: CNT102_1.TXT

LOG ID :

sDOT District 2 Traffic Count

TRUCKS & PEDSTRIANS

LOCATION:STH 158 and Dairyland Greyhound Park
AY & DATE:Tues 07/01/03(pm); Wed 07/02/03(am)
WEATHER:Pt Cloudy;Sunny

TRUCKS : X
BUSES :
SCHOOL BUSES :
PASSENGER VEHICLES:

OBSERVER NAME :Greg Hansen
PROCESSER NAME :Lisa Abraham

reet NM: ---------1	From North				Dairyland Greyhound From South				STH 158 From East				STH 158 From West				TOTALS			PEDSTRIANS [X] BICYCLES [ ]						
ime I	L	A	R	TOTAL	L	A	R	TOTAL	L	A	R	TOTAL	L	A	R	TOTAL	N-S	E-W	ALL	N	S	E	W	NS	EW	TOTAL
- 7	0	0	0	0	0	0	0	0	0	26	0	26	0	34	0	34	0	60	60	0	0	0	0	0	0	0
- 8	0	0	0	0	0	0	0	0	0	63	0	63	0	59	0	59	0	122	122	0	0	0	0	0	0	0
- 9	0	0	0	0	0	0	0	0	0	65	0	65	0	58	0	58	0	123	123	0	0	0	0	0	0	0
-10	0	0	0	0	0	0	0	0	0	46	0	46	0	65	0	65	0	111	111	0	0	0	0	0	0	0
-11	0	0	0	0	0	0	0	0	0	52	0	52	0	65	1	66	0	118	118	0	0	0	0	0	0	0
-12	0	0	0	0	0	0	0	0	0	52	0	52	0	62	0	62	0	114	114	0	0	0	0	0	0	0
-13	0	0	0	0	1	0	0	1	0	61	0	61	0	57	2	59	1	120	121	0	0	0	0	0	0	0
-14	0	0	0	0	0	0	0	0	0	58	0	58	0	64	0	64	0	122	122	0	0	0	0	0	0	0
-15	0	0	0	0	0	0	0	0	0	73	0	73	0	55	0	55	0	128	128	0	0	3	0	0	3	3
-16	0	0	0	0	0	0	0	0	0	53	0	53	0	61	0	61	0	114	114	0	0	5	0	0	5	5
-17	0	0	0	0	0	0	0	0	0	39	0	39	0	26	0	26	0	65	65	0	0	0	0	0	0	0
-18	0	0	0	0	1	0	0	1	0	23	0	23	0	24	1	25	1	48	49	0	0	0	0	0	0	0
TAL	0	0	0	0	2	0	0	2	0	611	0	611	0	630	4	634	2	1245	1247	0	0	8	0	0	8	8

FILE NAME: CNT102_3.TXT

LOG ID :

OT District 2 Traffic Count

ALL VEHICLES & U-TURNS

EXPANSION FACTORS

HOURLY EXP. = 1.3590
MONTHLY EXP. = 1.0390

OCATION:STH 158 and 104th Ave.
& DATE:Fri 12/5/03(am); Mon 12/8/03(pm)
WEATHER:Ovrcast;Ovrcast

TRUCKS : X
BUSES : X
SCHOOL BUSES : X
PASSENGER VEHICLES: X

OBSERVER NAME :Ron Lawson
PROCESSER NAME :Emily Lintner

et NM :	Ruth Harman Dr. From North				104th Ave. From South				STH 158 From East				STH 158 From West				Totals			U-Turns				
--I																								
e I	L	A	R	TOTAL	L	A	R	TOTAL	L	A	R	TOTAL	L	A	R	TOTAL	N-S	E-W	ALL	N	S	E	W	TOTAL
7	1	0	0	1	31	1	43	75	69	508	10	587	4	322	6	332	76	919	995	0	0	1	0	1
8	3	0	3	6	32	0	95	127	113	418	5	536	6	487	22	515	133	1051	1184	0	0	0	0	0
9	1	0	2	3	57	3	96	156	84	373	11	468	18	376	9	403	159	871	1030	0	0	0	0	0
	5		5		30	0	95		115	420	5		5	485	20									
0	2	1	4	7	20	3	65	88	61	265	12	338	7	206	10	223	95	561	656	0	0	0	0	0
1	5	2	0	7	14	0	89	103	56	205	0	261	17	233	6	256	110	517	627	0	0	0	0	0
2	8	1	5	14	4	1	60	65	70	238	19	327	2	252	4	258	79	585	664	0	0	0	0	0
3	3	3	5	11	7	3	89	99	100	270	11	381	5	272	7	284	110	665	775	0	0	0	0	0
4	3	1	1	5	16	5	87	108	123	331	4	458	1	284	8	293	113	751	864	0	0	0	0	0
5	6	1	2	9	4	2	59	65	100	324	3	427	2	242	15	259	74	686	760	0	0	0	0	0
6	9	2	13	24	9	0	101	110	120	396	5	521	8	357	20	385	134	906	1040	0	0	0	2	2
7	8	6	9	23	9	4	132	145	83	396	3	482	7	484	18	509	168	991	1159	0	0	0	0	0
8	9	0	12	21	19	0	146	165	109	324	0	433	1	555	21	577	186	1010	1196	0	0	0	0	0
	10	5	10		10	5	130		85	395	5		5	485	20									
TL	58	17	56	131	222	22	1062	1306	1088	4048	83	5219	78	4070	146	4294	1437	9513	10950	0	0	1	2	3
ARTING FROM				183				1251				5191				4328	1434	9519	10953					

EXPANDED TO 24 HOURS

VL	82	24	79	185	313	31	1500	1844	1536	5716	117	7369	110	5747	206	6063	2029	13432	15461	0	0	1	3	4
UCKS				12.21				2.83				10.17				14.00	3.7	11.9	10.8					
G				258				1766				7330				6111	2025	13441	15466					
UCKS				8.76				2.24				12.06				11.90	3.1	12.0	10.8					

ILE NAME: CNT057_1.TXT

LOG ID :

WisDOT District 2 Traffic Count

TRUCKS & PEDSTRIANS

LOCATION:STH 158 and 104th Ave.
DAY & DATE:Fri 12/5/03(am), Mon 12/8/03(pm)
WEATHER:Ovrcast,Ovrcast

TRUCKS : X
BUSES :
SCHOOL BUSES :
PASSENGER VEHICLES:

OBSERVER NAME :Ron Lawson
PROCESSER NAME :Emily Lintner

Street NM:	Ruth Harman Dr. From North				104th Ave. From South				STH 158 From East				STH 158 From West				TOTALS			PEDSTRIANS [X] BICYCLES [ ]						
Time I	L	A	R	TOTAL	L	A	R	TOTAL	L	A	R	TOTAL	L	A	R	TOTAL	N-S	E-W	ALL	N	S	E	W	NS	EW	TOTAL
6- 7	0	0	0	0	0	0	0	0	0	28	0	28	1	32	0	33	0	61	61	0	0	0	0	0	0	0
7- 8	0	0	2	2	0	0	1	1	0	36	1	37	0	73	0	73	3	110	113	0	0	0	0	0	0	0
8- 9	1	0	0	1	0	0	3	3	2	59	0	61	1	88	1	90	4	151	155	0	0	0	0	0	0	0
9-10	0	0	2	2	0	2	1	3	0	56	1	57	3	57	0	60	5	117	122	0	0	0	0	0	0	0
0-11	1	1	0	2	1	0	4	5	2	29	0	31	1	53	0	54	7	85	92	0	0	0	0	0	0	0
1-12	1	0	1	2	0	1	0	1	1	55	0	56	0	63	1	64	3	120	123	0	0	0	0	0	0	0
2-13	0	0	2	2	0	1	0	1	1	39	0	40	0	38	0	38	3	78	81	0	0	0	0	0	0	0
3-14	1	0	0	1	0	1	1	2	1	74	1	76	0	35	1	36	3	112	115	0	0	0	0	0	0	0
4-15	2	0	1	3	0	0	0	0	0	46	0	46	0	52	0	52	3	98	101	0	0	0	0	0	0	0
5-16	0	0	1	1	0	0	2	2	1	31	1	33	1	42	0	43	3	76	79	0	0	0	0	0	0	0
6-17	0	0	0	0	0	0	0	0	0	33	0	33	0	26	1	27	0	60	60	0	0	0	0	0	0	0
7-18	0	0	0	0	0	0	0	0	1	19	0	20	0	27	0	27	0	47	47	0	0	0	0	0	0	0
OTAL	6	1	9	16	1	5	12	18	9	505	4	518	7	586	4	597	34	1115	1149	0	0	0	0	0	0	0

FILE NAME: CNT057_3.TXT

LOG ID :

'IC COUNT INTERSECTION

ALL VEHICLES & U-TURNS

EXPANSION FACTORS

HOURLY EXP. = 1.3624
MONTHLY EXP. = 0.8920

)CATION:STH 158 & 95TH AVE/AIRPORT FIRE STATION DRIVE
& DATE:Monday 6/16/03 & Tuesday 6/17/03
VEATHER:Sunny/Warm

TRUCKS : X
BUSES : X
SCHOOL BUSES : X
PASSENGER VEHICLES: X

OBSERVER NAME :Lee Jay
PROCESSER NAME :Debbie Noble

et NM :	Airport Fire Stn Dr From North				95th Avenue From South				STH 158 From East				STH 158 From West				Totals			U-Turns				
e I	L	A	R	TOTAL	L	A	R	TOTAL	L	A	R	TOTAL	L	A	R	TOTAL	N-S	E-W	ALL	N	S	E	W	TOTAL
7	1	0	0	1	9	1	13	23	92	519	3	614	0	251	88	339	24	953	977	0	0	0	0	0
8	3	0	2	5	12	0	28	40	50	440	9	499	4	383	52	439	45	938	983	0	0	0	0	0
9	2	0	3	5	7	1	19	27	25	316	1	342	2	247	42	291	32	633	665	0	1	0	0	1
0	4	0	4	8	14	0	17	31	16	274	0	290	2	246	35	283	39	573	612	0	0	0	0	0
1	4	0	4	8	22	0	20	42	23	300	10	333	5	254	17	276	50	609	659	0	1	0	1	2
2	4	0	5	9	23	1	45	69	20	281	4	305	2	315	29	346	78	651	729	0	0	0	1	1
3	8	0	2	10	25	1	36	62	48	297	7	352	2	334	31	367	72	719	791	0	0	0	0	0
4	4	1	1	6	9	1	23	33	26	348	3	377	3	338	20	361	39	738	777	0	0	1	0	1
5	2	2	2	6	25	0	27	52	41	462	1	504	4	390	35	429	58	933	991	0	0	0	0	0
6	2	0	1	3	62	0	103	165	33	466	2	501	1	474	31	506	168	1007	1175	0	0	0	0	0
7	5	0	2	7	71	0	73	144	18	427	1	446	4	509	15	528	151	974	1125	0	0	0	0	0
8	1	0	0	1	45	0	23	68	7	409	1	417	2	532	6	540	69	957	1026	0	0	0	0	0
TL	40	3	26	69	324	5	427	756	399	4539	42	4980	31	4273	401	4705	825	9685	10510	0	2	1	2	5
RTING FROM				78				805				4741				4891	883	9632	10515					

EXPANDED TO 24 HOURS

VL	49	4	32	84	394	6	519	919	485	5516	51	6052	38	5193	487	5718	1003	11770	12773	0	2	1	2	6
UCKS				13.02				14.15				10.02				11.18	14.1	10.6	10.9					
'G				95				978				5762				5944	1073	11705	12778					
UCKS				11.51				13.17				10.61				10.69	13.0	10.7	10.9					

LE NAME: LOC54P1.TXT

LOG ID :

FFIC COUNT INtERSECTION

TRUCKS & PEDSTRIANS

LOCATION:STH 158 & 95TH AVE/AIRPORT FIRE STATION DRIVE
.Y & DATE:Monday 6/16/03 & Tuesday 6/17/03
WEATHER:Sunny/Warm

TRUCKS : X
BUSES :
SCHOOL BUSES :
PASSENGER VEHICLES:

OBSERVER NAME :Lee Jay
PROCESSER NAME :Debbie Noble

eet NM:	Airport Fire Stn Dr From North				95th Avenue From South				STH 158 From East				STH 158 From West				TOTALS			PEDSTRIANS [X] BICYCLES [ ]						
me I	L	A	R	TOTAL	L	A	R	TOTAL	L	A	R	TOTAL	L	A	R	TOTAL	N-S	E-W	ALL	N	S	E	W	NS	EW	TOTAL
7	0	0	0	0	0	0	2	2	0	39	0	39	0	29	7	36	2	75	77	0	0	0	0	0	0	0
8	0	0	1	1	2	0	3	5	0	47	0	47	0	34	6	40	6	87	93	0	0	0	0	0	0	0
9	1	0	0	1	2	0	5	7	1	40	0	41	0	40	8	48	8	89	97	0	0	0	0	0	0	0
10	1	0	0	1	1	0	5	6	1	35	0	36	0	32	11	43	7	79	86	0	0	0	0	0	0	0
11	0	0	1	1	9	0	4	13	6	47	1	54	0	40	7	47	14	101	115	0	0	0	0	0	0	0
12	1	0	1	2	7	1	5	13	4	43	2	49	1	45	8	54	15	103	118	0	0	0	0	0	0	0
13	0	0	1	1	8	1	8	17	5	35	0	40	0	52	3	55	18	95	113	0	0	0	0	0	0	0
14	0	0	0	0	3	0	5	8	6	33	0	39	0	45	3	48	8	87	95	0	0	0	0	0	0	0
15	0	2	0	2	6	0	3	9	4	47	0	51	2	45	6	53	11	104	115	0	0	0	0	0	0	0
16	0	0	0	0	9	0	2	11	4	46	1	51	0	31	7	38	11	89	100	0	0	0	0	0	0	0
17	0	0	0	0	9	0	4	13	3	23	0	26	0	24	1	25	13	51	64	0	1	0	0	1	0	1
18	0	0	0	0	0	0	1	1	0	17	0	17	0	19	1	20	1	37	38	0	0	0	0	0	0	0
TAL	3	2	4	9	56	2	47	105	34	452	4	490	3	436	68	507	114	997	1111	0	1	0	0	1	0	1

FILE NAME: LOC54P3.TXT

LOG ID :

OT District 2 Traffic Count

ALL VEHICLES & U-TURNS

EXPANSION FACTORS

HOURLY EXP. = 1.3590
MONTHLY EXP. = 1.0390

OCATION:STH 158 and CTH "H"
& DATE:Wed 12/3/03(pm); Thurs 12/4/03(am)
WEATHER:Sunny; Overcast

TRUCKS : X
BUSES : X
SCHOOL BUSES : X
PASSENGER VEHICLES: X

OBSERVER NAME :Ron Lawson
PROCESSER NAME :Emily Lintner

et NM :	CTH H From North				CTH H From South				STH 158 From East				STH 158 From West				Totals			U-Turns				
e I	L	A	R	TOTAL	L	A	R	TOTAL	L	A	R	TOTAL	L	A	R	TOTAL	N-S	E-W	ALL	N	S	E	W	TOTAL
7	41	178	96	315	14	71	24	109	57	644	64	765	14	249	6	269	424	1034	1458	0	0	0	0	0
8	52	239	82	373	6	143	58	207	61	568	23	652	60	471	14	545	580	1197	1777	0	0	0	0	0
9	36	163	72	271	15	97	32	144	70	401	15	486	30	336	18	384	415	870	1285	0	0	0	0	0
10	29	115	44	188	20	105	29	154	44	241	10	295	26	287	9	322	342	617	959	0	0	0	0	0
11	15	100	34	149	10	106	65	181	65	338	16	419	18	261	17	296	330	715	1045	0	0	0	0	0
12	44	111	32	187	15	95	61	171	36	358	35	429	25	291	29	345	358	774	1132	0	0	0	0	0
13	35	128	53	216	12	121	86	219	55	340	48	443	36	332	9	377	435	820	1255	0	0	0	0	0
14	31	133	36	200	29	127	60	216	90	275	36	401	57	267	14	338	416	739	1155	0	0	0	0	0
15	66	160	45	271	19	134	78	231	80	370	40	490	66	335	24	425	502	915	1417	0	0	0	0	0
16	51	162	55	268	30	250	68	348	64	529	54	647	152	529	18	699	616	1346	1962	0	0	0	0	0
17	58	257	56	371	17	277	69	363	74	383	92	549	111	511	15	637	734	1186	1920	0	0	0	0	0
18	49	253	45	347	10	286	43	339	35	425	53	513	79	424	15	518	686	1031	1717	0	0	0	0	0
TL	507	1999	650	3156	197	1812	673	2682	731	4872	486	6089	674	4293	188	5155	5838	11244	17082	0	0	0	0	0
ARTING FROM				2972				2918				5473				5719	5890	11192	17082					

EXPANDED TO 24 HOURS

VL	716	2823	918	4456	278	2559	950	3787	1032	6879	686	8598	952	6062	265	7279	8243	15877	24120	0	0	0	0	0
RUCKS				5.89				7.23				9.98				11.99	6.5	10.9	9.4					
T'G				4196				4120				7728				8075	8317	15803	24120					
RUCKS				5.62				7.95				11.26				10.33	6.8	10.8	9.4					

ILE NAME: CNT056_1.TXT

LOG ID :

sDOT District 2 Traffic Count

TRUCKS & PEDSTRIANS

LOCATION:STH 158 and CTH "H"
AY & DATE:Wed 12/3/03(pm); Thurs 12/4/03(am)
WEATHER:Sunny; Overcast

TRUCKS : X
BUSES :
SCHOOL BUSES :
PASSENGER VEHICLES:

OBSERVER NAME :Ron Lawson
PROCESSER NAME :Emily Lintner

reet NM:	CTH H From North				CTH H From South				STH 158 From East				STH 158 From West				TOTALS			PEDSTRIANS [X] BICYCLES [ ]						
----------I ime I	L	A	R	TOTAL	L	A	R	TOTAL	L	A	R	TOTAL	L	A	R	TOTAL	N-S	E-W	ALL	N	S	E	W	NS	EW	TOTAL
- 7	2	6	0	8	3	2	0	5	0	50	4	54	0	27	2	29	13	83	96	0	0	0	0	0	0	0
- 8	2	15	0	17	1	1	2	4	2	45	1	48	2	41	6	49	21	97	118	0	0	0	0	0	0	0
- 9	0	15	0	15	5	6	1	12	1	51	0	52	0	54	11	65	27	117	144	0	0	0	0	0	0	0
-10	1	20	0	21	9	18	4	31	1	64	3	68	1	45	7	53	52	121	173	0	0	0	0	0	0	0
-11	0	12	3	15	3	12	5	20	2	53	1	56	0	57	2	59	35	115	150	0	0	0	0	0	0	0
-12	3	8	2	13	1	6	0	7	7	53	2	62	0	62	2	64	20	126	146	0	0	0	0	0	0	0
-13	3	12	3	18	0	21	1	22	3	49	2	54	2	66	3	71	40	125	165	0	0	0	0	0	0	0
-14	1	17	3	21	4	11	3	18	7	40	5	52	0	61	5	66	39	118	157	0	0	0	0	0	0	0
-15	1	6	0	7	6	11	1	18	1	45	1	47	5	38	12	55	25	102	127	0	0	0	0	0	0	0
-16	3	6	1	10	1	10	3	14	4	32	2	38	0	42	0	42	24	80	104	0	0	0	0	0	0	0
-17	1	8	0	9	0	16	1	17	0	24	1	25	2	27	0	29	26	54	80	0	0	1	0	0	1	1
-18	1	8	4	13	0	5	2	7	0	14	0	14	0	16	0	16	20	30	50	0	0	0	0	0	0	0
TAL	18	133	16	167	33	119	23	175	28	520	22	570	12	536	50	598	342	1168	1510	0	0	1	0	0	1	1

FILE NAME: CNT056_3 TXT

LOG ID :

Wet Friday

(6)

OT District 2 Traffic Count

ALL VEHICLES & U-TURNS

EXPANSION FACTORS

HOURLY EXP. = 0.0000
MONTHLY EXP. = 0.0000

OCATION:USH 41/I-94 Ramps and STH 158
& DATE:Thur 06/26/03(am); Mon 06/30/03(pm)
WEATHER:Cloudy;M. Sunny

TRUCKS : X
BUSES : X
SCHOOL BUSES : X
PASSENGER VEHICLES: X

OBSERVER NAME :Ron Lawson
PROCESSER NAME :Lisa Abraham

et NM : --I	Construction Area From North				W. Frontage Rd. From South				STH 158 From East				STH 158 From West				Totals			U-Turns				
e I	L	A	R	TOTAL	L	A	R	TOTAL	L	A	R	TOTAL	L	A	R	TOTAL	N-S	E-W	ALL	N	S	E	W	TOTAL
7	0	0	1	1	9	0	34	43	42	275	0	317	0	191	14	205	44	522	566	0	0	0	0	0
8	0	0	0	0	12	0	51	63	61	226	0	287	2	245	26	273	63	560	623	0	0	0	0	0
9	0	0	1	1	1	0	27	28	53	140	1	194	0	160	37	197	29	391	420	0	5	0	0	5
					10		50		60	225	0		0	245	25									
0	0	0	0	0	7	0	18	25	48	66	0	114	0	114	24	138	25	252	277	0	2	0	0	2
1	0	0	0	0	7	0	21	28	62	114	0	176	0	146	44	190	28	366	394	0	0	0	0	0
2	0	0	0	0	9	0	34	43	88	109	0	197	0	141	36	177	43	374	417	1	0	0	0	1
3	0	0	0	0	8	0	31	39	84	70	0	154	0	159	52	211	39	365	404	0	0	0	0	0
4	0	0	0	0	9	0	24	33	75	90	0	165	0	178	32	210	33	375	408	0	0	0	0	0
5	0	0	0	0	7	0	30	37	110	124	0	234	0	180	52	232	37	466	503	2	0	0	0	2
6	0	0	0	0	4	0	29	33	116	123	0	239	1	220	54	275	33	514	547	0	0	0	0	0
7	0	0	0	0	5	0	34	39	117	91	0	208	2	181	66	249	39	457	496	0	0	0	0	0
8	0	0	0	0	10	0	37	47	127	112	0	239	0	207	57	264	47	503	550	1	0	0	0	1
					10	0	35		125	110	0		0	205	55									
TL	0	0	2	2	88	0	370	458	983	1540	1	2524	5	2122	494	2621	460	5145	5605	4	7	0	0	11
ARTING FROM				10				1484				2492				1630	1494	4122	5616					

EXPANDED TO 24 HOURS

VL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RUCKS				0.00				0.00				0.00				0.00	0.00	0.00	0.00					
T'G				0				0				0				0	0	0	0					
RUCKS				0.00				0.00				0.00				0.00	0.00	0.00	0.00					

ILE NAME: CT098_R1.TXT

LOG ID :

sDOT District 2 Traffic Count

TRUCKS & PEDSTRIANS

LOCATION:USH 41/I-94 Ramps and STH 158
AY & DATE:Thur 06/26/03(am); Mon 06/30/03(pm)
WEATHER:Cloudy;M. Sunny

TRUCKS : X
BUSES :
SCHOOL BUSES :
PASSENGER VEHICLES:

OBSERVER NAME :Ron Lawson
PROCESSER NAME :Lisa Abraham

eet NM:	Construction Area From North				W. Frontage Rd. From South				STH 158 From East				STH 158 From West				TOTALS			PEDSTRIANS [X] BICYCLES [ ]						
----------I ime I	L	A	R	TOTAL	L	A	R	TOTAL	L	A	R	TOTAL	L	A	R	TOTAL	N-S	E-W	ALL	N	S	E	W	NS	EW	TOTAL
- 7	0	0	0	0	0	0	2	2	7	16	0	23	0	16	1	17	2	40	42	0	0	0	0	0	0	0
- 8	0	0	0	0	5	0	2	7	6	35	0	41	0	33	4	37	7	78	85	0	0	0	0	0	0	0
- 9	0	0	0	0	0	0	1	1	10	25	1	36	0	28	3	31	1	67	68	0	0	0	0	0	0	0
-10	0	0	0	0	3	0	1	4	8	10	0	18	0	22	3	25	4	43	47	0	0	0	0	0	0	0
-11	0	0	0	0	2	0	3	5	6	34	0	40	0	24	9	33	5	73	78	0	0	0	0	0	0	0
-12	0	0	0	0	0	0	2	2	10	28	0	38	0	19	5	24	2	62	64	0	0	0	0	0	0	0
-13	0	0	0	0	2	0	1	3	9	25	0	34	0	37	4	41	3	75	78	0	1	0	0	1	0	1
-14	0	0	0	0	3	0	2	5	10	27	0	37	0	37	3	40	5	77	82	0	0	0	0	0	0	0
-15	0	0	0	0	0	0	3	3	12	28	0	40	0	26	3	29	3	69	72	0	0	0	0	0	0	0
-16	0	0	0	0	0	0	2	2	9	12	0	21	0	27	7	34	2	55	57	0	0	0	0	0	0	0
-17	0	0	0	0	0	0	2	2	5	8	0	13	0	14	6	20	2	33	35	0	0	0	0	0	0	0
-18	0	0	0	0	1	0	0	1	2	3	0	5	0	10	2	12	1	17	18	0	0	0	0	0	0	0
TAL	0	0	0	0	16	0	21	37	94	251	1	346	0	293	50	343	37	689	726	0	1	0	0	1	0	1

FILE NAME: CT098_R3.TXT

LOG ID :

(5)

OT District 2 Traffic Count

ALL VEHICLES & U-TURNS

EXPANSION FACTORS

HOURLY EXP. = 0.0000
MONTHLY EXP. = 0.0000

OCATION:USH 41/1-94 Ramps and STH 158
& DATE:Thur 06/26/03(am); Mon 06/30/03(pm)
WEATHER:Cloudy;M. Sunny

TRUCKS : X
BUSES : X
SCHOOL BUSES : X
PASSENGER VEHICLES: X

OBSERVER NAME :Mike Phelps
PROCESSER NAME :Lisa Abraham

et NM :	W. Frontage Rd From North A				41/94 SB On Ramp From South				41/94 SB Off Ramp From East B				W. Frontage Rd From West C				Totals			U-Turns				
e I	L	A	R	TOTAL	L	A	R	TOTAL	L	A	R	TOTAL	L	A	R	TOTAL	N-S	E-W	ALL	N	S	E	W	TOTAL
7	0	0	19	19	0	0	0	0	0	192	0	192	4	0	271	275	19	467	486	0	0	0	0	0
8	0	0	19	19	0	0	0	0	0	250	0	250	4	0	226	230	19	480	499	0	0	0	0	0
9	0	0	26	26	0	0	0	0	0	172	0	172	6	0	142	148	26	320	346	0	0	0	0	0
			20							250			5		225									
0	0	0	19	19	0	0	0	0	0	139	0	139	5	0	94	99	19	238	257	0	0	0	0	0
1	0	0	27	27	0	0	0	0	0	173	0	173	6	0	110	116	27	289	316	0	0	0	0	0
2	0	0	22	22	0	0	0	0	0	164	0	164	9	0	102	111	22	275	297	0	0	0	0	0
3	0	0	33	33	0	0	0	0	0	189	0	189	13	0	79	92	33	281	314	0	0	0	0	0
4	0	0	46	46	0	0	0	0	0	185	0	185	14	0	91	105	46	290	336	0	0	0	0	0
5	0	0	40	40	0	0	0	0	0	202	0	202	7	0	113	120	40	322	362	0	0	0	0	0
6	0	0	43	43	0	0	0	0	0	232	0	232	5	0	110	115	43	347	390	0	0	0	0	0
7	0	0	35	35	0	0	0	0	0	264	0	264	3	0	102	105	35	369	404	0	0	0	0	0
8	0	0	18	18	0	0	0	0	0	265	0	265	8	0	100	108	18	373	391	0	0	0	0	0
			20										10											
TL	0	0	347	347	0	0	0	0	0	2427	0	2427	84	0	1540	1624	347	4051	4398	0	0	0	0	0
RTING FROM				84				1540				0				2774	1624	2774	4398					

EXPANDED TO 24 HOURS

VL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
UCKS				0.00				0.00				0.00				0.00	0.00	0.00	0.00					
T'G				0				0				0				0	0	0	0					
RUCKS				0.00				0.00				0.00				0.00	0.00	0.00	0.00					

ILE NAME: CT098_M1.TXT

LOG ID :

DOT District 2 Traffic Count

BUSES & BICYCLES

TRUCKS :
BUSES : X
SCHOOL BUSES : X
PASSENGER VEHICLES:

LOCATION:USH 41/I-94 Ramps and STH 158
Y & DATE:Thur 06/26/03(am); Mon 06/30/03(pm)
WEATHER:Cloudy/M. Sunny

OBSERVER NAME :Mike Phelps
PROCESSER NAME :Lisa Abraham

eet NM:	W. Frontage Rd From North				41/94 SB On Ramp From South				41/94 SB Off Ramp From East				W. Frontage Rd From West				TOTALS			PEDESTRIANS [ ] BICYCLES [X]						
me I	L	A	R	TOTAL	L	A	R	TOTAL	L	A	R	TOTAL	L	A	R	TOTAL	N-S	E-W	ALL	N	S	E	W	NS	EW	TOTAL
7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	1	1	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	2	0	2	0	0	0	0	0	2	2	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	1	1	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	1	1	0	0	0	0	0	0	0
14	0	0	1	1	0	0	0	0	0	1	0	1	0	0	0	0	1	1	2	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	1	1	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	1	1	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL	0	0	1	1	0	0	0	0	0	8	0	8	0	0	0	0	1	8	9	0	0	0	0	0	0	0

FILE NAME: CT098_M6.TXT

LOG ID :

DOT District 2 Traffic Count : ALL VEHICLES & U-TURNS

EXPAN CTORS

HOURLY E 0.0000
MONTHLY 0.0000

LOCATION:USH 41/I-94 Ramps and STH 158
Y & DATE:Thur 06/26/03(am); Mon 06/30/03(pm)
WEATHER:Cloudy;M. Sunny

TRUCKS : X
BUSES : X
SCHOOL BUSES : X
PASSENGER VEHICLES: X

OBSERVER NAME :Warren Mecus; Orris Strelow
PROCESSER NAME :Lisa Abraham

eet NM :	E. Frontage Rd C From North				H E. Frontage Rd From South				STH 158 F From East				STH 158 G From West				Totals			U-T			
---I me I	L	A	R	TOTAL	L	A I	R J	TOTAL	L	A	R	TOTAL	L	A	R	TOTAL	N-S	E-W	ALL	N	S	W	TOTAL
7	1	0	3	4	4	23	161	188	0	310	0	310	10	215	0	225	192	535	727	0		0	0
8	2	0	9	11	4	28	135	167	0	274	0	274	15	281	0	296	178	570	748	0		0	0
9	0	0	7	7	6	28	112	146	0	181	0	181	9	178	0	187	153	368	521	0		0	0
	0	0	10		5	34	135		0	275	0		15	230	0								
10	3	0	2	5	12	24	109	145	0	100	0	100	4	128	0	132	150	232	382	0		0	0
11	2	0	6	8	13	35	111	159	0	157	0	157	8	159	0	167	167	324	491	0		0	0
12	5	0	5	10	14	47	124	185	0	178	0	178	5	170	0	175	195	353	548	0		0	0
13	8	0	7	15	16	51	158	225	0	131	0	131	6	184	0	190	240	321	561	0		0	0
14	1	0	3	4	22	41	151	214	0	140	0	140	12	190	0	202	218	342	560	0		0	0
15	3	0	5	8	29	46	175	250	0	200	0	200	11	199	0	210	258	410	668	0		0	0
16	2	0	4	6	22	62	192	276	0	213	0	213	7	242	0	249	282	462	744	0		0	0
17	7	0	2	9	21	58	237	316	0	185	0	185	11	204	0	215	325	400	725	0		0	0
18	1	0	5	6	23	56	250	329	0	211	0	211	9	235	0	244	335	455	790	0		0	0
	5	0	0		25	55	250		0	185			10	205	0								
TL	35	0	58	93	186	499	1915	2600	0	2280	0	2280	107	2385	0	2492	2693	4772	7465	0		0	0
PARTING FROM				606				0				4335				2524	606	6859	7465				

EXPANDED TO 24 HOURS

VL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0
TRUCKS				0.00				0.00				0.00				0.00	0.00	0.00	0.00				
T G				0				0				0				0	0	0	0				
TRUCKS				0.00				0.00				0.00				0.00	0.00	0.00	0.00				

FILE NAME: C098_EF1.TXT

SDOT District 2 Traffic Count

BUSES & BICYCLES

LOCATION:USH 41/I 94 Ramps and STH 158
AY & DATE:Thur 06/26/03(am); Mon 06/30/03(pm)
WEATHER:Cloudy;N Sunny

TRUCKS :
BUSES : X
SCHOOL BUSES : X
PASSENGER VEHICLES:

OBSERVER NAME :Warren Mecus; Orris Strelow
PROCESSER NAME Lisa Abraham

reet NM:	E. Frontage Rd From North				E. Frontage Rd From South				STH 158 From East				STH 158 From West				TOTALS			PEDSTRIANS BICYCLES					
ime I	L	A	R	TOTAL	L	A	R	TOTAL	L	A	R	TOTAL	L	A	R	TOTAL	N-S	E-W	ALL	N	S	E		EW	TOTAL
- 7	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	0	1	0	0	0		0	0
- 8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0
- 9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0
-10	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	1	0	0	0		0	0
-11	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	1	1	0	0	0		0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0
-13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0
-14	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	1	0	0	0		0	0
-15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0
-16	0	0	0	0	0	0	1	1	0	0	0	0	0	1	0	1	1	1	2	0	0	0		0	0
-17	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1	0	1	0	0	0		0	0
-18	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	0	1	0	0	0		0	0
TAL	0	0	0	0	0	1	3	4	0	0	0	0	1	3	0	4	4	4	8	0	0	0	0	0	0

FILE NAME: C098_EF6.TXT

LOG ID :

(3)

PROJECT: H0404.20
DATE: 5/6/2004
DAY: THURSDAY
WEATHER: SUNNY
COUNT TIME: 7:00 AM - 9:00 AM

15-MINUTE SUMMARY OF ALL VEHICLE MOVEMENTS

104TH AVE. & 60TH ST.

15 MIN BEGIN	104TH AVE.								60TH ST.								INTER-SECTION TOTAL
	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				
	LEFT	THRU	RIGHT	TOTAL	LEFT	THRU	RIGHT	TOTAL	LEFT	THRU	RIGHT	TOTAL	LEFT	THRU	RIGHT	TOTAL	
7:00 AM	0	18	11	29	0	20	4	24	1	16	5	22	11	8	4	23	98
7:15 AM	2	32	27	61	2	29	5	36	0	13	2	15	13	26	1	40	152
7:30 AM	3	27	23	53	2	29	7	38	7	30	3	40	27	24	1	52	183
7:45 AM	2	36	16	54	2	58	9	69	3	41	11	55	31	30	3	64	242
8:00 AM	2	35	28	65	2	29	8	39	0	27	2	29	22	19	2	43	176
8:15 AM	0	28	27	55	1	20	3	24	4	20	6	30	24	25	1	50	159
8:30 AM	1	21	17	39	1	19	5	25	5	24	4	33	23	25	0	48	145
8:45 AM	2	18	19	39	1	26	9	36	6	27	3	36	16	21	1	38	149
TOTAL:	12	215	168	395	11	230	50	291	26	198	36	260	167	178	13	358	1304

HOURLY SUMMARY OF ALL VEHICLE MOVEMENTS

104TH AVE. & 60TH ST.

HOUR BEGIN	104TH AVE.								60TH ST.								INTER-SECTION TOTAL
	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				
	LEFT	THRU	RIGHT	TOTAL	LEFT	THRU	RIGHT	TOTAL	LEFT	THRU	RIGHT	TOTAL	LEFT	THRU	RIGHT	TOTAL	
7:00 AM	7	113	77	197	6	136	25	167	11	100	21	132	82	88	9	179	675
7:15 AM	9	130	94	233	8	145	29	182	10	111	18	139	93	99	7	199	753
7:30 AM	7	126	94	227	7	136	27	170	14	118	22	154	104	98	7	209	760
7:45 AM	5	120	88	213	6	126	25	157	12	112	23	147	100	99	6	205	722
8:00 AM	5	102	91	198	5	94	25	124	15	98	15	128	85	90	4	179	629

5 [illegible] 25 5 [illegible] 25 10 [illegible] 30 [illegible] 10

PEAK HOUR SUMMARY

HOUR BEGIN	104TH AVE.								60TH ST.								INTER-SECTION TOTAL
	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				
	LEFT	THRU	RIGHT	TOTAL	LEFT	THRU	RIGHT	TOTAL	LEFT	THRU	RIGHT	TOTAL	LEFT	THRU	RIGHT	TOTAL	
7:30 AM	7	126	94	227	7	136	27	170	14	118	22	154	104	98	7	209	760
																PHF =	0.79

PROJECT: H0404.20
DATE: 5/6/2004
DAY: THURSDAY
WEATHER: SUNNY
COUNT TIME: 4:00 PM - 6:00 PM

104TH AVE. & 60TH ST.

15 MIN BEGIN	104TH AVE.								60TH ST.								INTER-SECTION TOTAL
	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				
	LEFT	THRU	RIGHT	TOTAL	LEFT	THRU	RIGHT	TOTAL	LEFT	THRU	RIGHT	TOTAL	LEFT	THRU	RIGHT	TOTAL	
4:00 PM	1	29	34	64	3	31	5	39	7	45	7	59	29	52	3	84	246
4:15 PM	4	24	24	52	3	27	10	40	6	27	7	40	22	44	1	67	199
4:30 PM	8	45	36	89	0	29	9	38	4	34	5	43	20	45	5	70	240
4:45 PM	4	28	33	65	1	27	8	36	4	35	5	44	20	40	1	61	206
5:00 PM	4	34	29	67	7	30	3	40	1	42	5	48	18	56	7	81	236
5:15 PM	3	34	26	63	2	23	7	32	4	36	4	44	15	45	8	68	207
5:30 PM	2	38	16	56	0	23	6	29	5	56	4	65	18	39	8	65	215
5:45 PM	5	21	15	41	1	21	7	29	2	22	4	28	19	35	2	56	154
TOTAL:	31	253	213	497	17	211	55	283	33	297	41	371	161	356	35	552	1703

HOURLY SUMMARY OF ALL VEHICLE MOVEMENTS

104TH AVE. & 60TH ST.

HOUR BEGIN	104TH AVE.								60TH ST.								INTER-SECTION TOTAL
	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				
	LEFT	THRU	RIGHT	TOTAL	LEFT	THRU	RIGHT	TOTAL	LEFT	THRU	RIGHT	TOTAL	LEFT	THRU	RIGHT	TOTAL	
4:00 PM	17	126	127	270	7	114	32	153	21	141	24	186	91	181	10	282	891
4:15 PM	20	131	122	273	11	113	30	154	15	138	22	175	80	185	14	279	881
4:30 PM	19	141	124	284	10	109	27	146	13	147	19	179	73	186	21	280	889
4:45 PM	13	134	104	251	10	103	24	137	14	169	18	201	71	180	24	275	864
5:00 PM	14	127	86	227	10	97	23	130	12	156	17	185	70	175	25	270	812
	15	125	85		10	95	25		10	155	15		70	175	25		

PEAK HOUR SUMMARY

HOUR BEGIN	104TH AVE.								60TH ST.								INTER-SECTION TOTAL
	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				
	LEFT	THRU	RIGHT	TOTAL	LEFT	THRU	RIGHT	TOTAL	LEFT	THRU	RIGHT	TOTAL	LEFT	THRU	RIGHT	TOTAL	
4:00 PM	17	126	127	270	7	114	32	153	21	141	24	186	91	181	10	282	891
																PHF =	0.91

(4)

OJECT: H0404.20
DATE: 5/6/2004
DAY: THURSDAY
WEATHER: SUNNY

15 MINUTE SUMMARY OF ALL VEHICLE MOVEMENTS

EAST FRONTAGE RD. & 60TH ST.

15 MIN BEGIN	EAST FRONTAGE RD.								60TH ST.								INTER-SECTION TOTAL
	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				
	LEFT	THRU	RIGHT	TOTAL	LEFT	THRU	RIGHT	TOTAL	LEFT	THRU	RIGHT	TOTAL	LEFT	THRU	RIGHT	TOTAL	
7:00 AM	1	3	4	8	0	0	0	0	5	19	5	29	9	13	0	22	59
7:15 AM	5	7	5	17	0	0	0	0	7	22	5	34	13	21	2	36	87
7:30 AM	4	6	2	12	0	1	0	1	7	37	7	51	8	22	1	31	95
7:45 AM	6	6	9	21	0	0	1	1	9	32	7	48	11	24	3	38	108
8:00 AM	2	6	5	13	2	0	0	2	2	20	6	28	1	17	3	21	64
8:15 AM	6	11	2	19	0	0	0	0	12	32	10	54	11	20	2	33	106
8:30 AM	6	10	6	22	0	0	0	0	11	29	6	46	11	22	4	37	105
8:45 AM	5	12	6	23	0	0	0	0	9	23	6	38	8	18	6	32	93
TOTAL:	35	61	39	135	2	1	1	4	62	214	52	328	72	157	21	250	717

HOURLY SUMMARY OF ALL VEHICLE MOVEMENTS

EAST FRONTAGE RD. & 60TH ST.

HOUR BEGIN	EAST FRONTAGE RD.								60TH ST.								INTER-SECTION TOTAL
	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				
	LEFT	THRU	RIGHT	TOTAL	LEFT	THRU	RIGHT	TOTAL	LEFT	THRU	RIGHT	TOTAL	LEFT	THRU	RIGHT	TOTAL	
7:00 AM	16	22	20	58	0	1	1	2	28	110	24	162	41	80	6	127	349
7:15 AM	17	25	21	63	2	1	1	4	25	111	25	161	33	84	9	126	354
7:30 AM	18	29	18	65	2	1	1	4	30	121	30	181	31	83	9	123	373
7:45 AM	20	33	22	75	2	0	1	3	34	113	29	176	34	83	12	129	383
8:00 AM	19	39	19	77	2	0	0	2	34	104	28	166	31	77	15	123	368
	15	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]		30	110	25		40	60	5		

PEAK HOUR SUMMARY

HOUR BEGIN	EAST FRONTAGE RD.								60TH ST.								INTER-SECTION TOTAL
	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				
	LEFT	THRU	RIGHT	TOTAL	LEFT	THRU	RIGHT	TOTAL	LEFT	THRU	RIGHT	TOTAL	LEFT	THRU	RIGHT	TOTAL	
7:45 AM	20	33	22	75	2	0	1	3	34	113	29	176	34	83	12	129	383
																PHF =	0.89

PROJECT: H0404.20
DATE: 5/6/2004
DAY: THURSDAY
WEATHER: SUNNY

15 MINUTE SUMMARY OF ALL VEHICLE MOVEMENTS

EAST FRONTAGE RD. & 60TH ST.

15 MIN BEGIN	EAST FRONTAGE RD.								60TH ST.								INTER-SECTION TOTAL
	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				
	LEFT	THRU	RIGHT	TOTAL	LEFT	THRU	RIGHT	TOTAL	LEFT	THRU	RIGHT	TOTAL	LEFT	THRU	RIGHT	TOTAL	
4:00 PM	10	18	12	40	1	1	3	5	4	50	10	64	7	46	5	58	167
4:15 PM	13	11	14	38	1	0	2	3	7	25	7	39	6	38	4	48	128
4:30 PM	15	19	12	46	3	2	3	8	13	31	7	51	12	39	4	55	160
4:45 PM	14	12	14	40	1	3	1	5	4	32	9	45	15	40	7	62	152
5:00 PM	17	16	11	44	0	0	2	2	10	33	20	63	21	37	6	64	173
5:15 PM	10	18	6	34	4	2	2	8	9	31	13	53	12	38	4	54	149
5:30 PM	10	18	21	49	2	3	1	6	5	36	10	51	11	27	4	42	148
5:45 PM	9	14	17	40	2	2	3	7	7	32	11	50	9	24	5	38	135
TOTAL:	98	126	107	331	14	13	17	44	59	270	87	416	93	289	39	421	1212

HOURLY SUMMARY OF ALL VEHICLE MOVEMENTS

EAST FRONTAGE RD. & 60TH ST.

HOUR BEGIN	EAST FRONTAGE RD.								60TH ST.								INTER-SECTION TOTAL
	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				
	LEFT	THRU	RIGHT	TOTAL	LEFT	THRU	RIGHT	TOTAL	LEFT	THRU	RIGHT	TOTAL	LEFT	THRU	RIGHT	TOTAL	
4:00 PM	52	60	52	164	6	6	9	21	28	138	33	199	40	163	20	223	607
4:15 PM	59	58	51	168	5	5	8	18	34	121	43	198	54	154	21	229	613
4:30 PM	56	65	43	164	8	7	8	23	36	127	49	212	60	154	21	235	634
4:45 PM	51	64	52	167	7	8	6	21	28	132	52	212	59	142	21	222	622
5:00 PM	46	66	55	167	8	7	8	23	31	132	54	217	53	126	19	198	605
	45	65	55		10	5	10		30	130	55		55	125	20		

PEAK HOUR SUMMARY

HOUR BEGIN	EAST FRONTAGE RD.								60TH ST.								INTER-SECTION TOTAL
	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				
	LEFT	THRU	RIGHT	TOTAL	LEFT	THRU	RIGHT	TOTAL	LEFT	THRU	RIGHT	TOTAL	LEFT	THRU	RIGHT	TOTAL	
4:30 PM	56	65	43	164	8	7	8	23	36	127	49	212	60	154	21	235	634
																PHF =	0.92

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Then Click the Comments Tab

File Name : 88TH60~1
Site Code : 00000000
Start Date : 2/2/2005
Page No : 1

Groups Printed- Unshifted - Bank 1 - Bank 2

	88 Southbound				60 Westbound				88 Northbound				60 Eastbound				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
Factor	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
07:00 AM	2	24	6	0	4	14	5	0	1	28	3	0	8	35	2	0	132
07:15 AM	4	21	6	0	5	24	2	0	3	29	10	0	8	34	3	0	149
07:30 AM	1	23	4	0	8	16	6	0	3	35	9	0	10	40	2	0	157
07:45 AM	2	28	6	0	10	29	3	0	0	38	11	0	12	44	2	0	185
Total	9	96	22	0	27	83	16	0	7	130	33	0	38	153	9	0	623
08:00 AM	6	33	9	0	10	33	7	0	2	39	18	0	18	48	4	0	227
08:15 AM	3	59	13	0	29	44	8	0	7	38	17	0	8	40	3	0	269
08:30 AM	4	40	7	0	12	17	7	0	4	50	6	0	9	21	2	0	179
08:45 AM	1	37	9	0	9	27	5	0	0	36	6	0	6	30	2	0	168
Total	14	169	38	0	60	121	27	0	13	163	47	0	41	139	11	0	843
Grand Total	23	265	60	0	87	204	43	0	20	293	80	0	79	292	20	0	1466
Apprch %	6.6	76.1	17.2	0	26	61.1	12.9	0	5.1	74.6	20.4	0	20.2	74.7	5.1	0	
Total %	1.6	18.1	4.1	0	5.9	13.9	2.9	0	1.4	20	5.5	0	5.4	19.9	1.4	0	
Unshifted	23	240	56	0	84	198	42	0	11	258	74	0	78	283	18	0	1365
% Unshifted	100	90.6	93.3	0	96.6	97.1	97.7	0	55	88.1	92.5	0	98.7	96.9	90	0	93.1
Bank 1	0	23	4	0	3	6	1	0	9	33	6	0	0	9	2	0	96
% Bank 1	0	8.7	6.7	0	3.4	2.9	2.3	0	45	11.3	7.5	0	0	3.1	10	0	6.5
Bank 2	0	2	0	0	0	0	0	0	0	2	0	0	1	0	0	0	5
% Bank 2	0	0.8	0	0	0	0	0	0	0	0.7	0	0	1.3	0	0	0	0.3

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File Name : 88th60thPM
Site Code : 00000000
Start Date : 2/2/2005
Page No : 1

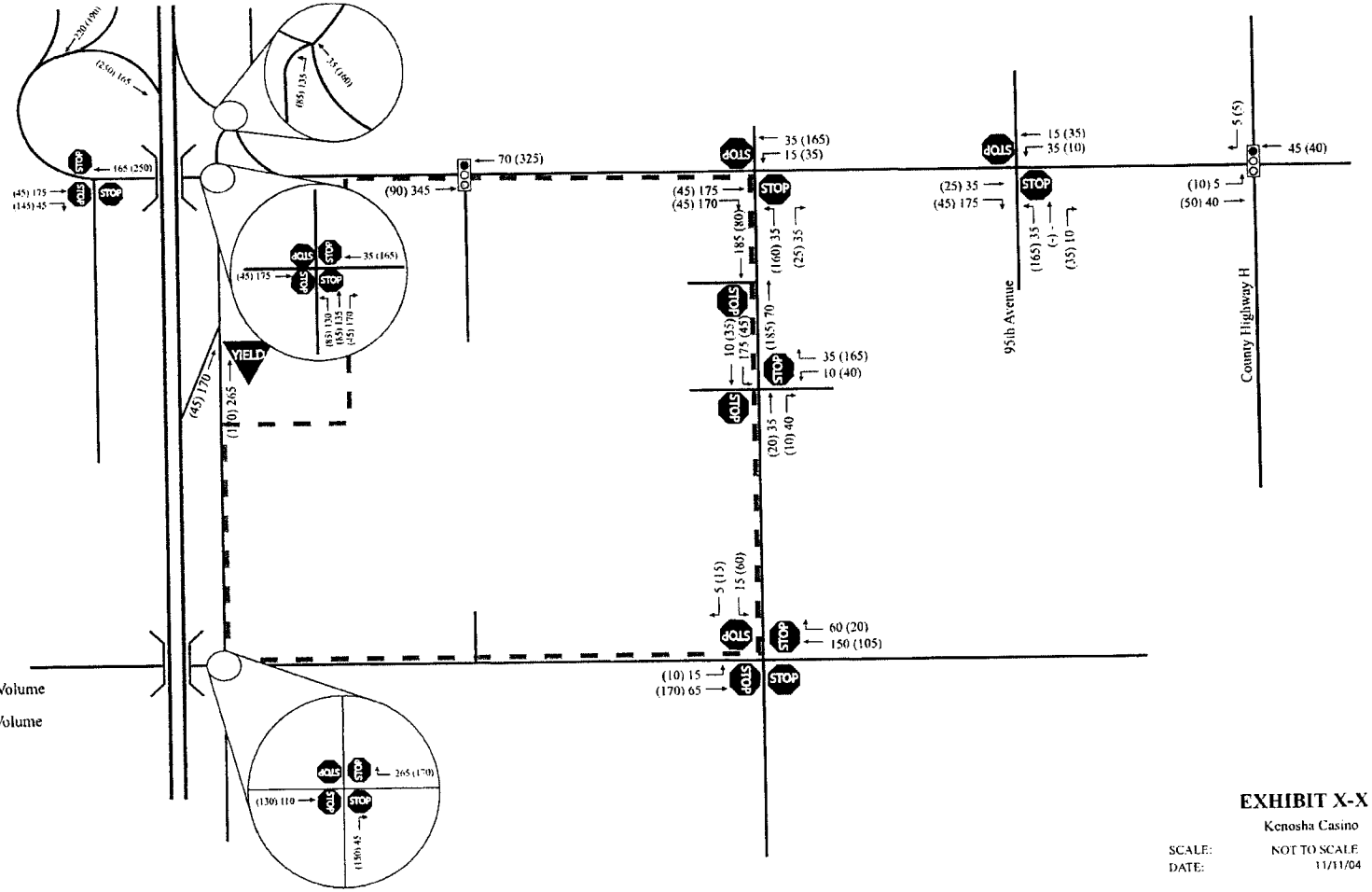
Groups Printed- Unshifted - Bank 1 - Bank 2

	88 From North				60 From East				88 From South				60 From West				
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Int. Total
Factor	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
04:00 PM	15	61	22	0	6	40	16	0	13	70	4	0	2	42	12	0	303
04:15 PM	11	54	20	0	11	39	10	0	14	55	8	0	7	45	13	0	287
04:30 PM	20	62	25	0	8	43	8	1	17	58	3	0	5	35	18	0	303
04:45 PM	19	53	24	0	10	37	12	0	15	84	6	0	6	61	11	0	338
Total	65	230	91	0	35	159	46	1	59	267	21	0	20	183	54	0	1231
05:00 PM	19	73	21	0	11	55	18	0	17	80	2	0	3	45	14	0	358
05:15 PM	20	77	18	0	7	43	17	0	17	61	5	0	5	48	17	0	335
05:30 PM	24	74	9	0	4	50	16	0	13	65	1	0	5	49	9	0	319
05:45 PM	12	58	12	0	4	38	15	0	17	37	4	0	3	56	3	0	259
Total	75	282	60	0	26	186	66	0	64	243	12	0	16	198	43	0	1271
Grand Total	140	512	151	0	61	345	112	1	123	510	33	0	36	381	97	0	2502
Apprch %	17.4	63.8	18.8	0	11.8	66.5	21.6	0.2	18.5	76.6	5	0	7	74.1	18.9	0	
Total %	5.6	20.5	6	0	2.4	13.8	4.5	0	4.9	20.4	1.3	0	1.4	15.2	3.9	0	
Unshifted	139	510	150	0	60	341	112	1	120	501	33	0	33	379	96	0	2475
% Unshifted	99.3	99.6	99.3	0	98.4	98.8	100	100	97.6	98.2	100	0	91.7	99.5	99	0	98.9
Bank 1	0	1	0	0	0	3	0	0	3	8	0	0	3	1	1	0	20
% Bank 1	0	0.2	0	0	0	0.9	0	0	2.4	1.6	0	0	8.3	0.3	1	0	0.8
Bank 2	1	1	1	0	1	1	0	0	0	1	0	0	0	1	0	0	7
% Bank 2	0.7	0.2	0.7	0	1.6	0.3	0	0	0	0.2	0	0	0	0.3	0	0	0.3

OFF SITE LAND USE AND DEVELOPMENT

TRIP GENERATION OF NEIGHBORING DEVELOPMENTS

Development	Size	Weekday AM Peak Hour			Weekday PM Peak Hour		
		In	Out	Total	In	Out	Total
Kilbourn Woods	98 single family homes	20	60	80	65	40	105
Tyler's Ridge	155 single family homes	30	90	120	100	60	160
Peterson Golden Meadows	329 single family homes	60	180	240	200	115	315
Business Park of Kenosha Phase II	74.36 acres	430	90	520	110	405	515



Legend:

XX : Weekday AM Peak Hour Volume

(XX) : Weekday PM Peak Hour Volume

: Signalized Intersection

: Stop Controlled Approach

LAND STRATEGIES, INC.
PLANNING/TRANSPORTATION/URBAN DESIGN

BACKGROUND TRAFFIC

EXHIBIT X-X

Kenosha Casino

SCALE: NOT TO SCALE
DATE: 11/11/04

N

EXISTING CAPACITY ANALYSIS

HCS2000: Signalized Intersections Release 4.1e

Analyst: md
Agency:
Date: 1/4/2005
Period: am
Project ID: existing traffic
E/W St: sth 158

Inter.: sth 158/cth h
Area Type: All other areas
Jurisd: wisdot
Year : 2007

N/S St: cth h

SIGNALIZED INTERSECTION SUMMARY

	Eastbound L	Eastbound T	Eastbound R	Westbound L	Westbound T	Westbound R	Northbound L	Northbound T	Northbound R	Southbound L	Southbound T	Southbound R
No. Lanes	1	1	0	1	1	0	0	1	0	0	1	0
LGConfig	L	TR		L	TR			LTR			LTR	
Volume	60	470	15	60	510	25	5	145	60	50	240	70
Lane Width	12.0	12.0		12.0	12.0			12.0			12.0	
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A	A			NB Left	A			
Thru		A			Thru	A			
Right		A			Right	A			
Peds					Peds				
WB Left	A	A			SB Left	A			
Thru		A			Thru	A			
Right		A			Right	A			
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	6.0	41.0				28.0			
Yellow	3.0	4.5				4.5			
All Red	0.0	1.5				1.5			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	295	1805	0.23	0.56	13.4	B		
TR	861	1891	0.64	0.46	20.4	C	19.7	B
Westbound								
L	337	1805	0.20	0.56	12.3	B		
TR	860	1887	0.71	0.46	22.4	C	21.4	C
Northbound								
LTR	562	1805	0.43	0.31	25.1	C	25.1	C
Southbound								
LTR	528	1696	0.78	0.31	35.4	D	35.4	D

Intersection Delay = 24.2 (sec/veh) Intersection LOS = C

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/4/2005
Analysis Time Period: am
Intersection: sth 158/cth h
Area Type: All other areas
Jurisdiction: wisdot
Analysis Year: 2007
Project ID: existing traffic
East/West Street: sth 158 North/South Street: cth h

VOLUME DATA

	Eastbound L	Eastbound T	Eastbound R	Westbound L	Westbound T	Westbound R	Northbound L	Northbound T	Northbound R	Southbound L	Southbound T	Southbound R
Volume	60	470	15	60	510	25	5	145	60	50	240	70
% Heavy Veh	0	0	0	0	0	0	0	0	0	0	0	0
PHF	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
PK 15 Vol	17	134	4	17	145	7	2	41	17	14	68	20
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900		1900	1900			1900			1900	
ParkExist												
NumPark												
No. Lanes	1	1	0	1	1	0	0	1	0	0	1	0
LGConfig	L	TR		L	TR			LTR			LTR	
Lane Width	12.0	12.0		12.0	12.0			12.0			12.0	
RTOR Vol			0			0			0			0
Adj Flow	68	551		68	608			239			410	
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000			0.025			0.139	
Prop RTs		0.031			0.046		0.285			0.195		
Peds Bikes		0			0		0			0		
Buses	0	0		0	0		0			0		
%InProtPhase	0.0			0.0								

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound L	Eastbound T	Eastbound R	Westbound L	Westbound T	Westbound R	Northbound L	Northbound T	Northbound R	Southbound L	Southbound T	Southbound R
Init Unmet	0.0	0.0		0.0	0.0			0.0			0.0	
Arriv. Type	3	3		3	3			3			3	
Unit Ext.	3.0	3.0		3.0	3.0			3.0			3.0	
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0		2.0	2.0			2.0			2.0	
Ext of g	2.0	2.0		2.0	2.0			2.0			2.0	
Ped Min g	3.2			3.2			3.2			3.2		

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A	A			NB Left	A			
Thru		A			Thru	A			
Right		A			Right	A			
Peds					Peds				
WB Left	A	A			SB Left	A			
Thru		A			Thru	A			
Right		A			Right	A			
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	6.0	41.0				28.0			
Yellow	3.0	4.5				4.5			
All Red	0.0	1.5				1.5			

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound L	Eastbound T	Eastbound R	Westbound L	Westbound T	Westbound R	Northbound L	Northbound T	Northbound R	Southbound L	Southbound T	Southbound R
Volume, V	60	470	15	60	510	25	5	145	60	50	240	70
PHF	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Adj flow	68	534	17	68	580	28	6	165	68	57	273	80
No. Lanes	1	1	0	1	1	0	0	1	0	0	1	0
Lane group	L	TR		L	TR			LTR			LTR	
Adj flow	68	551		68	608			239			410	
Prop LTs	1.000	0.000		1.000	0.000			0.025			0.139	
Prop RTs		0.031			0.046		0.285			0.195		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound L	Eastbound TR	Westbound L	Westbound TR	Northbound LTR	Southbound LTR
So	1900	1900	1900	1900	1900	1900
Lanes	1	1 0	1	1 0 0	1 0 0	1 0
fW	1.000	1.000	1.000	1.000	1.000	1.000
fHV	1.000	1.000	1.000	1.000	1.000	1.000
fG	1.000	1.000	1.000	1.000	1.000	1.000
fP	1.000	1.000	1.000	1.000	1.000	1.000
fBB	1.000	1.000	1.000	1.000	1.000	1.000
fA	1.000	1.000	1.000	1.000	1.000	1.000
fLU	1.000	1.000	1.000	1.000	1.000	1.000
fRT		0.995		0.993	0.962	0.974
fLT	0.950	1.000	0.950	1.000	0.988	0.917
Sec.	0.188		0.233			
fLpb	1.000	1.000	1.000	1.000	1.000	1.000
fRpb		1.000		1.000	1.000	1.000
S	1805	1891	1805	1887	1805	1696
Sec.	357		443			

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		68	1805	0.04	0.067	120	0.57
Perm		0	357	0.00	0.489	175	0.00
Left	L	68			0.56	295	0.23
Prot							
Perm							
Thru	TR	551	1891	0.29	0.46	861	0.64
Right							
Westbound							
Prot		68	1805	# 0.04	0.067	120	0.57
Perm		0	443	0.00	0.489	217	0.00
Left	L	68			0.56	337	0.20
Prot							
Perm							
Thru	TR	608	1887	# 0.32	0.46	860	0.71
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	239	1805	0.13	0.31	562	0.43
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	410	1696	# 0.24	0.31	528	0.78
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.60
Total lost time per cycle, L = 18.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.75

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	0.23	0.56	13.0	1.000	295	0.11	0.4	0.0	13.4	B		
TR	0.64	0.46	18.8	1.000	861	0.22	1.6	0.0	20.4	C	19.7	B
Westbound												
L	0.20	0.56	12.1	1.000	337	0.11	0.3	0.0	12.3	B		
TR	0.71	0.46	19.7	1.000	860	0.27	2.7	0.0	22.4	C	21.4	C
Northbound												
LTR	0.43	0.31	24.6	1.000	562	0.11	0.5	0.0	25.1	C	25.1	C
Southbound												

LTR	0.78	0.31	28.2	1.000	528	0.33	7.2	0.0	35.4	D	35.4	D

Intersection delay = 24.2 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M		
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	50.0	50.0		
Effective permitted green time for LT lane group, g(s)	44.0	44.0		
Opposing effective green time, go (s)	41.0	41.0		
Number of lanes in LT lane group, N	1	1		
Number of lanes in opposing approach, No	1	1		
Adjusted LT flow rate, VLT (veh/h)	68	68		
Proportion of LT in LT lane group, PLT	1.000	1.000		
Proportion of LT in opposing flow, PLTo	0.00	0.00		
Adjusted opposing flow rate, Vo (veh/h)	608	551		
Lost time for LT lane group, tL	6.00	6.00		
Computation				
LT volume per cycle, LTC=VLTC/3600	1.70	1.70		
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	15.20	13.77		
gf=G[exp(- a * (LTC ** b)]-tl, gf<=g	0.0	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.54	0.54		
gq, (see Exhibit C16-4,5,6,7,8)	24.99	21.62		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	19.01	22.38		
n=Max(gq-gf)/2,0)	12.50	10.81		
PTHo=1-PLTo	1.00	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00		
EL1 (refer to Exhibit C16-3)	2.30	2.18		
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.09	0.09		
gdiff=max(gq-gf,0)	0.00	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.19	0.23		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.188	0.233		

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach			S	S
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)			28.0	28.0
Effective permitted green time for LT lane group, g(s)			28.0	28.0
Opposing effective green time, go (s)			28.0	28.0
Number of lanes in LT lane group, N			1	1
Number of lanes in opposing approach, No			1	1
Adjusted LT flow rate, VLT (veh/h)			6	57
Proportion of LT in LT lane group, PLT	0.000	0.000	0.025	0.139
Proportion of LT in opposing flow, PLTo			0.14	0.03
Adjusted opposing flow rate, Vo (veh/h)			410	239
Lost time for LT lane group, tL			6.00	6.00
Computation				
LT volume per cycle, LTC=VLTC/3600			0.15	1.43
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			10.25	5.97
gf=G[exp(- a * (LTC ** b)]-tl, gf<=g			15.6	3.6
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.69	0.69
gq, (see Exhibit C16-4,5,6,7,8)			13.61	7.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf			12.43	21.00
n=Max(gq-gf)/2,0)			0.00	1.72
PTHo=1-PLTo			0.86	0.97
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			0.03	0.14
EL1 (refer to Exhibit C16-3)			2.10	1.77
EL2=Max((1-Ptho**n)/Plto, 1.0)			1.00	1.70
fmin=2(1+PL)/g or fmin=2(1+Pl)/g			0.07	0.08
gdiff=max(gq-gf,0)			0.00	3.44
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.99	0.92
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.988	0.917

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 90.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v	68	68		
v/c ratio from Capacity Worksheet, X	0.23	0.20		
Protected phase effective green interval, g (s)	6.0	6.0		
Opposing queue effective green interval, gq	24.99	21.62		
Unopposed green interval, gu	19.01	22.38		
Red time r=(C-g-gq-gu)	40.0	40.0		
Arrival rate, qa=v/(3600(max[X,1.0]))	0.02	0.02		
Protected ph. departure rate, Sp=s/3600	0.501	0.501		
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.23	0.24		
XPerm	0.19	0.15		
XProt	0.29	0.29		
Case	1	1		
Queue at beginning of green arrow, Qa	0.76	0.76		
Queue at beginning of unsaturated green, Qu	0.47	0.41		
Residual queue, Qr	0.00	0.00		
Uniform Delay, d1	13.0	12.1		

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Dur. Unmet Demand Q veh	Unmet Demand t hrs.	Uniform Delay Unadj. ds	Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 24.2 sec/veh Intersection LOS C

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound	Southbound
LaneGroup	L	TR	L	TR	LTR	LTR
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	68	551	68	608	239	410
So	1900	1900	1900	1900	1900	1900
No.Lanes	1	1 0	1	1 0	0 1 0	0 1 0
SL	531	1891	606	1887	1805	1696
LnCapacity	295	861	337	860	562	528
Flow Ratio	0.13	0.29	0.11	0.32	0.13	0.24
v/c Ratio	0.23	0.64	0.20	0.71	0.43	0.78
Grn Ratio	0.56	0.46	0.56	0.46	0.31	0.31
I Factor		1.000		1.000	1.000	1.000
AT or PVG	3	3	3	3	3	3
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00	1.00	1.00	1.00	1.00	1.00
Q1	0.8	10.6	0.8	12.2	4.7	9.3
kB	0.3	0.6	0.4	0.6	0.5	0.5
Q2	0.1	1.1	0.1	1.5	0.4	1.5
Q Average	0.9	11.7	0.9	13.7	5.1	10.8
Q Spacing	25.0	25.0	25.0	25.0	25.0	25.0
Q Storage	0	0	0	0	0	0
Q S Ratio						
70th Percentile Output:						
fB%	1.2	1.2	1.2	1.2	1.2	1.2
BOQ	1.0	13.7	1.0	16.0	6.1	12.7
QSRatio						
85th Percentile Output:						
fB%	1.6	1.5	1.6	1.5	1.6	1.5
BOQ	1.4	17.6	1.4	20.4	7.9	16.3
QSRatio						
90th Percentile Output:						
fB%	1.8	1.6	1.8	1.6	1.7	1.6
BOQ	1.5	19.0	1.5	21.9	8.7	17.6
QSRatio						
95th Percentile Output:						
fB%	2.1	1.8	2.1	1.8	2.0	1.8
BOQ	1.8	21.2	1.8	24.3	10.0	19.7
QSRatio						
98th Percentile Output:						
fB%	2.6	2.1	2.6	2.0	2.4	2.1
BOQ	2.3	24.6	2.3	28.0	12.1	23.1
QSRatio						

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: md
Agency:
Date: 1/4/2005
Period: pm
Project ID: existing traffic
E/W St: sth 158

Inter.: sth 158/cth h
Area Type: All other areas
Jurisd: wisdot
Year : 2007

N/S St: cth h

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	1	1	0	0	1	0	0	1	0
LGConfig	L	TR		L	TR			LTR			LTR	
Volume	115	595	20	35	350	55	10	285	45	50	255	35
Lane Width	12.0	12.0		12.0	12.0			12.0			12.0	
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A	A			NB Left	A			
Thru		A			Thru	A			
Right		A			Right	A			
Peds					Peds				
WB Left	A	A			SB Left	A			
Thru		A			Thru	A			
Right		A			Right	A			
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	6.0	36.0				33.0			
Yellow	3.0	4.5				4.5			
All Red	0.0	1.5				1.5			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	335	1805	0.39	0.50	15.1	B		
TR	756	1891	0.92	0.40	42.8	D	38.5	D
Westbound								
L	205	1805	0.20	0.50	18.7	B		
TR	744	1861	0.62	0.40	23.1	C	22.8	C
Northbound								
LTR	674	1839	0.57	0.37	24.0	C	24.0	C
Southbound								
LTR	600	1636	0.64	0.37	26.0	C	26.0	C

Intersection Delay = 29.8 (sec/veh) Intersection LOS = C

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OPERATIONAL ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/4/2005
Analysis Time Period: pm
Intersection: sth 158/cth h
Area Type: All other areas
Jurisdiction: wisdot
Analysis Year: 2007
Project ID: existing traffic
East/West Street: sth 158 North/South Street: cth h

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	115	595	20	35	350	55	10	285	45	50	255	35
% Heavy Veh	0	0	0	0	0	0	0	0	0	0	0	0
PHF	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
PK 15 Vol	33	169	6	10	99	16	3	81	13	14	72	10
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900		1900	1900			1900			1900	
ParkExist												
NumPark												
No. Lanes	1	1	0	1	1	0	0	1	0	0	1	0
LGConfig	L	TR		L	TR			LTR			LTR	
Lane Width	12.0	12.0		12.0	12.0			12.0			12.0	
RTOR Vol			0			0			0			0
Adj Flow	131	699		40	461			386			387	
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000			0.028			0.147	
Prop RTs		0.033			0.137		0.132			0.103		
Peds		0			0		0			0		
Bikes							0			0		
Buses	0	0		0	0							
%InProtPhase	0.0			0.0								

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0	0.0			0.0			0.0	
Arriv. Type	3	3		3	3			3			3	
Unit Ext.	3.0	3.0		3.0	3.0			3.0			3.0	
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0		2.0	2.0			2.0			2.0	
Ext of g	2.0	2.0		2.0	2.0			2.0			2.0	
Ped Min g	3.2			3.2				3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A	A			NB Left	A			
Thru		A			Thru	A			
Right		A			Right	A			
Peds					Peds				
WB Left	A	A			SB Left	A			
Thru		A			Thru	A			
Right		A			Right	A			
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	6.0	36.0				33.0			
Yellow	3.0	4.5				4.5			
All Red	0.0	1.5				1.5			

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	115	595	20	35	350	55	10	285	45	50	255	35
PHF	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Adj flow	131	676	23	40	398	63	11	324	51	57	290	40
No. Lanes	1	1	0	1	1	0	0	1	0	0	1	0
Lane group	L	TR		L	TR			LTR			LTR	
Adj flow	131	699		40	461			386			387	
Prop LTs	1.000	0.000		1.000	0.000			0.028			0.147	
Prop RTs		0.033			0.137		0.132			0.103		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L	TR		L	TR			LTR			LTR	
So	1900	1900		1900	1900			1900			1900	
Lanes	1	1	0	1	1	0	0	1	0	0	1	0
fW	1.000	1.000		1.000	1.000			1.000			1.000	
fHV	1.000	1.000		1.000	1.000			1.000			1.000	
fG	1.000	1.000		1.000	1.000			1.000			1.000	
fP	1.000	1.000		1.000	1.000			1.000			1.000	
fBB	1.000	1.000		1.000	1.000			1.000			1.000	
fA	1.000	1.000		1.000	1.000			1.000			1.000	
fLU	1.000	1.000		1.000	1.000			1.000			1.000	
fRT		0.995			0.980			0.982			0.986	
fLT	0.950	1.000		0.950	1.000			0.985			0.873	
Sec.	0.260			0.103								
fLpb	1.000	1.000		1.000	1.000			1.000			1.000	
fRpb		1.000			1.000			1.000			1.000	
S	1805	1891		1805	1861			1839			1636	
Sec.	495			195								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		120	1805	# 0.07	0.067	120	1.00
Perm		11	495	0.02	0.433	215	0.05
Left	L	131			0.50	335	0.39
Prot							
Perm							
Thru	TR	699	1891	# 0.37	0.40	756	0.92
Right							
Westbound							
Prot		40	1805	0.02	0.067	120	0.33
Perm		0	195	0.00	0.433	85	0.00
Left	L	40			0.50	205	0.20
Prot							
Perm							
Thru	TR	461	1861	0.25	0.40	744	0.62
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	386	1839	0.21	0.37	674	0.57
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	387	1636	# 0.24	0.37	600	0.64
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.67
Total lost time per cycle, L = 18.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.84

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	0.39	0.50	14.4	1.000	335	0.11	0.8	0.0	15.1	B		
TR	0.92	0.40	25.7	1.000	756	0.44	17.1	0.0	42.8	D	38.5	D
Westbound												
L	0.20	0.50	18.2	1.000	205	0.11	0.5	0.0	18.7	B		
TR	0.62	0.40	21.5	1.000	744	0.20	1.6	0.0	23.1	C	22.8	C
Northbound												
LTR	0.57	0.37	22.8	1.000	674	0.17	1.2	0.0	24.0	C	24.0	C
Southbound												

LTR	0.64	0.37	23.6	1.000	600	0.22	2.4	0.0	26.0	C	26.0	C

Intersection delay = 29.8 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M		
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	45.0	45.0		
Effective permitted green time for LT lane group, g(s)	39.0	39.0		
Opposing effective green time, go (s)	36.0	36.0		
Number of lanes in LT lane group, N	1	1		
Number of lanes in opposing approach, No	1	1		
Adjusted LT flow rate, VLT (veh/h)	131	40		
Proportion of LT in LT lane group, PLT	1.000	1.000		
Proportion of LT in opposing flow, PLTo	0.00	0.00		
Adjusted opposing flow rate, Vo (veh/h)	461	699		
Lost time for LT lane group, tL	6.00	6.00		
Computation				
LT volume per cycle, LTC=VLTC/3600	3.28	1.00		
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	11.52	17.48		
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g	0.0	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.60	0.60		
gq, (see Exhibit C16-4,5,6,7,8)	18.59	34.28		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	20.41	4.72		
n=Max(gq-gf)/2,0)	9.30	17.14		
PTHo=1-PLTo	1.00	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00		
EL1 (refer to Exhibit C16-3)	2.01	2.50		
EL2=Max((1 Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.10	0.10		
gdiff=max(gq-gf,0)	0.00	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.26	0.10		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.260	0.103		

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach			S	S
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)			33.0	33.0
Effective permitted green time for LT lane group, g(s)			33.0	33.0
Opposing effective green time, go (s)			33.0	33.0
Number of lanes in LT lane group, N			1	1
Number of lanes in opposing approach, No			1	1
Adjusted LT flow rate, VLT (veh/h)			11	57
Proportion of LT in LT lane group, PLT	0.000	0.000	0.028	0.147
Proportion of LT in opposing flow, PLTo			0.15	0.03
Adjusted opposing flow rate, Vo (veh/h)			387	386
Lost time for LT lane group, tL			6.00	6.00
Computation				
LT volume per cycle, LTC=VLTC/3600			0.28	1.43
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			9.68	9.65
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g			16.5	5.3
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.63	0.63
gq, (see Exhibit C16-4,5,6,7,8)			11.16	11.13
gu=g-gq if gq>=gf, or = g-gf if gq<gf			16.47	21.87
n=Max(gq-gf)/2,0)			0.00	2.93
PTHo=1-PLTo			0.85	0.97
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			0.03	0.15
EL1 (refer to Exhibit C16-3)			2.05	2.05
EL2=Max((1-Ptho**n)/Plto, 1.0)			1.00	2.85
fmin=2(1+PL)/g or fmin=2(1+Pl)/g			0.06	0.07
gdiff=max(gq-gf,0)			0.00	5.86
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.99	0.87
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.985	0.873

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 90.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v	131	40		
v/c ratio from Capacity Worksheet, X	0.39	0.20		
Protected phase effective green interval, g (s)	6.0	6.0		
Opposing queue effective green interval, gq	18.59	34.28		
Unopposed green interval, gu	20.41	4.72		
Red time r=(C-g-gq-gu)	45.0	45.0		
Arrival rate, qa=v/(3600(max[X,1.0]))	0.04	0.01		
Protected ph. departure rate, Sp=s/3600	0.501	0.501		
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.26	0.45		
XPerm	0.26	0.21		
XProt	0.62	0.19		
Case	1	1		
Queue at beginning of green arrow, Qa	1.64	0.50		
Queue at beginning of unsaturated green, Qu	0.68	0.38		
Residual queue, Qr	0.00	0.00		
Uniform Delay, d1	14.4	18.2		

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 29.8 sec/veh Intersection LOS C

BACK OF QUEUE WORKSHEET

LaneGroup	Eastbound L	Eastbound TR		Westbound L	Westbound TR		Northbound LTR		Southbound LTR	
Init Queue	0.0	0.0		0.0	0.0		0.0		0.0	
Flow Rate	131	699		40	461		386		387	
So	1900	1900		1900	1900		1900		1900	
No.Lanes	1	1	0	1	1	0	0 1	0	0 1	0
SL	670	1891		410	1861		1839		1636	
LnCapacity	335	756		205	744		674		600	
Flow Ratio	0.20	0.37		0.10	0.25		0.21		0.24	
v/c Ratio	0.39	0.92		0.20	0.62		0.57		0.64	
Grn Ratio	0.50	0.40		0.50	0.40		0.37		0.37	
I Factor		1.000			1.000		1.000		1.000	
AT or PVG	3	3		3	3		3		3	
Pltn Ratio	1.00	1.00		1.00	1.00		1.00		1.00	
PF2	1.00	1.00		1.00	1.00		1.00		1.00	
Q1	1.7	16.6		0.5	9.2		7.7		8.0	
kB	0.4	0.6		0.3	0.6		0.5		0.5	
Q2	0.2	4.4		0.1	0.9		0.7		0.9	
Q Average	1.9	21.1		0.6	10.1		8.5		8.9	
Q Spacing	25.0	25.0		25.0	25.0		25.0		25.0	
Q Storage	0	0		0	0		0		0	
Q S Ratio										
70th Percentile Output:										
fB%	1.2	1.2		1.2	1.2		1.2		1.2	
BOQ	2.3	24.4		0.7	11.9		10.0		10.5	
QSRatio										
85th Percentile Output:										
fB%	1.6	1.4		1.6	1.5		1.5		1.5	
BOQ	3.0	30.5		0.9	15.3		12.9		13.6	
QSRatio										
90th Percentile Output:										
fB%	1.8	1.5		1.8	1.6		1.7		1.7	
BOQ	3.4	32.4		1.0	16.6		14.0		14.8	
QSRatio										
95th Percentile Output:										
fB%	2.0	1.7		2.1	1.8		1.9		1.9	
BOQ	3.9	35.5		1.2	18.6		15.8		16.6	
QSRatio										
98th Percentile Output:										
fB%	2.6	1.9		2.7	2.2		2.2		2.2	
BOQ	4.9	40.0		1.5	21.8		18.8		19.7	
QSRatio										

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: md
Agency:
Date: 1/3/2005
Period: am
Project ID: 2007 background traffic - no improvements
E/W St: sth 158

Inter.: sth 158/greyhound access
Area Type: All other areas
Jurisd: wisdot
Year : 2007
N/S St: greyhound access

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	1	1	2	0	2	0	1	0	0	0
LGConfig		TR	R	L	T		L		R			
Volume		505	5	1	455		5		5			
Lane Width		12.0	12.0	12.0	12.0		12.0		12.0			
RTOR Vol			0						0			

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left					NB Left	A			
Thru		A			Thru				
Right		A			Right	A			
Peds					Peds				
WB Left	A	A			SB Left				
Thru	A	A			Thru				
Right					Right				
Peds					Peds				
NB Right	A				EB Right				
SB Right					WB Right				
Green	14.0	50.0				11.0			
Yellow	3.0	4.5				4.5			
All Red	0.0	1.5				1.5			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
TR	2010	3618	0.26	0.56	10.5	B	10.5	B
R	897	1615	0.01	0.56	8.9	A		
Westbound								
L	723	1805	0.00	0.74	3.2	A		
T	2693	3618	0.18	0.74	3.4	A	3.4	A
Northbound								
L	428	3505	0.01	0.12	34.7	C	27.1	C
R	556	1615	0.01	0.34	19.4	B		
Southbound								

Intersection Delay = 7.3 (sec/veh) Intersection LOS = A

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/3/2005
Analysis Time Period: am
Intersection: sth 158/greyhound access
Area Type: All other areas
Jurisdiction: wisdot
Analysis Year: 2007
Project ID: 2007 background traffic - no improvements
East/West Street: sth 158 North/South Street: greyhound access

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume		505	5	1	455		5		5			
% Heavy Veh		0	0	0	0		0		0			
PHF		0.96	0.96	0.96	0.96		0.96		0.96			
PK 15 Vol		132	2	1	118		2		2			
Hi Ln Vol												
% Grade		0			0			0				
Ideal Sat		1900	1900	1900	1900		1900		1900			
ParkExist												
NumPark												
No. Lanes	0	2	1	1	2	0	2	0	1	0	0	0
LGConfig		TR	R	L	T		L		R			
Lane Width		12.0	12.0	12.0	12.0		12.0		12.0			
RTOR Vol			0						0			
Adj Flow		526	5	1	474		5		5			
%InSharedLn			0									
Prop LTs		0.000		1.000	0.000							
Prop RTs		0.000	1.000		0.000				1.000			
Peds	0							0			0	
Buses		0	0	0	0		0		0			
%InProtPhase				0.0								

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0	0.0	0.0	0.0		0.0		0.0			
Arriv. Type		3	3	3	3		3		3			
Unit Ext.		3.0	3.0	3.0	3.0		3.0		3.0			
I Factor		1.000			1.000			1.000				
Lost Time		2.0	2.0	2.0	2.0		2.0		2.0			
Ext of g		2.0	2.0	2.0	2.0		2.0		2.0			
Ped Min g		3.2					3.2		3.2			

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left					NB Left	A			
Thru		A			Thru				
Right		A			Right	A			
Peds					Peds				
WB Left	A	A			SB Left				
Thru	A	A			Thru				
Right					Right				
Peds					Peds				
NB Right	A				EB Right				
SB Right					WB Right				
Green	14.0	50.0				11.0			
Yellow	3.0	4.5				4.5			
All Red	0.0	1.5				1.5			

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V		505	5	1	455		5		5			
PHF		0.96	0.96	0.96	0.96		0.96		0.96			
Adj flow		526	5	1	474		5		5			
No. Lanes	0	2	1	1	2	0	2	0	1	0	0	0
Lane group		TR	R	L	T		L		R			
Adj flow		526	5	1	474		5		5			
Prop LTs		0.000		1.000	0.000							
Prop RTs		0.000	1.000		0.000				1.000			

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound TR	Eastbound R	Westbound L	Westbound T	Northbound L	Northbound R	Southbound
So	1900	1900	1900	1900	1900	1900	
Lanes 0	2	1	1	2 0	2 0	1 0	0 0
fW	1.000	1.000	1.000	1.000	1.000	1.000	
fHV	1.000	1.000	1.000	1.000	1.000	1.000	
fG	1.000	1.000	1.000	1.000	1.000	1.000	
fP	1.000	1.000	1.000	1.000	1.000	1.000	
fBB	1.000	1.000	1.000	1.000	1.000	1.000	
fA	1.000	1.000	1.000	1.000	1.000	1.000	
fLU	0.952	1.000	1.000	0.952	0.971	1.000	
fRT	1.000	0.850		1.000		0.850	
fLT	1.000		0.950	1.000	0.950		
Sec.			0.395				
fLpb	1.000		1.000	1.000	1.000		
fRpb	1.000	1.000		1.000		1.000	
S	3618	1615	1805	3618	3505	1615	
Sec.			750				

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	526	3618	# 0.15	0.56	2010	0.26
Right	R	5	1615	0.00	0.56	897	0.01
Westbound							
Prot		1	1805	0.00	0.156	281	0.00
Perm		0	750	0.00	0.589	442	0.00
Left	L	1			0.74	723	0.00
Prot							
Perm							
Thru	T	474	3618	0.13	0.74	2693	0.18
Right							
Northbound							
Prot							
Perm							
Left	L	5	3505	0.00	0.12	428	0.01
Prot							
Perm							
Thru							
Right	R	5	1615	# 0.00	0.34	556	0.01
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.15
Total lost time per cycle, L = 9.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.16

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
TR	0.26	0.56	10.4	1.000	2010	0.11	0.1	0.0	10.5	B	10.5	B
R	0.01	0.56	8.9	1.000	897	0.11	0.0	0.0	8.9	A		
Westbound												
L	0.00	0.74	3.2	1.000	723	0.11	0.0	0.0	3.2	A		
T	0.18	0.74	3.4	1.000	2693	0.11	0.0	0.0	3.4	A	3.4	A
Northbound												
L	0.01	0.12	34.7	1.000	428	0.11	0.0	0.0	34.7	C	27.1	C
R	0.01	0.34	19.4	1.000	556	0.11	0.0	0.0	19.4	B		
Southbound												

Intersection delay = 7.3 (sec/veh) Intersection LOS = A

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach		M		
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)		67.0		
Effective permitted green time for LT lane group, g(s)		53.0		
Opposing effective green time, go (s)		50.0		
Number of lanes in LT lane group, N		1		
Number of lanes in opposing approach, No		2		
Adjusted LT flow rate, VLT (veh/h)		1		
Proportion of LT in LT lane group, PLT		1.000		
Proportion of LT in opposing flow, PLTo		0.00		
Adjusted opposing flow rate, Vo (veh/h)		526		
Lost time for LT lane group, tL		6.00		
Computation				
LT volume per cycle, LTC=VLTC/3600		0.03		
Opposing lane util. factor, fLUo	0.952	0.952		
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		6.91		
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g		0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.44		
gq, (see Exhibit C16-4,5,6,7,8)		7.25		
gu=g-gq if gq>=gf, or = g-gf if gq<gf		45.75		
n=Max(gq-gf)/2,0)		3.63		
PTHo=1-PLTo		1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00		
EL1 (refer to Exhibit C16-3)		2.19		
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+P1)/g		0.08		
gdiff=max(gq-gf,0)		0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.39		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.395		

For special case of single-lane approach opposed by multilane approach, see text.
* If P1>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT		0.000	0.000	
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo		0.952	0.952	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+P1)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If P1>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 90.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v		1		
v/c ratio from Capacity Worksheet, X		0.00		
Protected phase effective green interval, g (s)		14.0		
Opposing queue effective green interval, gq		7.25		
Unopposed green interval, gu		45.75		
Red time r=(C-g-gq-gu)		23.0		
Arrival rate, qa=v/(3600(max[X,1.0]))		0.00		
Protected ph. departure rate, Sp=s/3600		0.501		
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)		0.24		
XPerm		0.00		
XProt		0.00		
Case		1		
Queue at beginning of green arrow, Qa		0.01		
Queue at beginning of unsaturated green, Qu		0.00		
Residual queue, Qr		0.00		
Uniform Delay, d1		3.2		

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Dur. Unmet Demand Q veh	Unmet Demand t hrs.	Uniform Delay Unadj. ds	Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 7.3 sec/veh Intersection LOS A

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	TR	R	L	T	L	R		
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0		
Flow Rate	276	5	1	248	2	5		
So	1900	1900	1900	1900	1900	1900		
No.Lanes	2	1	1	2	1	1	0	0
SL	1900	1615	970	1900	1805	1615		
LnCapacity	1055	897	723	1414	220	556		
Flow Ratio	0.15	0.00	0.00	0.13	0.00	0.00		
v/c Ratio	0.26	0.01	0.00	0.18	0.01	0.01		
Grn Ratio	0.56	0.56	0.74	0.74	0.12	0.34		
I Factor	1.000			1.000	1.000			
AT or PVG	3	3	3	3	3	3		
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00		
PF2	1.00	1.00	1.00	1.00	1.00	1.00		
Q1	3.6	0.1	0.0	1.8	0.0	0.1		
kB	0.7	0.6	0.6	0.8	0.3	0.5		
Q2	0.3	0.0	0.0	0.2	0.0	0.0		
Q Average	3.8	0.1	0.0	2.0	0.0	0.1		
Q Spacing	25.0	25.0	25.0	25.0	25.0	25.0		
Q Storage	0	0	0	0	0	0		
Q S Ratio								
70th Percentile Output:								
fB%	1.2	1.2	1.2	1.2	1.2	1.2		
BOQ	4.6	0.1	0.0	2.4	0.1	0.1		
QSRatio								
85th Percentile Output:								
fB%	1.6	1.6	1.6	1.6	1.6	1.6		
BOQ	6.0	0.1	0.0	3.2	0.1	0.1		
QSRatio								
90th Percentile Output:								
fB%	1.7	1.8	1.8	1.8	1.8	1.8		
BOQ	6.6	0.1	0.0	3.5	0.1	0.2		
QSRatio								
95th Percentile Output:								
fB%	2.0	2.1	2.1	2.0	2.1	2.1		
BOQ	7.6	0.1	0.0	4.1	0.1	0.2		
QSRatio								
98th Percentile Output:								
fB%	2.4	2.7	2.7	2.6	2.7	2.7		
BOQ	9.4	0.2	0.0	5.1	0.1	0.2		
QSRatio								

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: md
Agency:
Date: 1/3/2005
Period: pm
Project ID: existing traffic
E/W St: sth 158

Inter.: sth 158/greyhound access
Area Type: All other areas
Jurisd: wisdot
Year : 2007

N/S St: greyhound access

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	1	1	2	0	2	0	1	0	0	0
LGConfig		TR	R	L	T		L		R			
Volume		575	35	25	330		10		5			
Lane Width		12.0	12.0	12.0	12.0		12.0		12.0			
RTOR Vol			0						0			

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left					NB Left	A			
Thru		A			Thru				
Right		A			Right	A			
Peds					Peds				
WB Left	A	A			SB Left				
Thru	A	A			Thru				
Right					Right				
Peds					Peds				
NB Right	A				EB Right				
SB Right					WB Right				
Green	22.0	42.0				11.0			
Yellow	3.0	4.5				4.5			
All Red	0.0	1.5				1.5			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
TR	1688	3618	0.35	0.47	15.5	B	15.3	B
R	754	1615	0.05	0.47	13.1	B		
Westbound								
L	755	1805	0.03	0.74	3.6	A		
T	2693	3618	0.13	0.74	3.3	A	3.3	A
Northbound								
L	428	3505	0.02	0.12	34.8	C	28.0	C
R	700	1615	0.01	0.43	14.5	B		
Southbound								

Intersection Delay = 11.2 (sec/veh) Intersection LOS = B

HCS2000: Signalized Intersections Release 4.1e

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Suite 202

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OPERATIONAL ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/3/2005
Analysis Time Period: pm
Intersection: sth 158/greyhound access
Area Type: All other areas
Jurisdiction: wisdot
Analysis Year: 2007
Project ID: existing traffic

East/West Street: sth 158
North/South Street: greyhound access

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume		575	35	25	330		10		5			
% Heavy Veh		0	0	0	0		0		0			
PHF		0.96	0.96	0.96	0.96		0.96		0.96			
PK 15 Vol		150	9	7	86		3		2			
Hi Ln Vol												
% Grade		0			0			0				
Ideal Sat		1900	1900	1900	1900		1900		1900			
ParkExist												
NumPark												
No. Lanes	0	2	1	1	2	0	2	0	1	0	0	0
LGConfig		TR	R	L	T		L		R			
Lane Width		12.0	12.0	12.0	12.0		12.0		12.0			
RTOR Vol			0						0			
Adj Flow		599	36	26	344		10		5			
%InSharedLn			0									
Prop LTs		0.000		1.000	0.000							
Prop RTs		0.000	1.000		0.000				1.000			
Peds Bikes	0					0				0		
Buses		0	0	0	0		0		0			
%InProtPhase				0.0								

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0	0.0	0.0	0.0		0.0		0.0			
Arriv. Type		3	3	3	3		3		3			
Unit Ext.		3.0	3.0	3.0	3.0		3.0		3.0			
I Factor		1.000			1.000			1.000				
Lost Time		2.0	2.0	2.0	2.0		2.0		2.0			
Ext of g		2.0	2.0	2.0	2.0		2.0		2.0			

Ped Min g	3.2				3.2		3.2		

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left					NB Left	A			
Thru		A			Thru				
Right		A			Right	A			
Peds					Peds				
WB Left	A	A			SB Left				
Thru	A	A			Thru				
Right					Right				
Peds					Peds				
NB Right	A				EB Right				
SB Right					WB Right				
Green	22.0	42.0				11.0			
Yellow	3.0	4.5				4.5			
All Red	0.0	1.5				1.5			

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V		575	35	25	330		10		5			
PHF		0.96	0.96	0.96	0.96		0.96		0.96			
Adj flow		599	36	26	344		10		5			
No. Lanes	0	2	1	1	2	0	2	0	1	0	0	0
Lane group		TR	R	L	T		L		R			
Adj flow		599	36	26	344		10		5			
Prop LTs		0.000		1.000	0.000							
Prop RTs		0.000	1.000		0.000				1.000			

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	TR	R	L	T	L	R		
So	1900	1900	1900	1900	1900	1900		
Lanes 0	2	1	1	2 0	2 0	1 0	0	0
fW	1.000	1.000	1.000	1.000	1.000	1.000		
fHV	1.000	1.000	1.000	1.000	1.000	1.000		
fG	1.000	1.000	1.000	1.000	1.000	1.000		
fP	1.000	1.000	1.000	1.000	1.000	1.000		
fBB	1.000	1.000	1.000	1.000	1.000	1.000		
fA	1.000	1.000	1.000	1.000	1.000	1.000		
fLU	0.952	1.000	1.000	0.952	0.971	1.000		
fRT	1.000	0.850		1.000		0.850		
fLT	1.000		0.950	1.000	0.950			
Sec.			0.330					
fLpb	1.000		1.000	1.000	1.000			
fRpb	1.000	1.000		1.000		1.000		
S	3618	1615	1805	3618	3505	1615		
Sec.			627					

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	599	3618	# 0.17	0.47	1688	0.35
Right	R	36	1615	0.02	0.47	754	0.05
Westbound							
Prot		26	1805	# 0.01	0.244	441	0.06
Perm		0	627	0.00	0.500	314	0.00
Left	L	26			0.74	755	0.03
Prot							
Perm							
Thru	T	344	3618	0.10	0.74	2693	0.13
Right							
Northbound							
Prot							
Perm							
Left	L	10	3505	# 0.00	0.12	428	0.02
Prot							
Perm							
Thru							
Right	R	5	1615	0.00	0.43	700	0.01
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.18
Total lost time per cycle, L = 18.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.23

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
TR	0.35	0.47	15.3	1.000	1688	0.11	0.1	0.0	15.5	B	15.3	B
R	0.05	0.47	13.1	1.000	754	0.11	0.0	0.0	13.1	B		
Westbound												
L	0.03	0.74	3.6	1.000	755	0.11	0.0	0.0	3.6	A		
T	0.13	0.74	3.2	1.000	2693	0.11	0.0	0.0	3.3	A	3.3	A
Northbound												
L	0.02	0.12	34.8	1.000	428	0.11	0.0	0.0	34.8	C	28.0	C
R	0.01	0.43	14.5	1.000	700	0.11	0.0	0.0	14.5	B		
Southbound												

Intersection delay = 11.2 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach		M		
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)		67.0		
Effective permitted green time for LT lane group, g(s)		45.0		
Opposing effective green time, go (s)		42.0		
Number of lanes in LT lane group, N		1		
Number of lanes in opposing approach, No		2		
Adjusted LT flow rate, VLT (veh/h)		26		
Proportion of LT in LT lane group, PLT		1.000		
Proportion of LT in opposing flow, PLTo		0.00		
Adjusted opposing flow rate, Vo (veh/h)		599		
Lost time for LT lane group, tL		6.00		
Computation				
LT volume per cycle, LTC=VLTC/3600		0.65		
Opposing lane util. factor, fLUo	0.952	0.952		
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		7.87		
gf=G[exp(- a * (LTC ** b)]-tl, gf<=g		0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.53		
gq, (see Exhibit C16-4,5,6,7,8)		10.17		
gu=g-gq if gq>=gf, or = g-gf if gq<gf		34.83		
n=Max(gq-gf)/2,0)		5.08		
PTHo=1-PLTo		1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00		
EL1 (refer to Exhibit C16-3)		2.35		
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.09		
gdiff=max(gq-gf,0)		0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.33		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.330		

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT		0.000	0.000	
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo		0.952	0.952	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b)]-tl, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 90.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v		26		
v/c ratio from Capacity Worksheet, X		0.03		
Protected phase effective green interval, g (s)		22.0		
Opposing queue effective green interval, gq		10.17		
Unopposed green interval, gu		34.83		
Red time r=(C-g-gq-gu)		23.0		
Arrival rate, qa=v/(3600(max[X,1.0]))		0.01		
Protected ph. departure rate, Sp=s/3600		0.501		
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)		0.22		
XPerm		0.04		
XProt		0.03		
Case		1		
Queue at beginning of green arrow, Qa		0.17		
Queue at beginning of unsaturated green, Qu		0.07		
Residual queue, Qr		0.00		
Uniform Delay, d1		3.6		

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 11.2 sec/veh Intersection LOS B

BACK OF QUEUE WORKSHEET

LaneGroup	Eastbound TR	Eastbound R	Westbound L	Westbound T	Northbound L	Northbound R	Southbound	
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0		
Flow Rate	314	36	26	180	5	5		
So	1900	1900	1900	1900	1900	1900		
No.Lanes	2	1	1	2	1	1		
SL	1900	1615	1014	1900	1805	1615		
LnCapacity	886	754	755	1414	220	700		
Flow Ratio	0.17	0.02	0.03	0.09	0.00	0.00		
v/c Ratio	0.35	0.05	0.03	0.13	0.02	0.01		
Grn Ratio	0.47	0.47	0.74	0.74	0.12	0.43		
I Factor	1.000			1.000	1.000			
AT or PVG	3	3	3	3	3	3		
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00		
PF2	1.00	1.00	1.00	1.00	1.00	1.00		
Q1	5.0	0.5	0.2	1.3	0.1	0.1		
kB	0.6	0.6	0.6	0.8	0.3	0.6		
Q2	0.4	0.0	0.0	0.1	0.0	0.0		
Q Average	5.4	0.5	0.2	1.4	0.1	0.1		
Q Spacing	25.0	25.0	25.0	25.0	25.0	25.0		
Q Storage	0	0	0	0	0	0		
Q S Ratio								
70th Percentile Output:								
fB%	1.2	1.2	1.2	1.2	1.2	1.2		
BOQ	6.4	0.6	0.2	1.7	0.1	0.1		
QSRatio								
85th Percentile Output:								
fB%	1.6	1.6	1.6	1.6	1.6	1.6		
BOQ	8.3	0.8	0.3	2.2	0.2	0.1		
QSRatio								
90th Percentile Output:								
fB%	1.7	1.8	1.8	1.8	1.8	1.8		
BOQ	9.2	0.9	0.3	2.5	0.2	0.1		
QSRatio								
95th Percentile Output:								
fB%	1.9	2.1	2.1	2.1	2.1	2.1		
BOQ	10.4	1.1	0.4	2.9	0.2	0.2		
QSRatio								
98th Percentile Output:								
fB%	2.4	2.7	2.7	2.6	2.7	2.7		
BOQ	12.7	1.4	0.5	3.6	0.3	0.2		
QSRatio								

ERROR MESSAGES

No errors to report.

HCS2000: Unsignalized Intersections Release 4.1d

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ALL-WAY STOP CONTROL(AWSC) ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 11/15/2004
Analysis Time Period: am
Intersection: STH 158/Western Frontage
Jurisdiction: WisDOT
Units: U. S. Customary
Analysis Year: 2004
Project ID: existing traffic
East/West Street: sth 158
North/South Street: Western Frontage Road

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	0	245	25	60	225	0	10	0	50	0	0	0

% Thrus Left Lane

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	T	R	LT		LR			
PHF	1.00	1.00	1.00		1.00			
Flow Rate	245	25	285		60			
% Heavy Veh	0	0	0		0			
No. Lanes	2		1		1			
Opposing-Lanes	1		2		0			
Conflicting-lanes	1		1		2			
Geometry group	5		3a		1			

Duration, T 0.25 hrs.

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	245	25	285		60			
Left-Turn	0	0	60		10			
Right-Turn	0	25	0		50			
Prop. Left-Turns	0.0	0.0	0.2		0.2			
Prop. Right-Turns	0.0	1.0	0.0		0.8			
Prop. Heavy Vehicle	0.0	0.0	0.0		0.0			
Geometry Group	5		3a		1			
Adjustments Exhibit 17-33:								
hLT-adj	0.5		0.2		0.2			
hRT-adj	-0.7		-0.6		-0.6			
hHV-adj	1.7		1.7		1.7			
hadj, computed	0.0	-0.7	0.0		-0.5			

Worksheet 4 - Departure Headway and Service Time

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow rate	245	25	285		60			
hd, initial value	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20
x, initial	0.22	0.02	0.25		0.05			
hd, final value	4.86	4.16	4.49		4.68			
x, final value	0.33	0.03	0.36		0.08			
Move-up time, m	2.3		2.0		2.0			
Service Time	2.6	1.9	2.5		2.7			

Worksheet 5 - Capacity and Level of Service

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rate	245	25	285		60			
Service Time	2.6	1.9	2.5		2.7			
Utilization, x	0.33	0.03	0.36		0.08			
Dep. headway, hd	4.86	4.16	4.49		4.68			
Capacity	495	275	535		310			
Delay	9.95	6.98	9.94		8.08			
LOS	A	A	A		A			
Approach:								
Delay	9.67		9.94		8.08			
LOS	A		A		A			

Intersection Delay 9.64 Intersection LOS A

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ALL-WAY STOP CONTROL(AWSC) ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 11/15/2004
Analysis Time Period: pm
Intersection: STH 158/Western Frontage
Jurisdiction: WisDOT
Units: U. S. Customary
Analysis Year: 2004
Project ID: existing traffic
East/West Street: sth 158
North/South Street: Western Frontage Road

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	0	205	55	125	110	0	10	0	35	0	0	0
% Thrus Left Lane												

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	T	R	LT		LR			
PHF	1.00	1.00	1.00		1.00			
Flow Rate	205	55	235		45			
% Heavy Veh	0	0	0		0			
No. Lanes	2		1		1			
Opposing-Lanes	1		2		0			
Conflicting-lanes	1		1		2			
Geometry group	5		3a		1			

Duration, T 0.25 hrs.

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	205	55	235		45			
Left-Turn	0	0	125		10			
Right-Turn	0	55	0		35			
Prop. Left-Turns	0.0	0.0	0.5		0.2			
Prop. Right-Turns	0.0	1.0	0.0		0.8			
Prop. Heavy Vehicle	0.0	0.0	0.0		0.0			
Geometry Group	5		3a		1			
Adjustments Exhibit 17-33:								
hLT-adj	0.5		0.2		0.2			
hRT-adj	-0.7		-0.6		-0.6			
hHV-adj	1.7		1.7		1.7			
hadj, computed	0.0	-0.7	0.1		-0.4			

Worksheet 4 - Departure Headway and Service Time

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow rate	205	55	235		45			
hd, initial value	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20
x, initial	0.18	0.05	0.21		0.04			
hd, final value	4.78	4.08	4.48		4.56			
x, final value	0.27	0.06	0.29		0.06			
Move-up time, m	2.3		2.0		2.0			
Service Time	2.5	1.8	2.5		2.6			

Worksheet 5 - Capacity and Level of Service

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rate	205	55	235		45			
Service Time	2.5	1.8	2.5		2.6			
Utilization, x	0.27	0.06	0.29		0.06			
Dep. headway, hd	4.78	4.08	4.48		4.56			
Capacity	455	305	485		295			
Delay	9.26	7.05	9.32		7.84			
LOS	A	A	A		A			
Approach:								
Delay	8.79		9.32		7.84			
LOS	A		A		A			

Intersection Delay 8.94 Intersection LOS A

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ALL-WAY STOP CONTROL(AWSC) ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 11/15/2004
Analysis Time Period: am
Intersection: STH 158/Eastern Frontage
Jurisdiction: WisDOT
Units: U. S. Customary
Analysis Year: 2004
Project ID: existing traffic
East/West Street: sth 158
North/South Street: Eastern Frontage Road

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	15	280	55	125	275	1	5	30	35	1	0	10

% Thrus Left Lane

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	LT		TR		LT		LR	
PHF	1.00		1.00		1.00		1.00	
Flow Rate	295		276		35		11	
% Heavy Veh	0		0		0		0	
No. Lanes		1		1		1		1
Opposing-Lanes		1		1		1		1
Conflicting-lanes		1		1		1		1
Geometry group		1		1		1		1

Duration, T 0.25 hrs.

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	295		276		35		11	
Left-Turn	15		0		5		1	
Right-Turn	0		1		0		10	
Prop. Left-Turns	0.1		0.0		0.1		0.1	
Prop. Right-Turns	0.0		0.0		0.0		0.9	
Prop. Heavy Vehicle	0.0		0.0		0.0		0.0	
Geometry Group		1		1		1		1
Adjustments Exhibit 17-33:								
hLT-adj		0.2		0.2		0.2		0.2
hRT-adj		-0.6		-0.6		-0.6		-0.6
hHV-adj		1.7		1.7		1.7		1.7
hadj, computed	0.0		-0.0		0.0		-0.5	

Worksheet 4 - Departure Headway and Service Time

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow rate	295		276		35		11	
hd, initial value	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20
x, initial	0.26		0.25		0.03		0.01	
hd, final value	4.32		4.32		5.20		4.68	
x, final value	0.35		0.33		0.05		0.01	
Move-up time, m		2.0		2.0		2.0		2.0
Service Time	2.3		2.3		3.2		2.7	

Worksheet 5 - Capacity and Level of Service

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rate	295		276		35		11	
Service Time	2.3		2.3		3.2		2.7	
Utilization, x	0.35		0.33		0.05		0.01	
Dep. headway, hd	4.32		4.32		5.20		4.68	
Capacity	545		526		285		261	
Delay	9.66		9.45		8.47		7.75	
LOS	A		A		A		A	
Approach:								
Delay		9.66		9.45		8.47		7.75
LOS		A		A		A		A

Intersection Delay 9.47 Intersection LOS A

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ALL-WAY STOP CONTROL(AWSC) ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 11/15/2004
Analysis Time Period: pm
Intersection: STH 158/Eastern Frontage
Jurisdiction: WisDOT
Units: U. S. Customary
Analysis Year: 2004
Project ID: existing traffic
East/West Street: sth 158
North/South Street: Eastern Frontage Road

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	10	235	55	125	210	1	25	55	35	1	0	5
% Thrus Left Lane												

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	LT		TR		LT		LR	
PHF	1.00		1.00		1.00		1.00	
Flow Rate	245		211		80		6	
% Heavy Veh	0		0		0		0	
No. Lanes	1		1		1		1	
Opposing-Lanes	1		1		1		1	
Conflicting-lanes	1		1		1		1	
Geometry group	1		1		1		1	

Duration, T 0.25 hrs.

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	245		211		80		6	
Left-Turn	10		0		25		1	
Right-Turn	0		1		0		5	
Prop. Left-Turns	0.0		0.0		0.3		0.2	
Prop. Right-Turns	0.0		0.0		0.0		0.8	
Prop. Heavy Vehicle	0.0		0.0		0.0		0.0	
Geometry Group	1		1		1		1	
Adjustments Exhibit 17-33:								
hLT-adj	0.2		0.2		0.2		0.2	
hRT-adj	-0.6		-0.6		-0.6		-0.6	
hHV-adj	1.7		1.7		1.7		1.7	
hadj, computed	0.0		-0.0		0.1		-0.5	

Worksheet 4 - Departure Headway and Service Time

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow rate	245		211		80		6	
hd, initial value	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20
x, initial	0.22		0.19		0.07		0.01	
hd, final value	4.36		4.39		4.99		4.58	
x, final value	0.30		0.26		0.11		0.01	
Move-up time, m	2.0		2.0		2.0		2.0	
Service Time	2.4		2.4		3.0		2.6	

Worksheet 5 - Capacity and Level of Service

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rate	245		211		80		6	
Service Time	2.4		2.4		3.0		2.6	
Utilization, x	0.30		0.26		0.11		0.01	
Dep. headway, hd	4.36		4.39		4.99		4.58	
Capacity	495		461		330		256	
Delay	9.19		8.90		8.62		7.61	
LOS	A		A		A		A	
Approach:								
Delay	9.19		8.90		8.62		7.61	
LOS	A		A		A		A	

Intersection Delay 8.98 Intersection LOS A

HCS2000: Unsignalized Intersections Release 4.1d

TWO-WAY STOP CONTROL SUMMARY

Analyst: md
Agency/Co.:
Date Performed: 11/12/2004
Analysis Time Period: am
Intersection: sth 158/104th avenue
Jurisdiction: wisdot
Units: U. S. Customary
Analysis Year: 2004
Project ID: existing traffic
East/West Street: sth 158
North/South Street: 104th Avenue
Intersection Orientation: EW
Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	20	485	5	115	420	5
Peak-Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate, HFR	20	485	5	115	420	5
Percent Heavy Vehicles	0	--	--	0	--	--
Median Type/Storage	Undivided			/		
RT Channelized?			No			No
Lanes	1	2	1	1	2	1
Configuration	L	T	R	L	T	R
Upstream Signal?		No			No	

Minor Street: Approach	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	30	1	95	5	1	5
Peak Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate, HFR	30	1	95	5	1	5
Percent Heavy Vehicles	0	0	0	0	0	0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No /			No /
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	L	L		LTR			LTR	
v (vph)	20	115		126			11	
C(m) (vph)	1145	1084		438			272	
v/c	0.02	0.11		0.29			0.04	
95% queue length	0.05	0.35		1.18			0.13	
Control Delay	8.2	8.7		16.5			18.8	
LOS	A	A		C			C	
Approach Delay				16.5			18.8	
Approach LOS				C			C	

HCS2000: Unsignalized Intersections Release 4.1d

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TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 11/12/2004
Analysis Time Period: am
Intersection: sth 158/104th avenue
Jurisdiction: wisdot
Units: U. S. Customary
Analysis Year: 2004
Project ID: existing traffic
East/West Street: sth 158
North/South Street: 104th Avenue
Intersection Orientation: EW
Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	20	485	5	115	420	5
Peak-Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Peak-15 Minute Volume	5	121	1	29	105	1
Hourly Flow Rate, HFR	20	485	5	115	420	5
Percent Heavy Vehicles	0	--	--	0	--	--
Median Type/Storage	Undivided			/		
RT Channelized?			No			No
Lanes	1	2	1	1	2	1
Configuration	L	T	R	L	T	R
Upstream Signal?		No			No	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	30	1	95	5	1	5
Peak Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Peak-15 Minute Volume	8	0	24	1	0	1
Hourly Flow Rate, HFR	30	1	95	5	1	5
Percent Heavy Vehicles	0	0	0	0	0	0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No /			No /
RT Channelized?						
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

		Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2	Left-Turn							
	Through							
S5	Left-Turn							
	Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1	4	7	8	9	10	11	12
		L	L	L	T	R	L	T	R
t(c,base)		4.1	4.1	7.5	6.5	6.9	7.5	6.5	6.9
t(c,hv)		2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
P(hv)		0	0	0	0	0	0	0	0
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Grade/100				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage	4.1	4.1	7.5	6.5	6.9	7.5	6.5	6.9
	2-stage								

Follow-Up Time Calculations

Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)	2.20	2.20	3.50	4.00	3.30	3.50	4.00	3.30
t(f,HV)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(HV)	0	0	0	0	0	0	0	0
t(f)	2.2	2.2	3.5	4.0	3.3	3.5	4.0	3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				
Total Saturation Flow Rate, s (vph)				
Arrival Type				
Effective Green, g (sec)				
Cycle Length, C (sec)				
Rp (from Exhibit 16-11)				
Proportion vehicles arriving on green P				
g(q1)				
g(q2)				
g(q)				

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p		0.000		0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5
Single-Stage Process

Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
V c,x	425	490	965	1180	242	932	1180	210
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process

	7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		3000		3000		3000		3000
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	242	210
Potential Capacity	765	802
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	765	802
Probability of Queue free St.	0.88	0.99

Step 2: LT from Major St.	4	1
Conflicting Flows	490	425
Potential Capacity	1084	1145
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	1084	1145
Probability of Queue free St.	0.89	0.98
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows	1180	1180
Potential Capacity	192	192
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.88	0.88
Movement Capacity	169	169
Probability of Queue free St.	0.99	0.99

Step 4: LT from Minor St.	7	10
Conflicting Flows	965	932
Potential Capacity	212	224
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.87	0.87
Maj. L, Min T Adj. Imp Factor.	0.90	0.90
Cap. Adj. factor due to Impeding mvmnt	0.90	0.79
Movement Capacity	190	177

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	1180	1180
Potential Capacity	192	192
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.88	0.88
Movement Capacity	169	169
Result for 2 stage process:		
a		
y		
C t	169	169
Probability of Queue free St.	0.99	0.99

Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	965	932
Potential Capacity	212	224
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.87	0.87
Maj. L, Min T Adj. Imp Factor.	0.90	0.90
Cap. Adj. factor due to Impeding mvmnt	0.90	0.79
Movement Capacity	190	177
Results for Two-stage process:		
a		
y		
C t	190	177

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	30	1	95	5	1	5
Movement Capacity (vph)	190	169	765	177	169	802
Shared Lane Capacity (vph)		438			272	

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	190	169	765	177	169	802
Volume	30	1	95	5	1	5
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh		438			272	
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	L	L		LTR			LTR	
v (vph)	20	115		126			11	
C(m) (vph)	1145	1084		438			272	
v/c	0.02	0.11		0.29			0.04	
95% queue length	0.05	0.35		1.18			0.13	
Control Delay	8.2	8.7		16.5			18.8	
LOS	A	A		C			C	
Approach Delay				16.5			18.8	
Approach LOS				C			C	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.98	0.89
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4	8.2	8.7
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS2000: Unsignalized Intersections Release 4.1d

TWO-WAY STOP CONTROL SUMMARY

Analyst:
Agency/Co.:
Date Performed: 11/12/2004
Analysis Time Period: pm
Intersection: sth 158/104th avenue
Jurisdiction: wisdot
Units: U. S. Customary
Analysis Year: 2004
Project ID: existing traffic
East/West Street: sth 158
North/South Street: 104th Avenue
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	20	565	5	85	395	5
Peak-Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate, HFR	20	565	5	85	395	5
Percent Heavy Vehicles	0	--	--	0	--	--
Median Type/Storage	Undivided			/		
RT Channelized?			No			No
Lanes	1	2	1	1	2	1
Configuration	L	T	R	L	T	R
Upstream Signal?		No			No	

Minor Street: Approach	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	10	5	130	10	5	10
Peak Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate, HFR	10	5	130	10	5	10
Percent Heavy Vehicles	0	0	0	0	0	0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No /			No /
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	L	L		LTR			LTR	
v (vph)	20	85		145			25	
C(m) (vph)	1170	1013		552			258	
v/c	0.02	0.08		0.26			0.10	
95% queue length	0.05	0.27		1.05			0.32	
Control Delay	8.1	8.9		13.8			20.4	
LOS	A	A		B			C	
Approach Delay				13.8			20.4	
Approach LOS				B			C	

HCS2000: Unsignalized Intersections Release 4.1d

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TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst:
Agency/Co.:
Date Performed: 11/12/2004
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Analysis Year: 2004
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East/West Street: sth 158
North/South Street: 104th Avenue
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	20	565	5	85	395	5
Peak-Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Peak-15 Minute Volume	5	141	1	21	99	1
Hourly Flow Rate, HFR	20	565	5	85	395	5
Percent Heavy Vehicles	0	--	--	0	--	--
Median Type/Storage	Undivided			/		
RT Channelized?			No			No
Lanes	1	2	1	1	2	1
Configuration	L	T	R	L	T	R
Upstream Signal?		No			No	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	10	5	130	10	5	10
Peak Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Peak-15 Minute Volume	2	1	32	2	1	2
Hourly Flow Rate, HFR	10	5	130	10	5	10
Percent Heavy Vehicles	0	0	0	0	0	0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No /			No /
RT Channelized?						
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

		Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2	Left-Turn							
	Through							
S5	Left-Turn							
	Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1	4	7	8	9	10	11	12
		L	L	L	T	R	L	T	R
t(c,base)		4.1	4.1	7.5	6.5	6.9	7.5	6.5	6.9
t(c,hv)		2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
P(hv)		0	0	0	0	0	0	0	0
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Grade/100				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage	4.1	4.1	7.5	6.5	6.9	7.5	6.5	6.9
	2-stage								

Follow-Up Time Calculations

Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)	2.20	2.20	3.50	4.00	3.30	3.50	4.00	3.30
t(f,HV)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(HV)	0	0	0	0	0	0	0	0
t(f)	2.2	2.2	3.5	4.0	3.3	3.5	4.0	3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(1,prot)	V(t)	V(1,prot)
V prog				
Total Saturation Flow Rate, s (vph)				
Arrival Type				
Effective Green, g (sec)				
Cycle Length, C (sec)				
Rp (from Exhibit 16-11)				
Proportion vehicles arriving on green P				
g(q1)				
g(q2)				
g(q)				

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2		Movement 5	
	V(t)	V(1,prot)	V(t)	V(1,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p		0.000		0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5
Single-Stage Process

Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
V c,x	400	570	975	1175	282	889	1175	198
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process

	7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		3000		3000		3000		3000
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	282	198
Potential Capacity	721	816
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	721	816
Probability of Queue free St.	0.82	0.99

Step 2: LT from Major St.	4	1
Conflicting Flows	570	400
Potential Capacity	1013	1170
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	1013	1170
Probability of Queue free St.	0.92	0.98
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows	1175	1175
Potential Capacity	193	193
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.90	0.90
Movement Capacity	174	174
Probability of Queue free St.	0.97	0.97

Step 4: LT from Minor St.	7	10
Conflicting Flows	975	889
Potential Capacity	209	241
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.87	0.87
Maj. L, Min T Adj. Imp Factor.	0.90	0.90
Cap. Adj. factor due to Impeding mvmnt	0.89	0.74
Movement Capacity	187	179

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	1175	1175
Potential Capacity	193	193
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.90	0.90
Movement Capacity	174	174
Result for 2 stage process:		
a		
y		
C t	174	174
Probability of Queue free St.	0.97	0.97

Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	975	889
Potential Capacity	209	241
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.87	0.87
Maj. L, Min T Adj. Imp Factor.	0.90	0.90
Cap. Adj. factor due to Impeding mvmnt	0.89	0.74
Movement Capacity	187	179
Results for Two-stage process:		
a		
y		
C t	187	179

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	10	5	130	10	5	10
Movement Capacity (vph)	187	174	721	179	174	816
Shared Lane Capacity (vph)		552			258	

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	187	174	721	179	174	816
Volume	10	5	130	10	5	10
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh		552			258	
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	L	L		LTR			LTR	
v (vph)	20	85		145			25	
C(m) (vph)	1170	1013		552			258	
v/c	0.02	0.08		0.26			0.10	
95% queue length	0.05	0.27		1.05			0.32	
Control Delay	8.1	8.9		13.8			20.4	
LOS	A	A		B			C	
Approach Delay				13.8			20.4	
Approach LOS				B			C	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.98	0.92
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4	8.1	8.9
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

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ALL-WAY STOP CONTROL(AWSC) ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 11/15/2004
Analysis Time Period: am
Intersection: 60th/Eastern Frontage Road
Jurisdiction: WisDOT
Units: U. S. Customary
Analysis Year: 2004
Project ID: existing traffic
East/West Street: 60th street
North/South Street: Eastern Frontage Road

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	30	110	25	40	80	5	5	115	75	1	1	1

% Thrus Left Lane

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	LTR		LTR		LTR		LTR	
PHF	1.00		1.00		1.00		1.00	
Flow Rate	165		125		195		3	
% Heavy Veh	0		0		0		0	
No. Lanes		1		1		1		1
Opposing-Lanes		1		1		1		1
Conflicting-lanes		1		1		1		1
Geometry group		1		1		1		1

Duration, T 0.25 hrs.

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	165		125		195		3	
Left-Turn	30		40		5		1	
Right-Turn	25		5		75		1	
Prop. Left-Turns	0.2		0.3		0.0		0.3	
Prop. Right-Turns	0.2		0.0		0.4		0.3	
Prop. Heavy Vehicle	0.0		0.0		0.0		0.0	
Geometry Group		1		1		1		1
Adjustments Exhibit 17-33:								
hLT-adj		0.2		0.2		0.2		0.2
hRT-adj		-0.6		-0.6		-0.6		-0.6
hHV-adj		1.7		1.7		1.7		1.7
hadj, computed	-0.1		0.0		-0.2		-0.1	

Worksheet 4 - Departure Headway and Service Time

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow rate	165		125		195		3	
hd, initial value	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20
x, initial	0.15		0.11		0.17		0.00	
hd, final value	4.46		4.59		4.36		4.69	
x, final value	0.20		0.16		0.24		0.00	
Move-up time, m		2.0		2.0		2.0		2.0
Service Time	2.5		2.6		2.4		2.7	

Worksheet 5 - Capacity and Level of Service

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rate	165		125		195		3	
Service Time	2.5		2.6		2.4		2.7	
Utilization, x	0.20		0.16		0.24		0.00	
Dep. headway, hd	4.46		4.59		4.36		4.69	
Capacity	415		375		445		253	
Delay	8.60		8.47		8.70		7.71	
LOS	A		A		A		A	
Approach:								
Delay		8.60		8.47		8.70		7.71
LOS		A		A		A		A

Intersection Delay 8.60 Intersection LOS A

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ALL-WAY STOP CONTROL(AWSC) ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 11/15/2004
Analysis Time Period: pm
Intersection: 60th/Eastern Frontage Road
Jurisdiction: WisDOT
Units: U. S. Customary
Analysis Year: 2004
Project ID: existing traffic
East/West Street: 60th street
North/South Street: Eastern Frontage Road

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	30	130	55	55	125	20	15	125	85	10	5	10

% Thrus Left Lane

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	LTR		LTR		LTR		LTR	
PHF	1.00		1.00		1.00		1.00	
Flow Rate	215		200		225		25	
% Heavy Veh	0		0		0		0	
No. Lanes	1		1		1		1	
Opposing-Lanes	1		1		1		1	
Conflicting-lanes	1		1		1		1	
Geometry group	1		1		1		1	

Duration, T 0.25 hrs.

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	215		200		225		25	
Left-Turn	30		55		15		10	
Right-Turn	55		20		85		10	
Prop. Left-Turns	0.1		0.3		0.1		0.4	
Prop. Right-Turns	0.3		0.1		0.4		0.4	
Prop. Heavy Vehicle	0.0		0.0		0.0		0.0	
Geometry Group	1		1		1		1	
Adjustments Exhibit 17-33:								
hLT-adj	0.2		0.2		0.2		0.2	
hRT-adj	-0.6		-0.6		-0.6		-0.6	
hHV-adj	1.7		1.7		1.7		1.7	
hadj, computed	-0.1		-0.0		-0.2		-0.2	

Worksheet 4 - Departure Headway and Service Time

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow rate	215		200		225		25	
hd, initial value	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20
x, initial	0.19		0.18		0.20		0.02	
hd, final value	4.67		4.80		4.73		5.08	
x, final value	0.28		0.27		0.30		0.04	
Move-up time, m	2.0		2.0		2.0		2.0	
Service Time	2.7		2.8		2.7		3.1	

Worksheet 5 - Capacity and Level of Service

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rate	215		200		225		25	
Service Time	2.7		2.8		2.7		3.1	
Utilization, x	0.28		0.27		0.30		0.04	
Dep. headway, hd	4.67		4.80		4.73		5.08	
Capacity	465		450		475		275	
Delay	9.47		9.54		9.71		8.27	
LOS	A		A		A		A	
Approach:								
Delay	9.47		9.54		9.71		8.27	
LOS	A		A		A		A	

Intersection Delay 9.53 Intersection LOS A

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ALL-WAY STOP CONTROL(AWSC) ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 11/15/2004
Analysis Time Period: am
Intersection: 60th/104th
Jurisdiction: Kenosha County
Units: U. S. Customary
Analysis Year: 2004
Project ID: Existing Traffic
East/West Street: 60th street
North/South Street: 104th

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	10	100	5	80	90	10	5	115	75	5	135	25

% Thrus Left Lane

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	LT	R	LTR		L	TR	LT	R
PHF	1.00	1.00	1.00		1.00	1.00	1.00	1.00
Flow Rate	110	5	180		5	190	140	25
% Heavy Veh	0	0	0		0	0	0	0
No. Lanes	2		1		2		2	
Opposing-Lanes	1		2		2		2	
Conflicting-lanes	2		2		2		2	
Geometry group	5		4b		5		5	

Duration, T 0.25 hrs.

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	110	5	180		5	190	140	25
Left-Turn	10	0	80		5	0	5	0
Right-Turn	0	5	10		0	75	0	25
Prop. Left-Turns	0.1	0.0	0.4		1.0	0.0	0.0	0.0
Prop. Right-Turns	0.0	1.0	0.1		0.0	0.4	0.0	1.0
Prop. Heavy Vehicle	0.0	0.0	0.0		0.0	0.0	0.0	0.0
Geometry Group	5		4b		5		5	
Adjustments Exhibit 17-33:								
hLT-adj	0.5		0.2		0.5		0.5	
hRT-adj	-0.7		-0.6		-0.7		-0.7	
hHV-adj	1.7		1.7		1.7		1.7	
hadj, computed	0.0	-0.7	0.1		0.5	-0.3	0.0	-0.7

Worksheet 4 - Departure Headway and Service Time

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow rate	110	5	180		5	190	140	25
hd, initial value	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20
x, initial	0.10	0.00	0.16		0.00	0.17	0.12	0.02
hd, final value	5.73	4.99	5.67		6.07	5.29	5.61	4.89
x, final value	0.18	0.01	0.28		0.01	0.28	0.22	0.03
Move-up time, m	2.3		2.3		2.3		2.3	
Service Time	3.4	2.7	3.4		3.8	3.0	3.3	2.6

Worksheet 5 - Capacity and Level of Service

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rate	110	5	180		5	190	140	25
Service Time	3.4	2.7	3.4		3.8	3.0	3.3	2.6
Utilization, x	0.18	0.01	0.28		0.01	0.28	0.22	0.03
Dep. headway, hd	5.73	4.99	5.67		6.07	5.29	5.61	4.89
Capacity	360	255	430		255	440	390	275
Delay	9.65	7.72	10.59		8.82	10.02	9.87	7.76
LOS	A	A	B		A	B	A	A
Approach:								
Delay	9.56		10.59		9.99		9.55	
LOS	A		B		A		A	

Intersection Delay 9.97 Intersection LOS A

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ALL-WAY STOP CONTROL(AWSC) ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 11/15/2004
Analysis Time Period: pm
Intersection: 60th/104th
Jurisdiction: Kenosha County
Units: U. S. Customary
Analysis Year: 2004
Project ID: Existing Traffic
East/West Street: 60th street
North/South Street: 104th

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	10	155	15	70	175	25	15	125	85	10	95	25

% Thrus Left Lane

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	LT	R	LTR		L	TR	LT	R
PHF	1.00	1.00	1.00		1.00	1.00	1.00	1.00
Flow Rate	165	15	270		15	210	105	25
% Heavy Veh	0	0	0		0	0	0	0
No. Lanes	2		1		2		2	
Opposing-Lanes	1		2		2		2	
Conflicting-lanes	2		2		2		2	
Geometry group	5		4b		5		5	

Duration, T 0.25 hrs.

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	165	15	270		15	210	105	25
Left-Turn	10	0	70		15	0	10	0
Right-Turn	0	15	25		0	85	0	25
Prop. Left-Turns	0.1	0.0	0.3		1.0	0.0	0.1	0.0
Prop. Right-Turns	0.0	1.0	0.1		0.0	0.4	0.0	1.0
Prop. Heavy Vehicle	0.0	0.0	0.0		0.0	0.0	0.0	0.0
Geometry Group	5		4b		5		5	
Adjustments Exhibit 17-33:								
hLT-adj	0.5		0.2		0.5		0.5	

WISDOT PROJECTIONS

TRAFFIC FORECAST REPORT

PROJECT ID(S): 2350-09-01
ROUTE(S): STH 158

DISTRICT/COUNTY(IES): #2 KENOSHA
LOCATION: IH 94 - CTH H
COMPLETED: November 11, 2004

Traffic Forecasting Section; Bureau of State Highway Programs; Division of Transportation Investment Management

Developed by: Lang Spicer
E-Mail ID: lang.spicer@dot.state.wi.us
Phone: (608) 266-7401
FAX #: (608) 267-0294

Design Values (%'s)

ROUTE(S):	STH 158		
Design Volume(s):			--
K250	9.7	--	--
K100	10.3	--	--
K30	10.9	--	--
P(PHV)	12.3	--	--
T(DHV)	2.6	--	--
T(PHV)	1.5	--	--
D (Dsgn hr)	58/42	--	--
K8(ADT)	--	--	--
T(A8HV)	--	--	--

Truck Class %'s

Truck Class	Seg. 1	Seg 2.	Seg. 3
2D	1.3	--	--
3AX	0.9	--	--
2S1+2S2	0.4	--	--
3-S2	0.5	--	--
DBL-BTM	0.1	--	--
TOTAL	3.3%	--	--

Specify Last Count & Forecast Year:

{000}	2002	AADT
(000)	2007	AADT
-000-	2017	AADT
000	2027	AADT

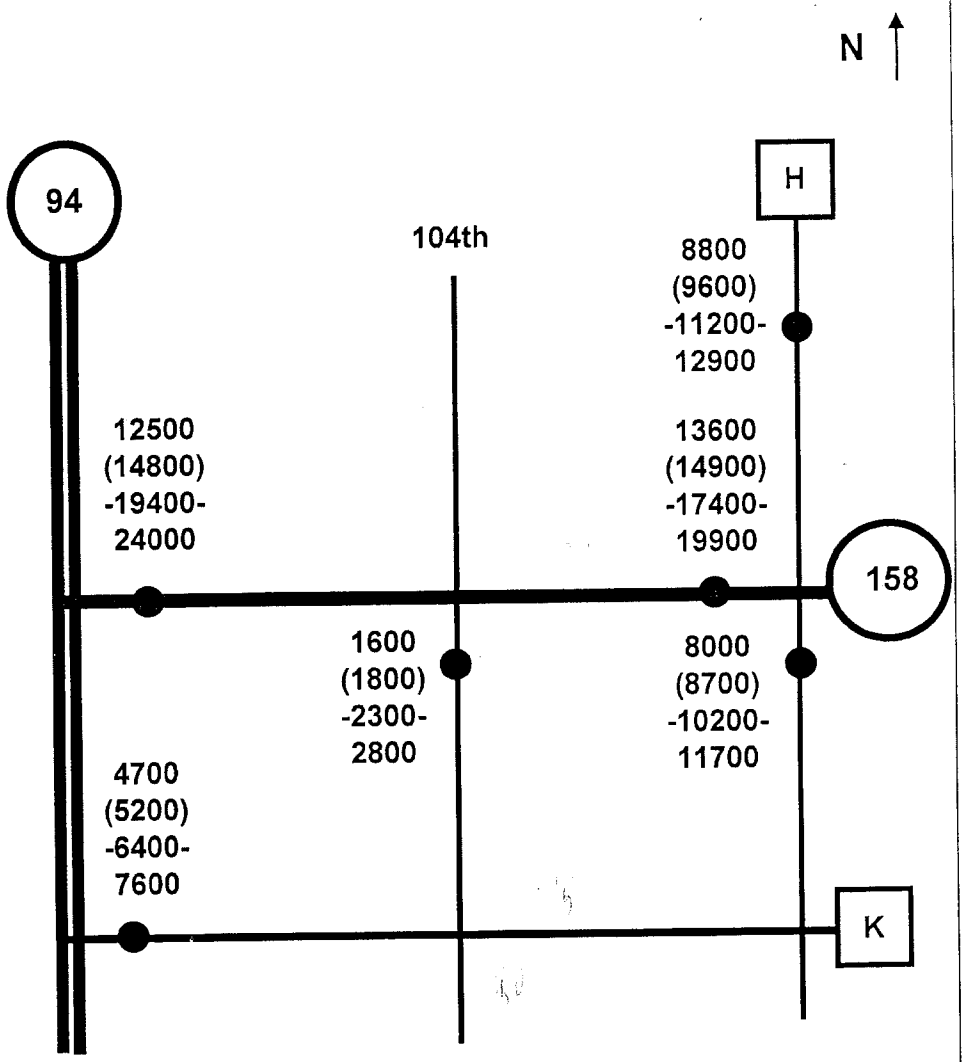
Notes on the Forecast:

1. The forecast assumes no significant new traffic generators will be developed in the area for the foreseeable future. It is considered a BASE or Existing traffic forecast

2. STH 158 is a factor group II highway indicating low to moderate fluctuation in traffic throughout the year. It is considered an urban minor arterial highway for count purposes at this location.

3. Truck type percentages were obtained from formulas based upon similar type highways throughout the state.

4. 2002 was the most recent year traffic count data was collected at this location.



● = Available mainline volumes

Base Forecast

WisDot Bureau of State Highway Programs
Traffic Forecasting Section
Developed by Lang Spicer
Phone: (608) 266-7401
Email: lang.spicer@dot.state.wi.us

Projected AM Design Hour Traffic Volumes

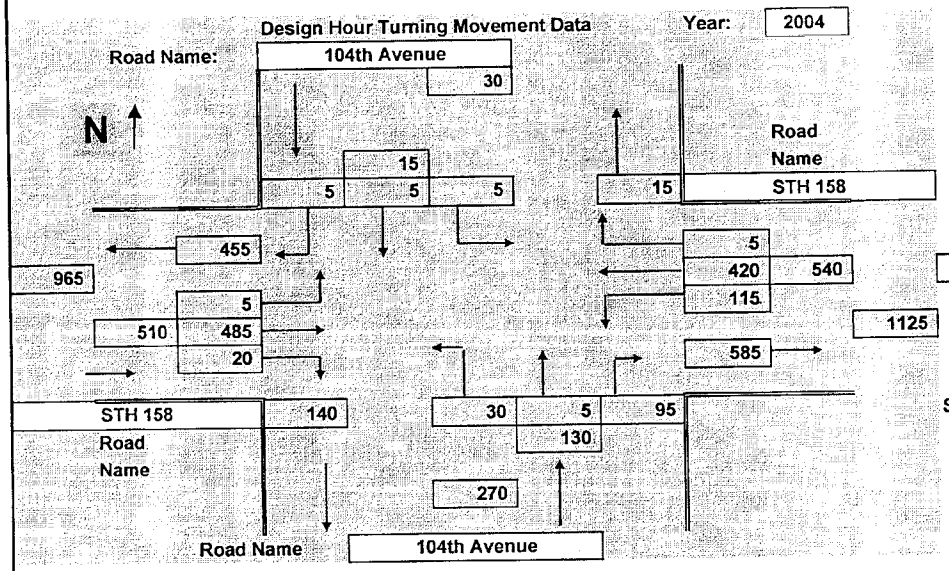
Design Hour: Weekday AM

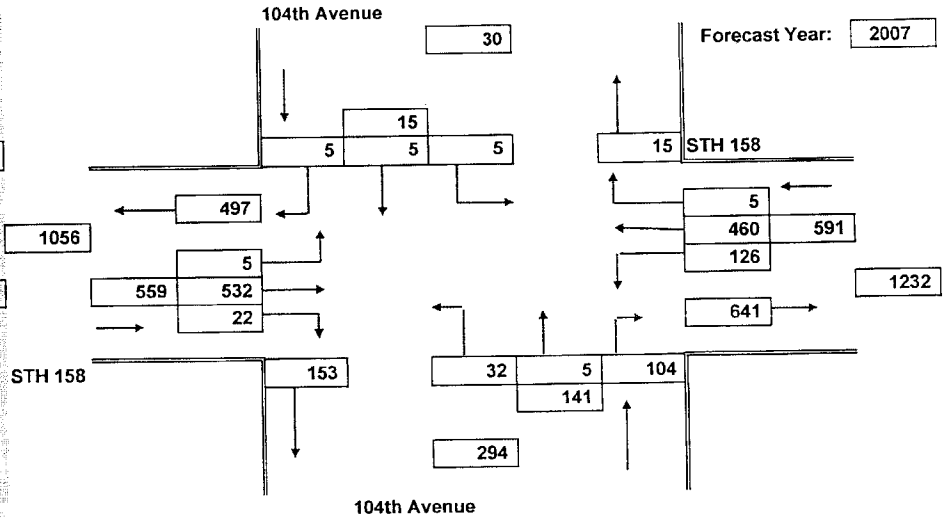
Forecast Completed: 12/16/04

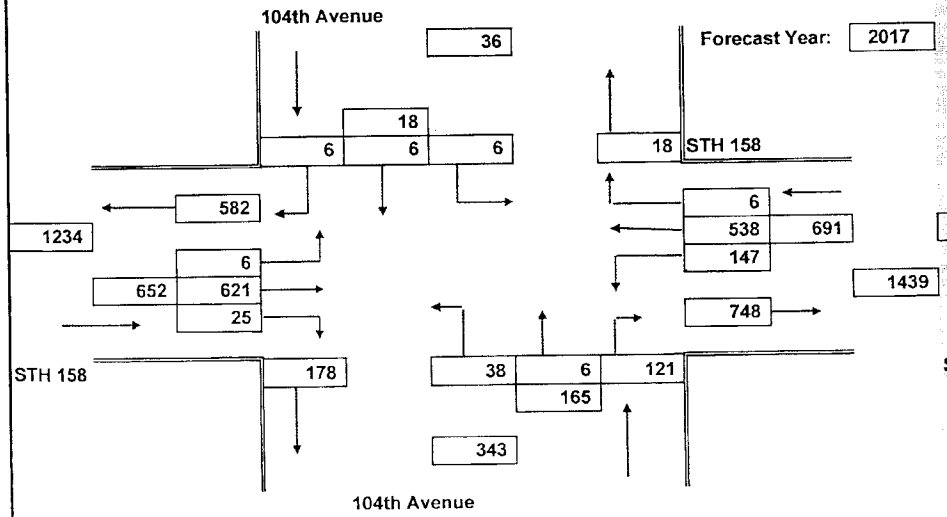
Project Description

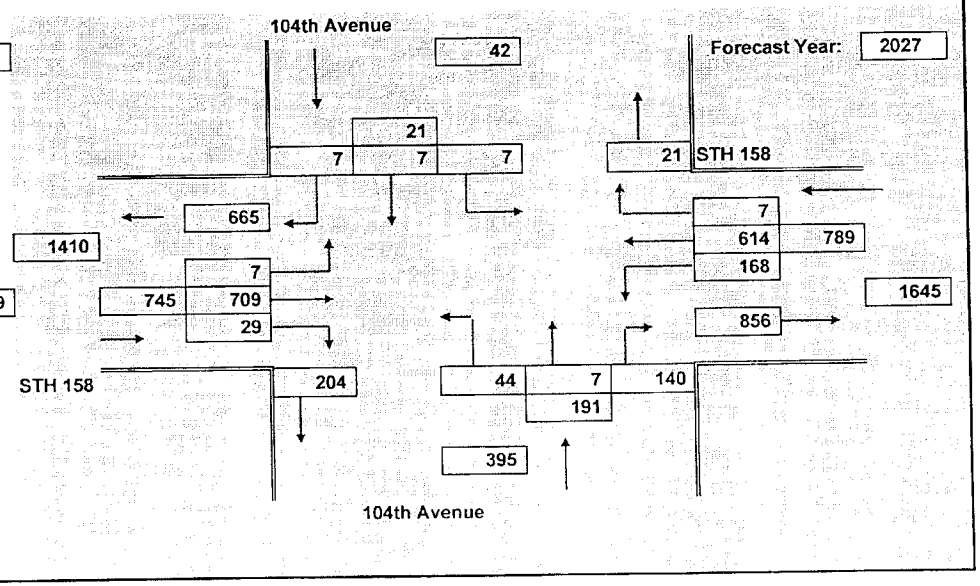
Project ID: N/A
Location: 104th Avenue Intersection

Route: STH 158
County: Kenosha









WisDot Bureau of State Highway Programs
Traffic Forecasting Section
Developed by Lang Spicer
Phone: (608) 266-7401
Email: lang.spicer@dot.state.wi.us

Projected PM Design Hour Traffic Volumes

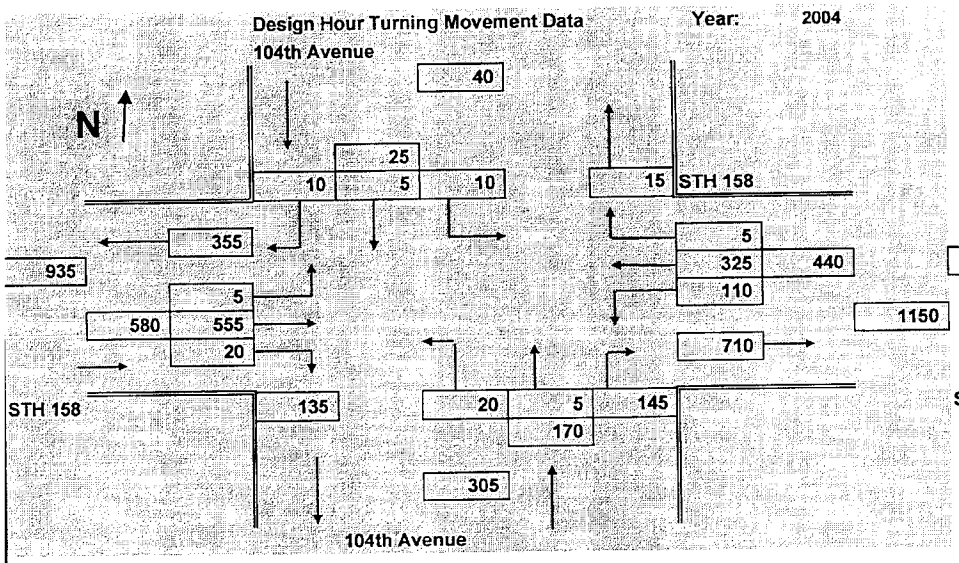
Design Hour: Weekday PM

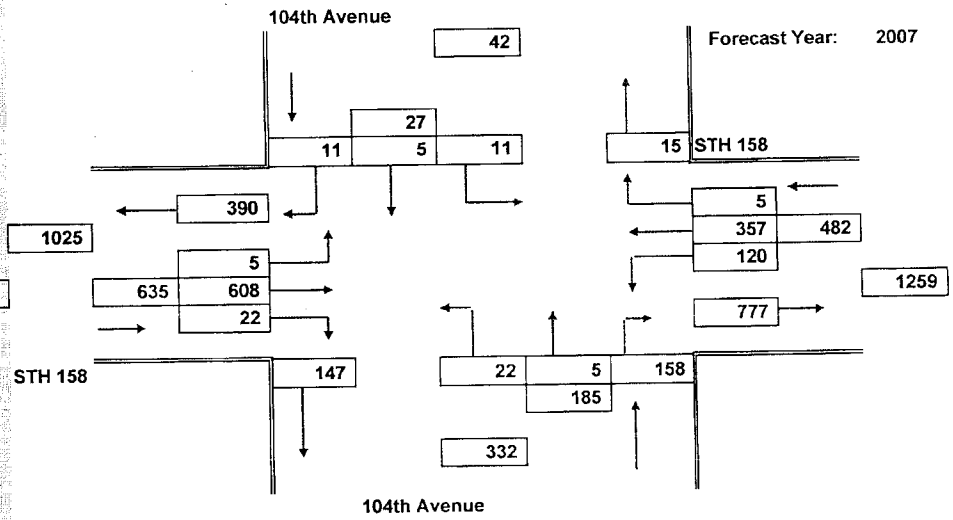
Forecast Completed: 12/16/04

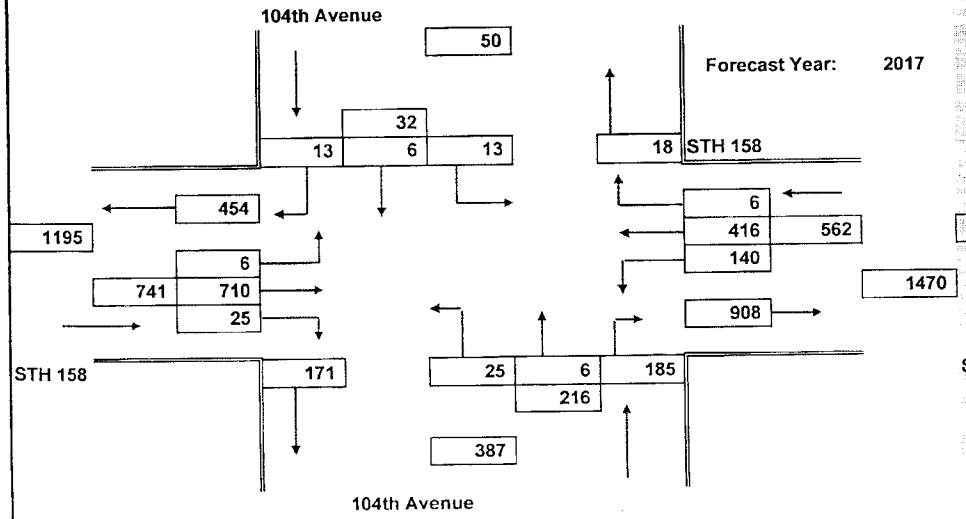
Project Description

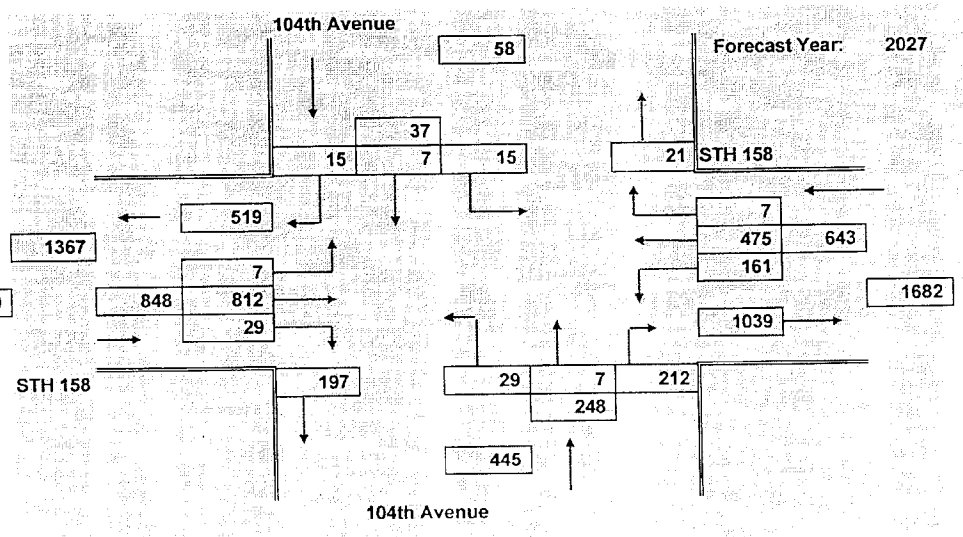
Project ID: N/A
Location: 104th Avenue Intersection

Route: STH 158
County: Kenosha









WisDot Bureau of State Highway Programs
Traffic Forecasting Section
Developed by Lang Spicer
Phone: (608) 266-7401
Email: lang.spicer@dot.state.wi.us

Projected AM Design Hour Traffic Volumes

Design Hour: Weekday AM

Forecast Completed: 12/16/04

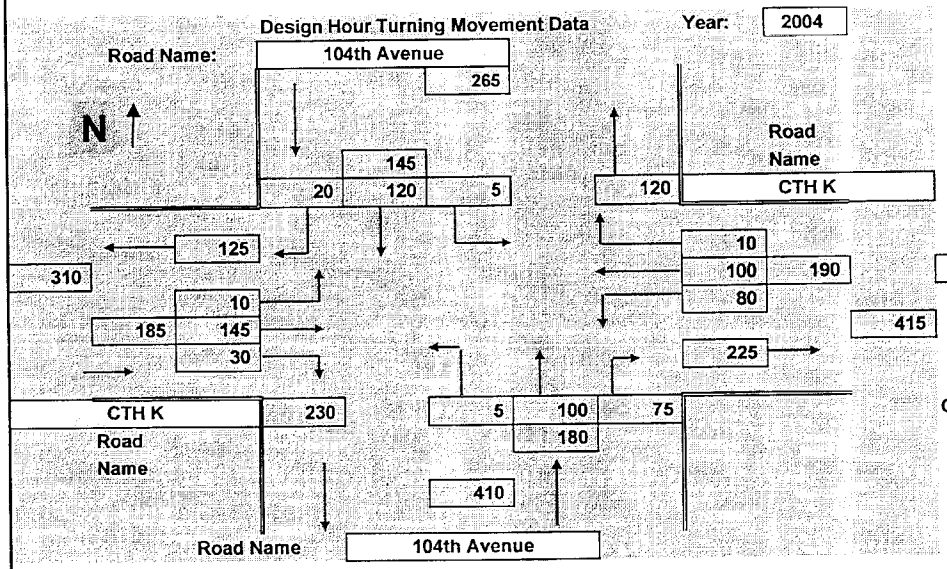
Project Description

Project ID: N/A
Location: CTH K

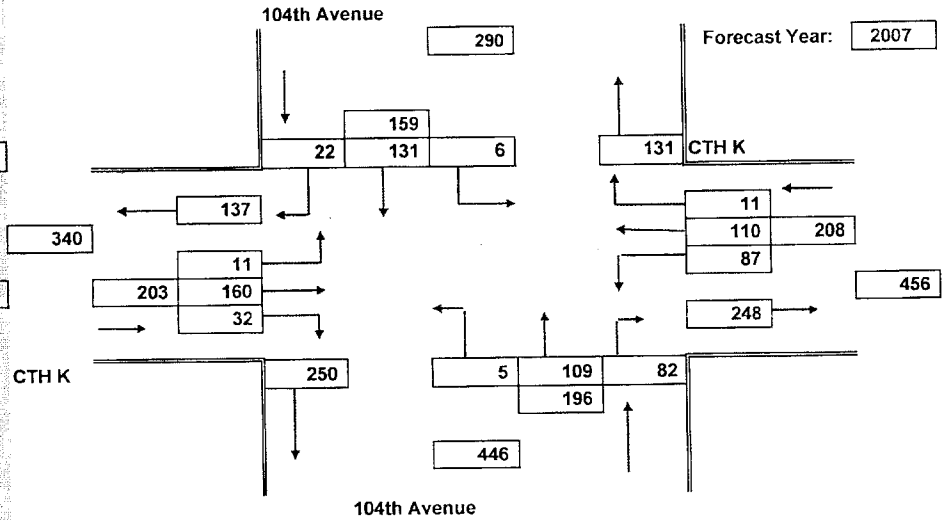
Route: 104th Avenue
County: Kenosha

Design Hour Turning Movement Data

Year: 2004



Forecast Year: 2007



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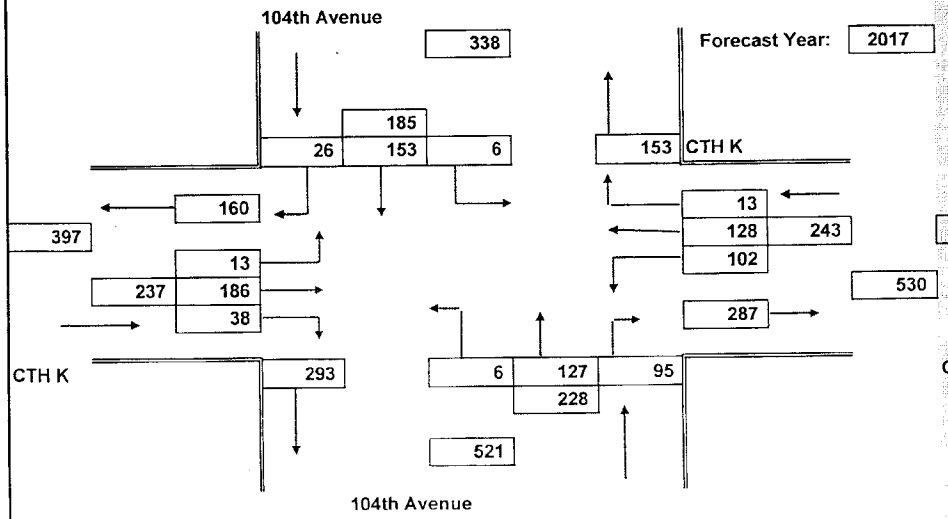
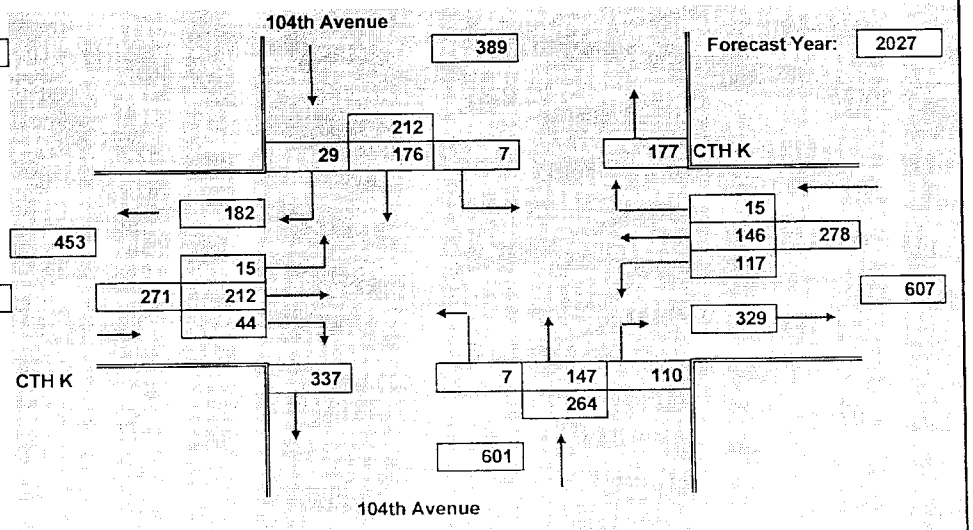


Forecast Year: 2027



WisDot Bureau of State Highway Programs
Traffic Forecasting Section
Developed by Lang Spicer
Phone: (608) 266-7401
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Projected PM Design Hour Traffic Volumes

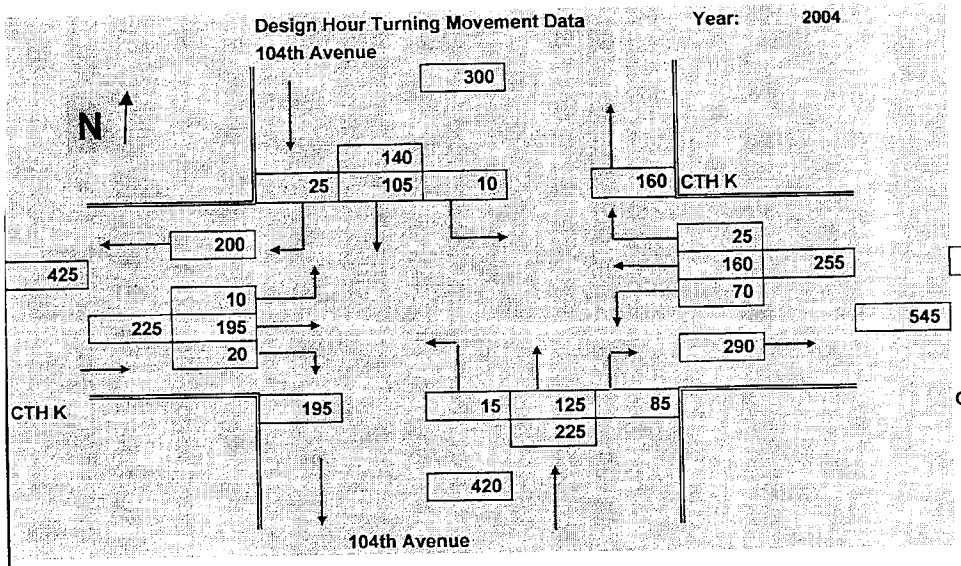
Design Hour: Weekday PM

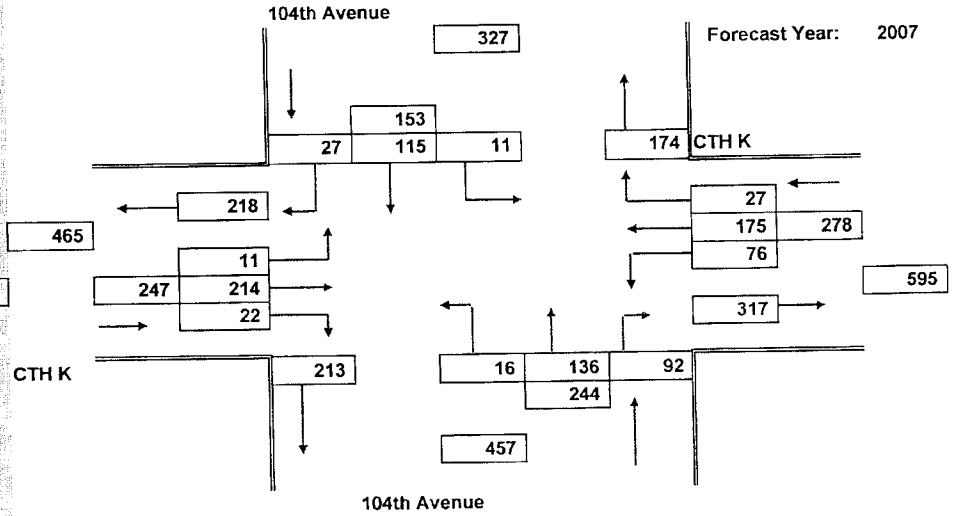
Forecast Completed: 12/16/04

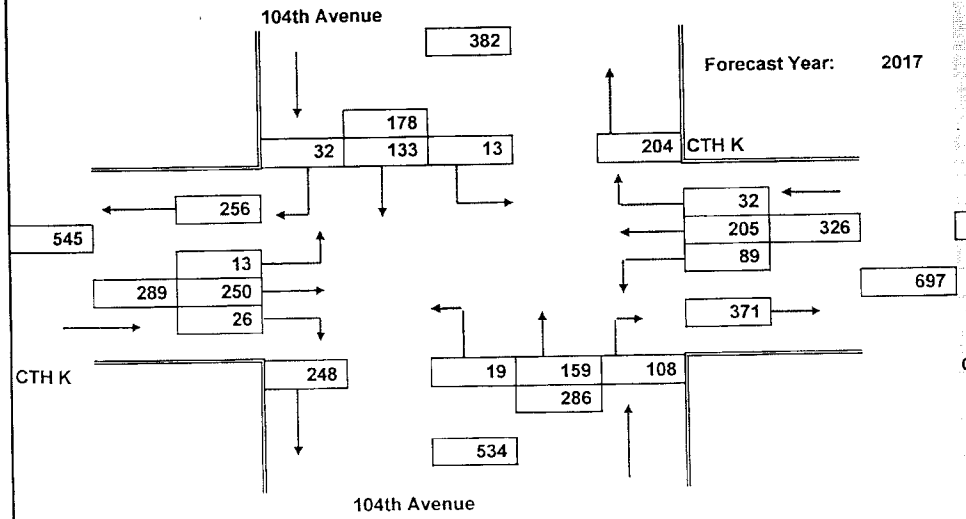
Project Description

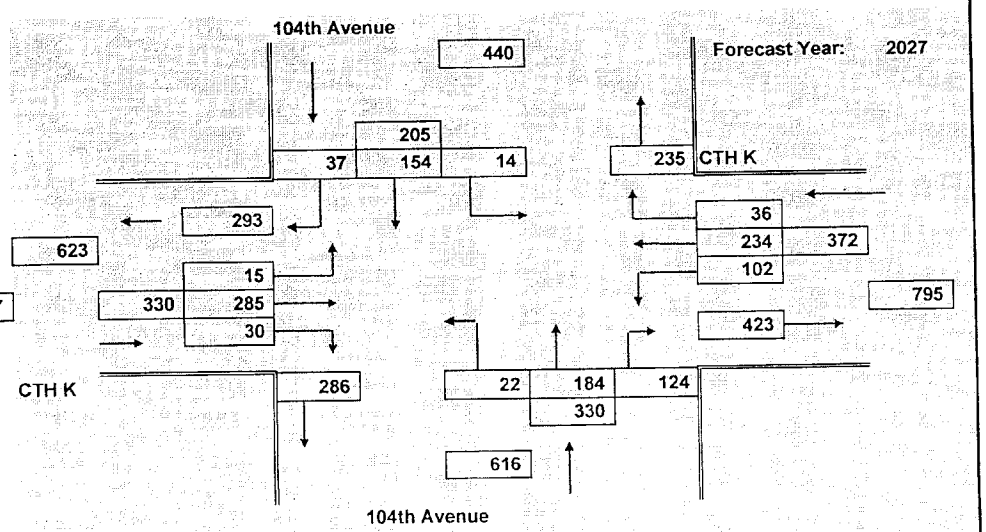
Project ID: N/A
Location: CTH K

Route: 104th Avenue
County: Kenosha









WisDot Bureau of State Highway Programs
Traffic Forecasting Section
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Projected AM Design Hour Traffic Volumes

Design Hour: Weekday AM

Forecast Completed: 12/16/04

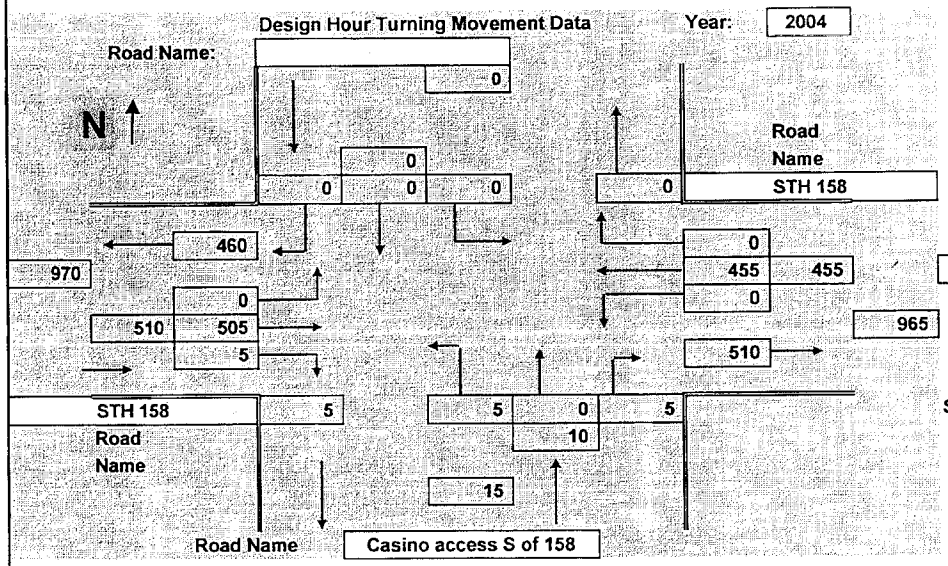
Project Description

Project ID: N/A
Location: Casino access S of STH 158

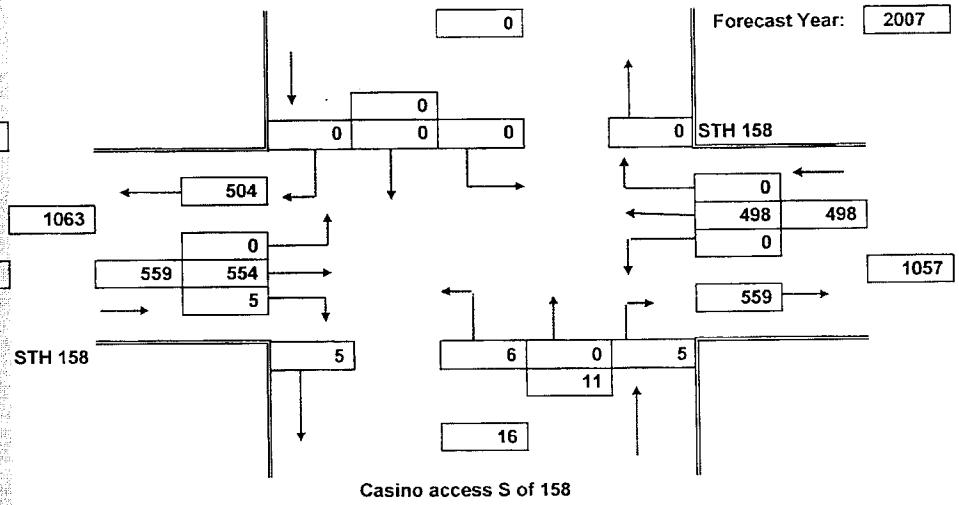
Route: STH 158
County: Kenosha

Design Hour Turning Movement Data

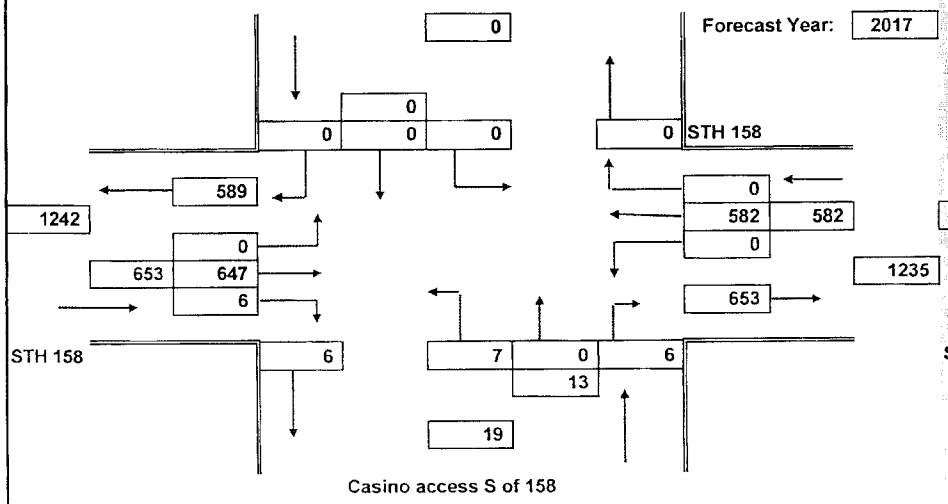
Year: 2004



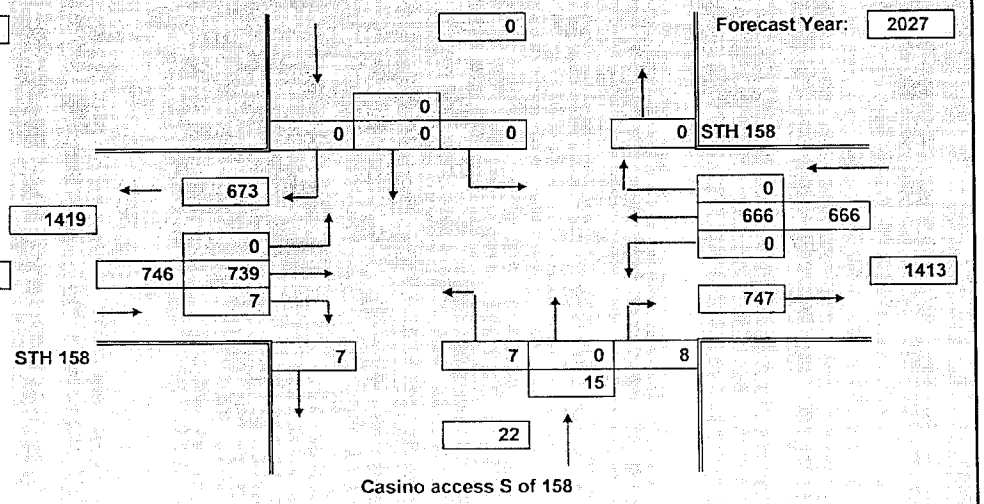
Forecast Year: 2007



Forecast Year: 2017



Forecast Year: 2027



WisDot Bureau of State Highway Programs
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Projected PM Design Hour Traffic Volumes

Design Hour: Weekday PM

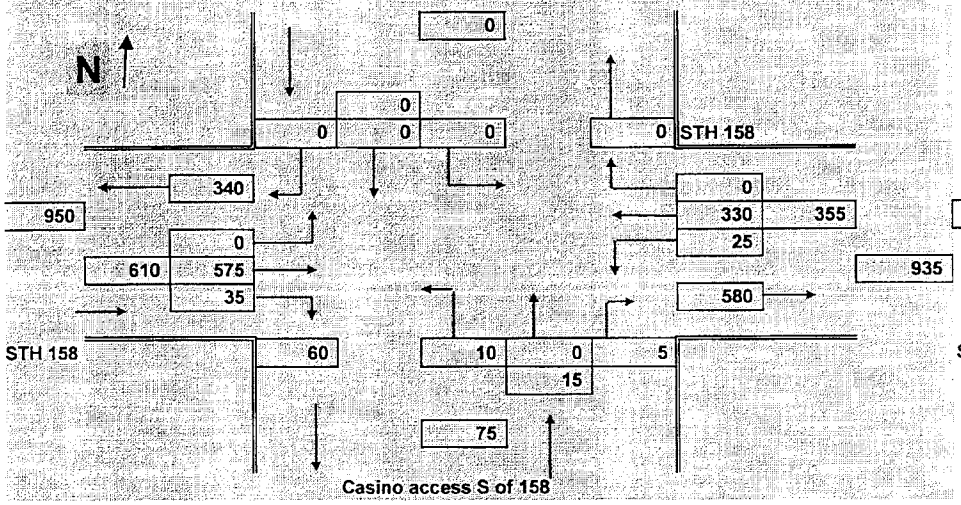
Forecast Completed: 12/16/04

Project Description

Project ID: N/A
Location: Casino access S of STH 158

Route: STH 158
County: Kenosha

Design Hour Turning Movement Data — Year: 2004



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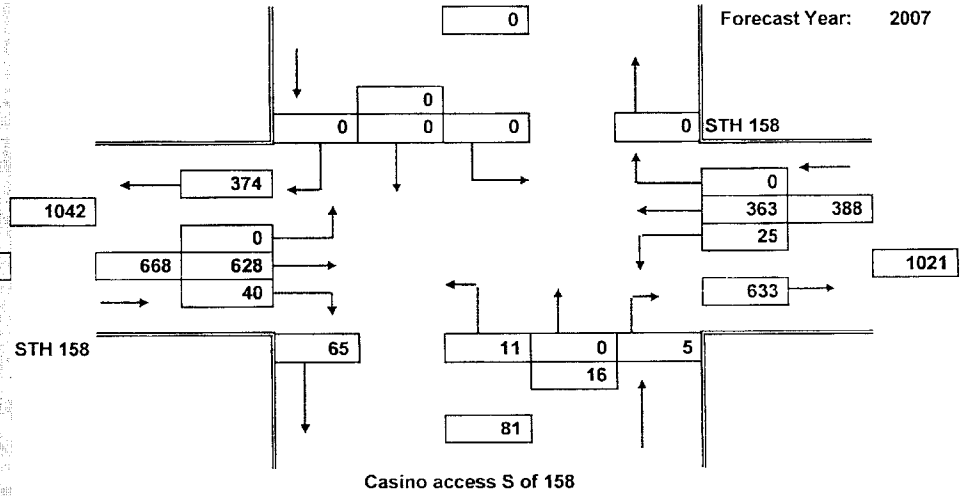

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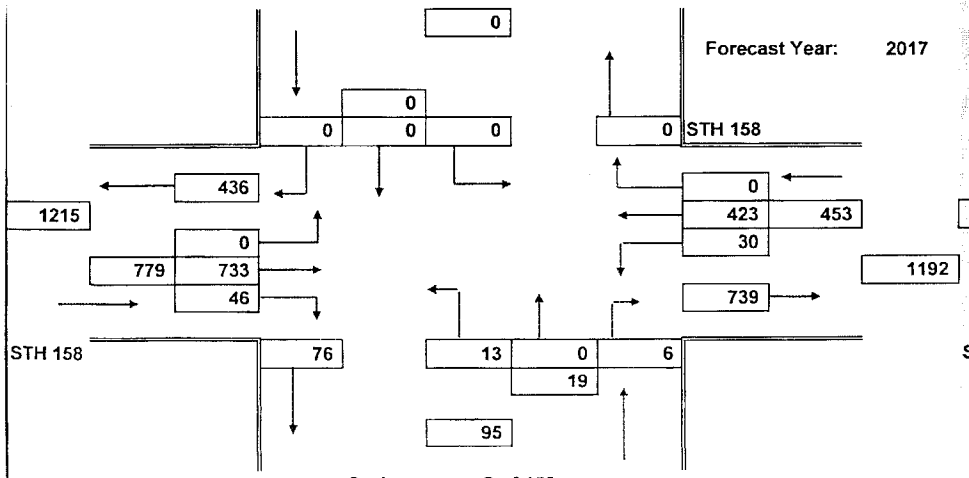
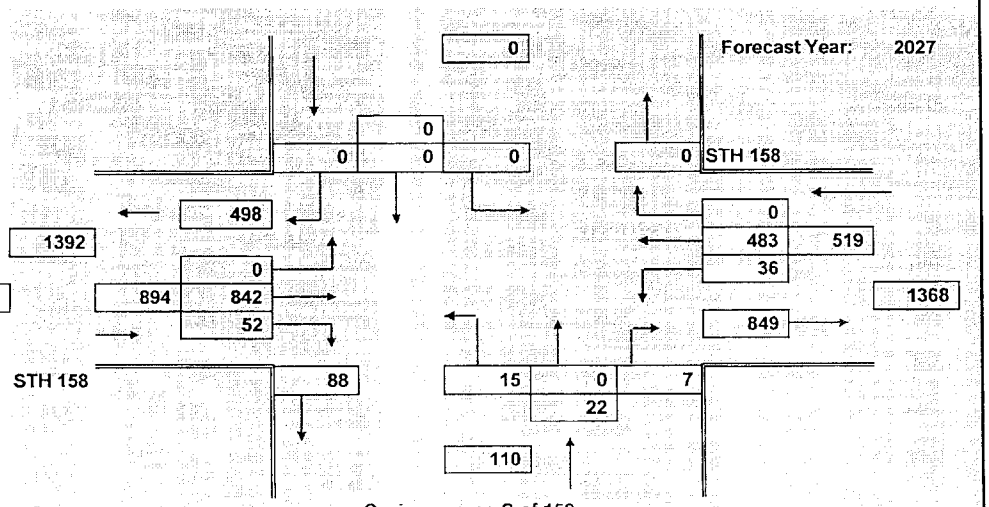


Forecast Year: 2027



WisDot Bureau of State Highway Programs
Traffic Forecasting Section
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Projected AM Design Hour Traffic Volumes

Design Hour: Weekday AM

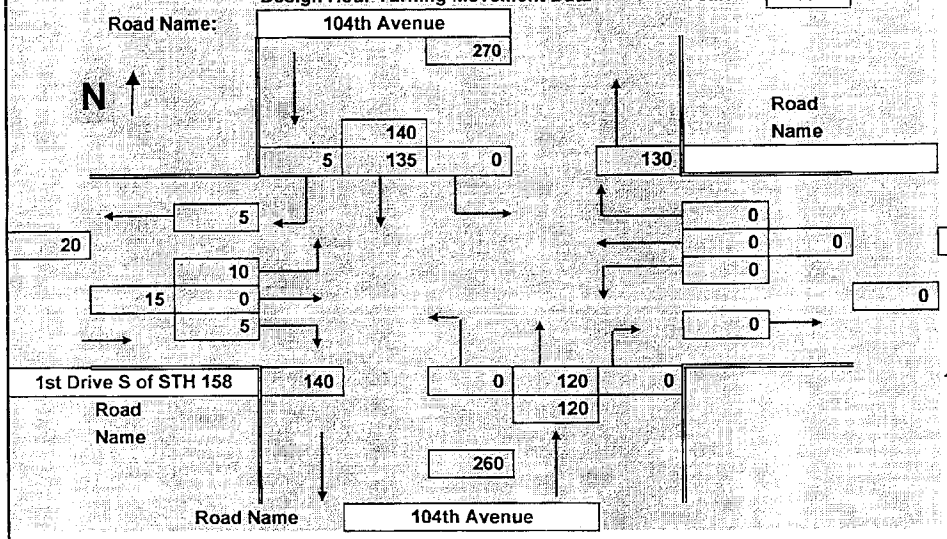
Forecast Completed: 12/16/04

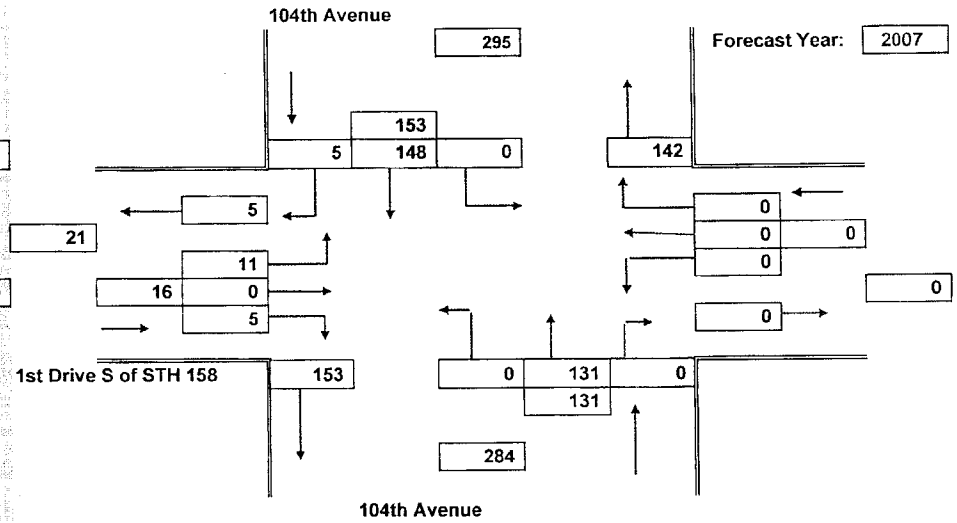
Project Description

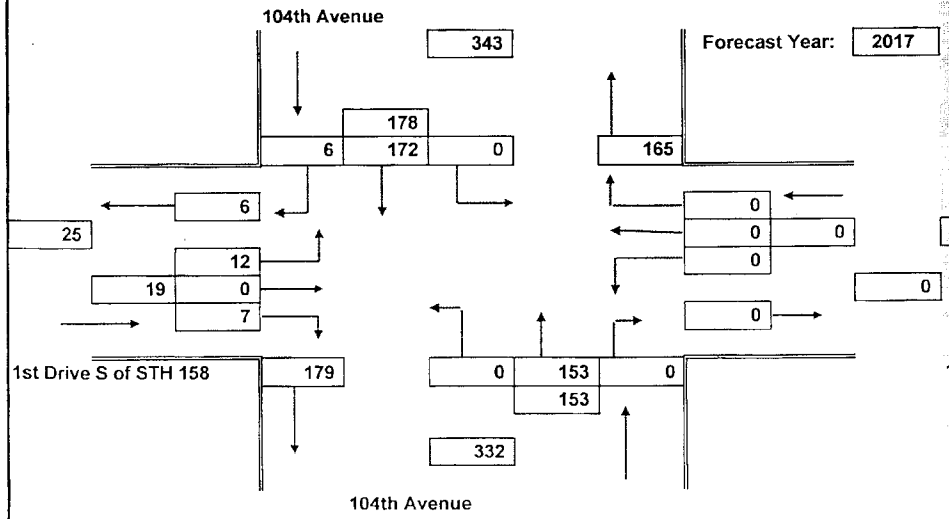
Project ID: N/A
Location: 1st Drive S of STH 158

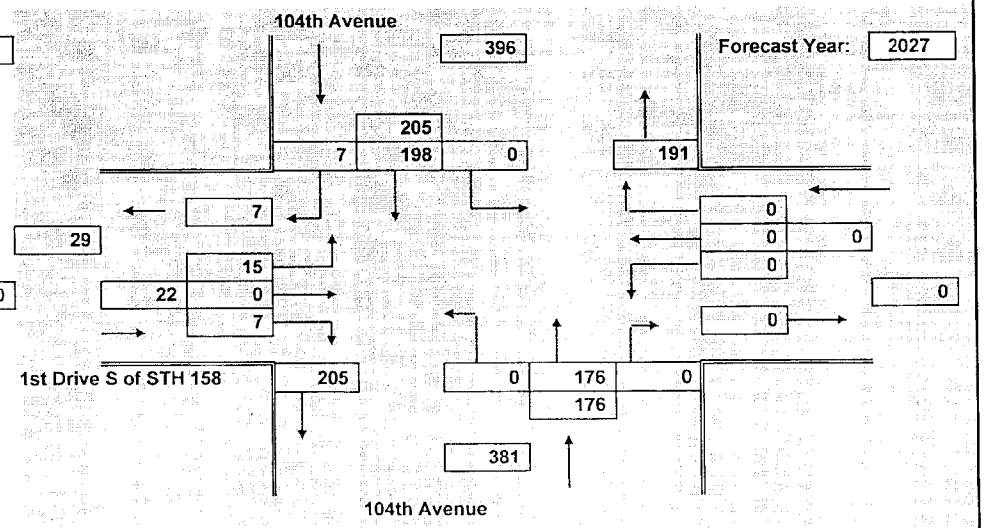
Route: 104th Avenue
County: Kenosha

Design Hour Turning Movement Data — Year: 2004









WisDot Bureau of State Highway Programs
Traffic Forecasting Section
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Projected PM Design Hour Traffic Volumes

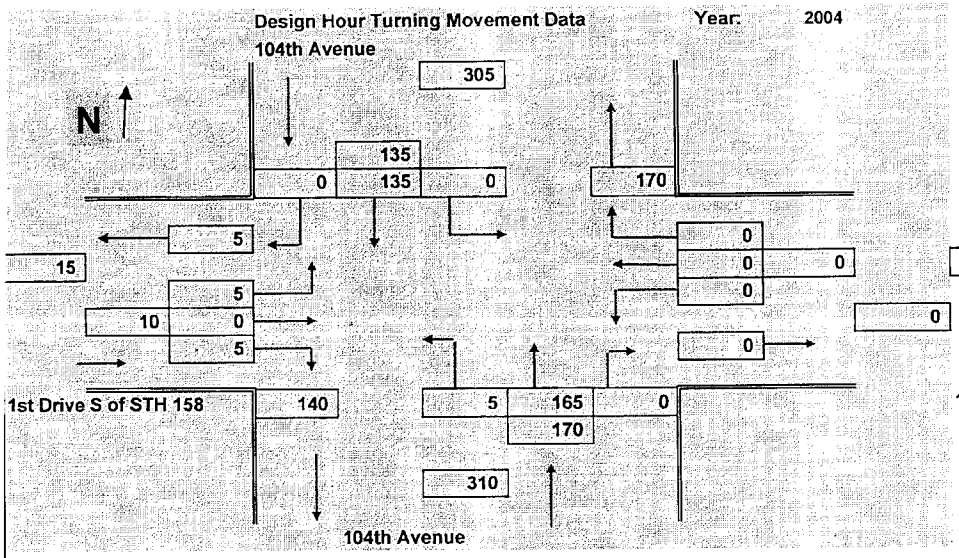
Design Hour: Weekday PM

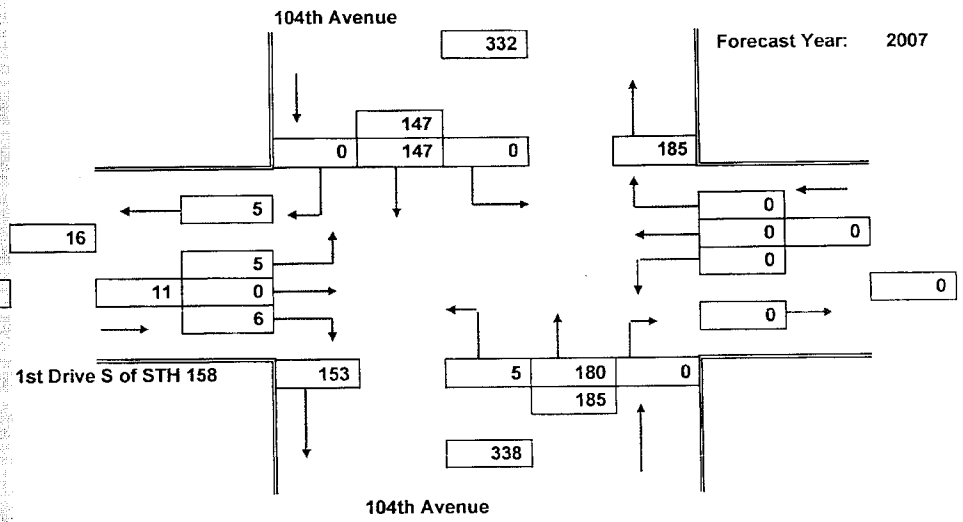
Forecast Completed: 12/16/04

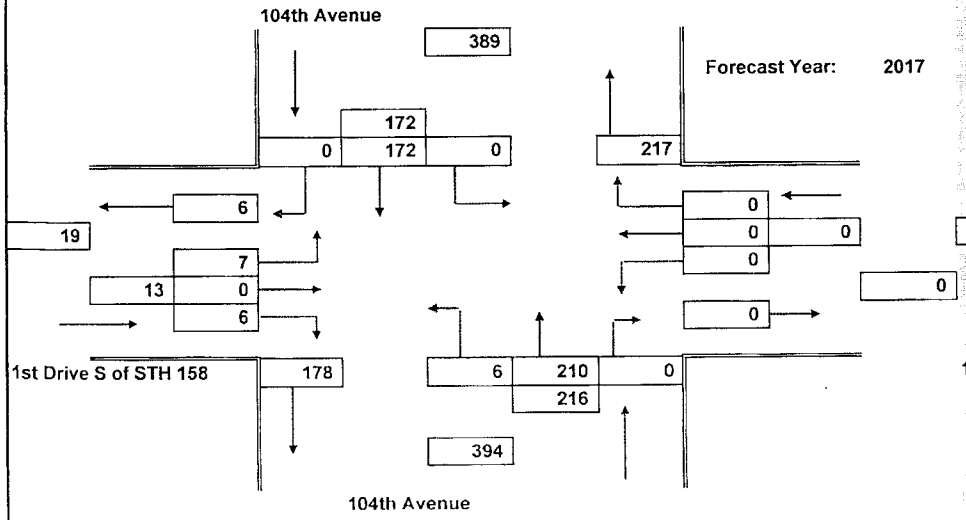
Project Description

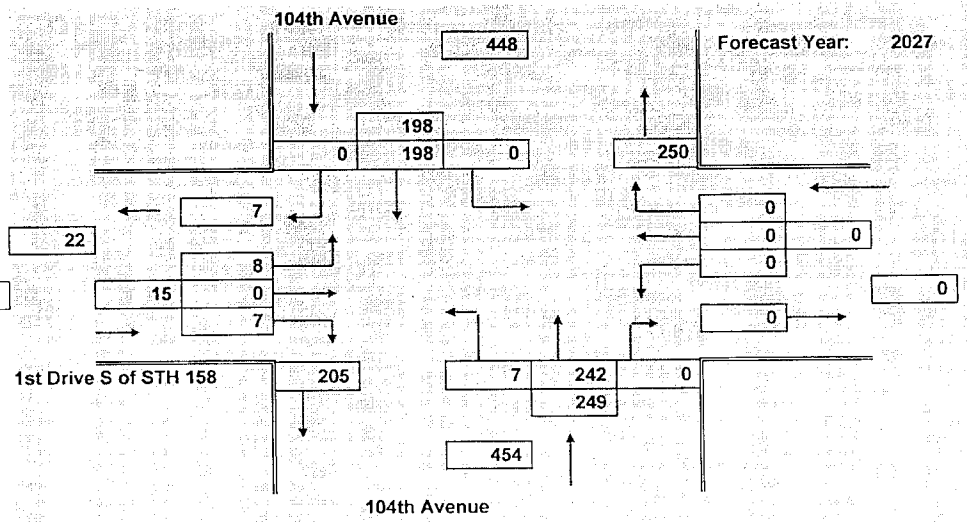
Project ID: N/A
Location: 1st Drive S of STH 158

Route: 104th Avenue
County: Kenosha









WisDot Bureau of State Highway Programs
Traffic Forecasting Section
Developed by Lang Spicer
Phone: (608) 266-7401
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Projected AM Design Hour Traffic Volumes

Design Hour: Weekday AM

Forecast Completed: 12/16/04

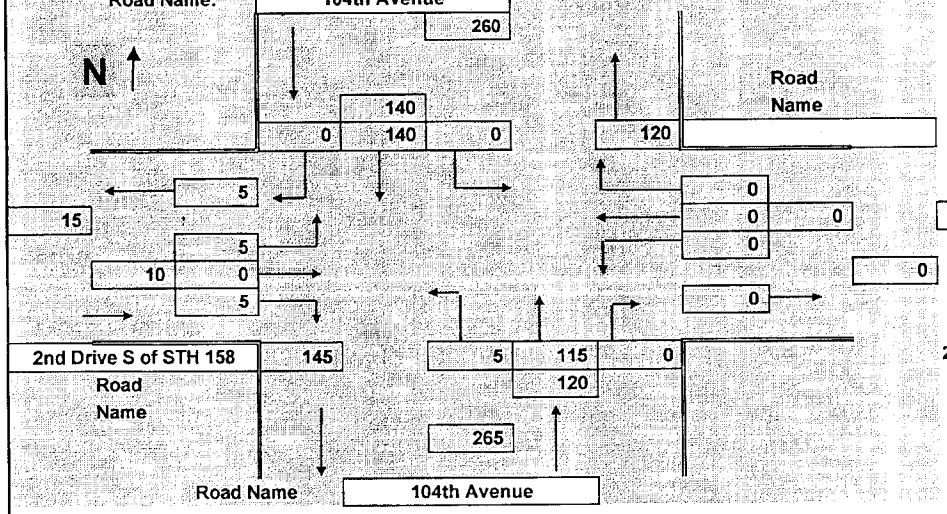
Project Description

Project ID: N/A
Location: 2nd Drive S of STH 158

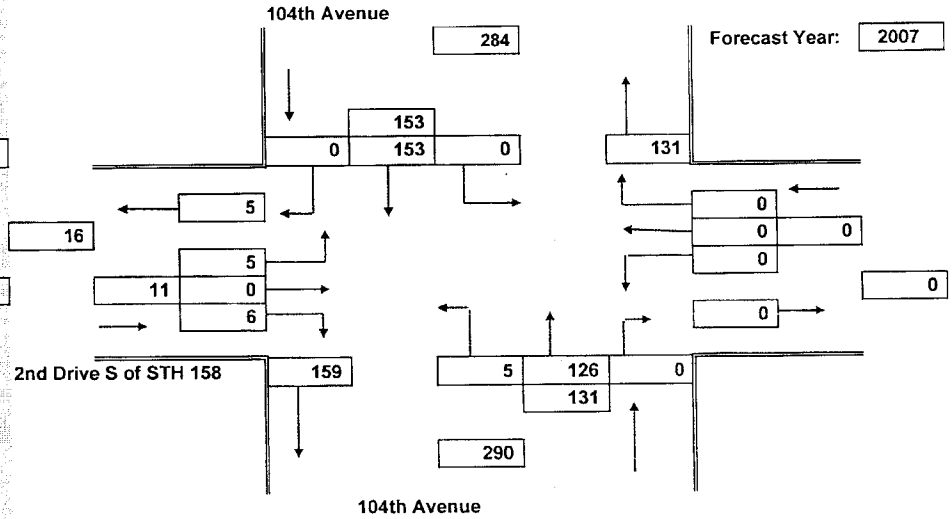
Route: 104th Avenue
County: Kenosha

Design Hour Turning Movement Data — Year: 2004

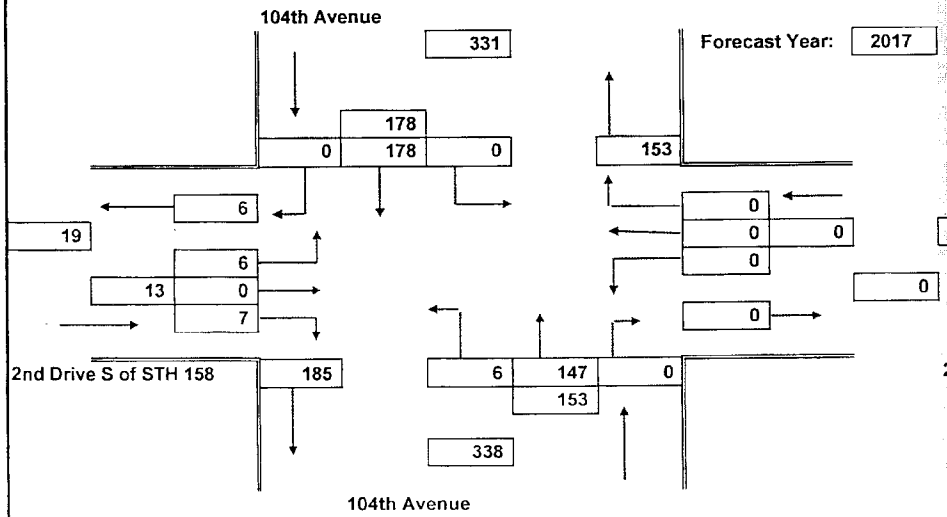
Road Name: 104th Avenue



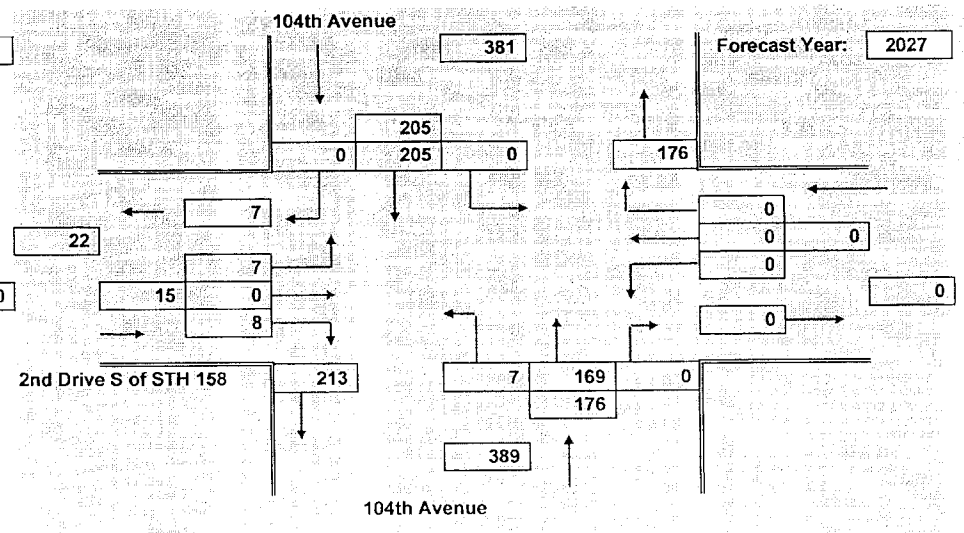
Forecast Year: 2007



Forecast Year: 2017



Forecast Year: 2027



WisDot Bureau of State Highway Programs
Traffic Forecasting Section
Developed by Lang Spicer
Phone: (608) 266-7401
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Projected PM Design Hour Traffic Volumes

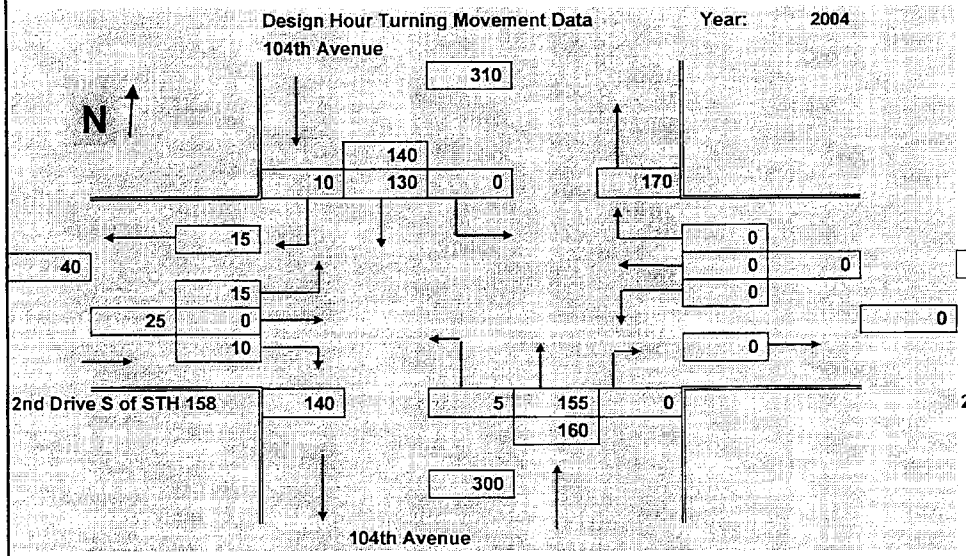
Design Hour: Weekday PM

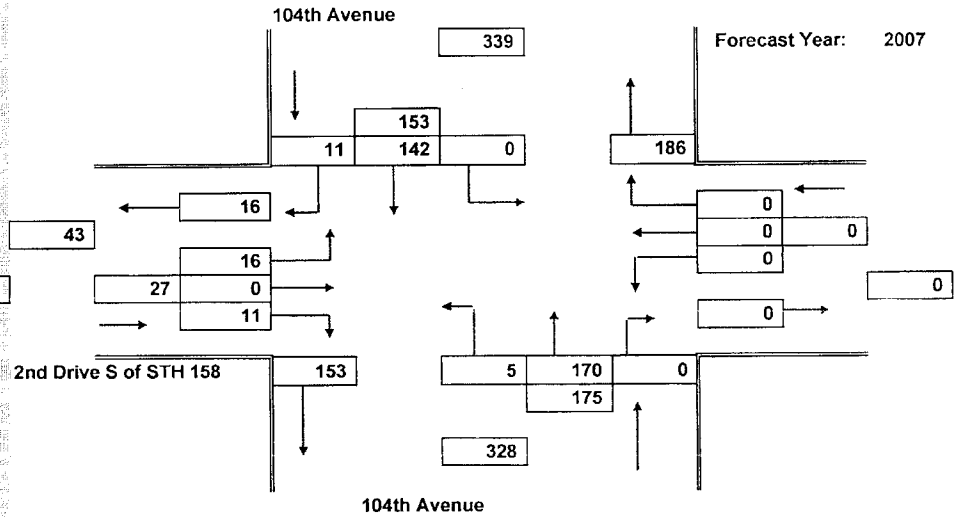
Forecast Completed: 12/16/04

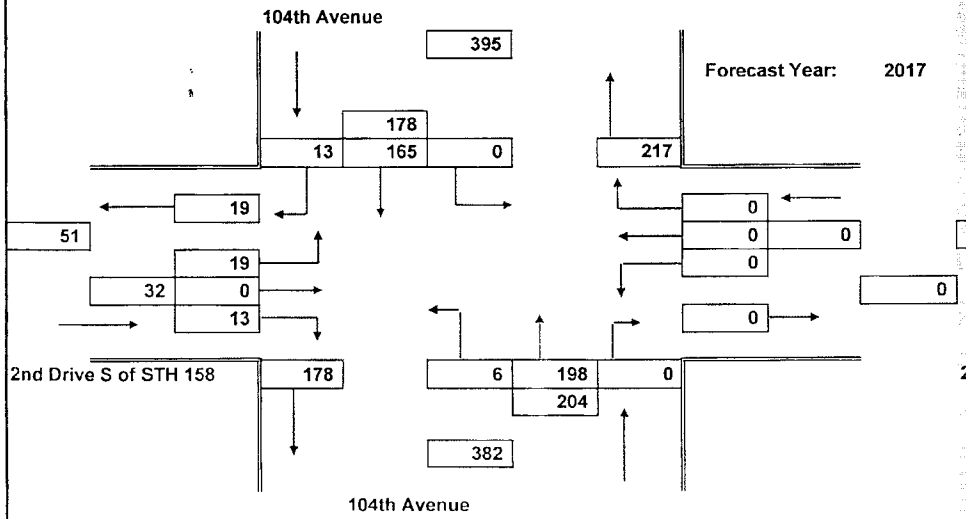
Project Description

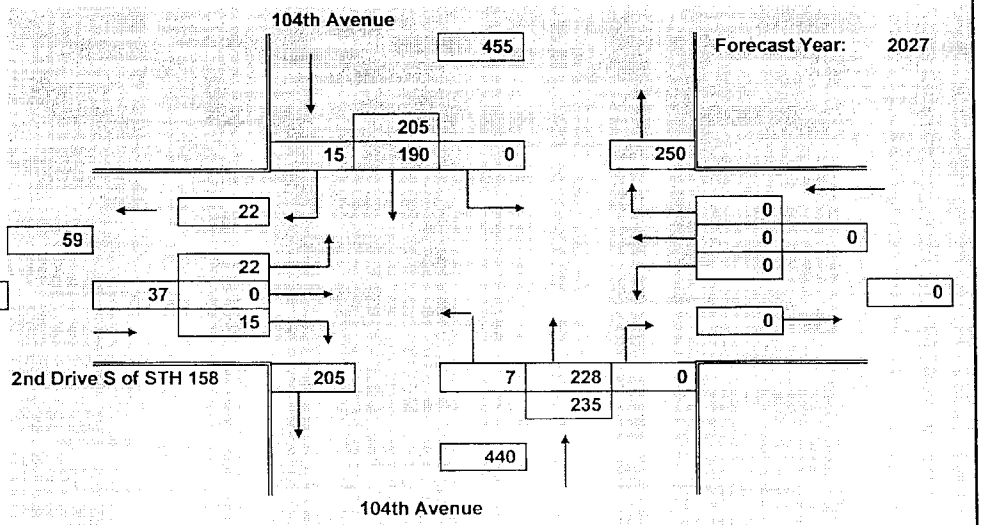
Project ID: N/A
Location: 2nd Drive S of STH 158

Route: 104th Avenue
County: Kenosha









WisDot Bureau of State Highway Programs
Traffic Forecasting Section
Developed by Lang Spicer
Phone: (608) 266-7401
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Projected AM Design Hour Traffic Volumes

Design Hour: Weekday AM

Forecast Completed: 12/16/04

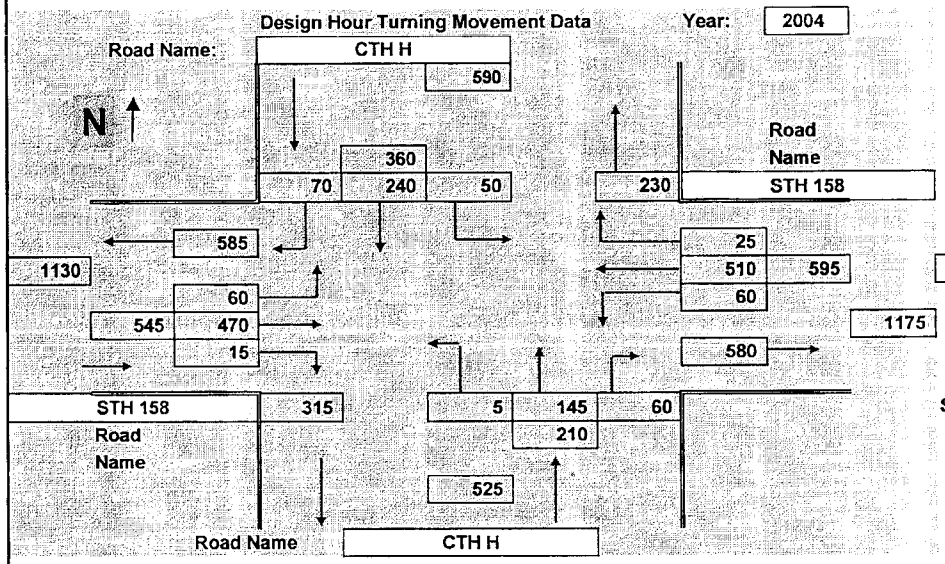
Project Description

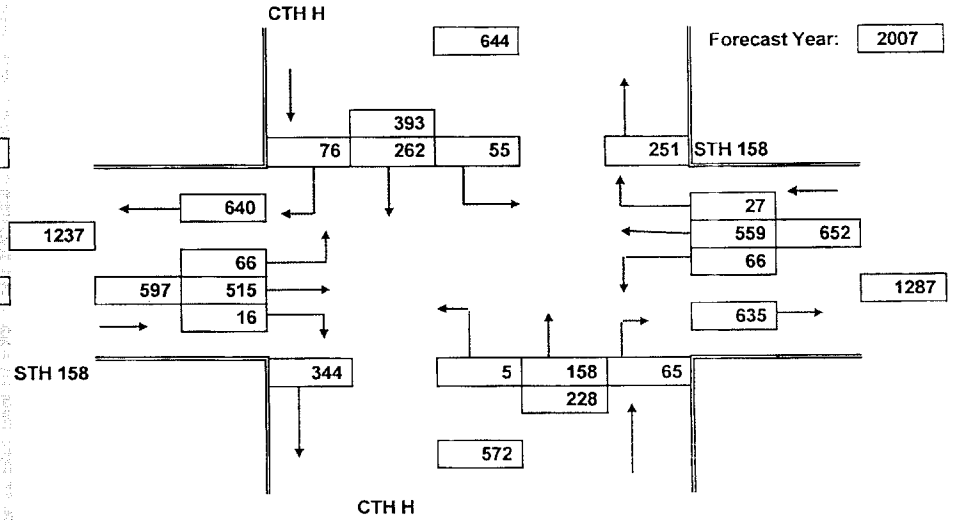
Project ID: N/A
Location: CTH H Intersection

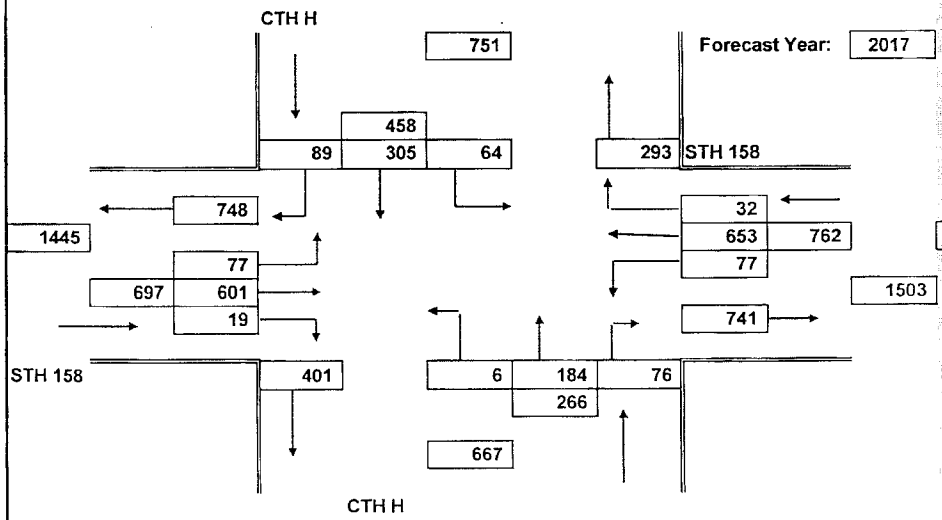
Route: STH 158
County: Kenosha

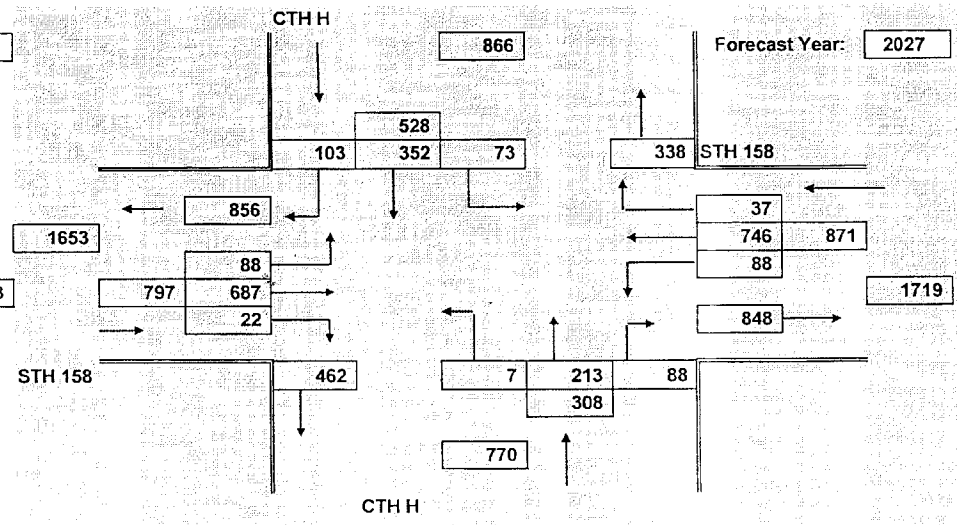
Design Hour Turning Movement Data

Year: 2004









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Projected PM Design Hour Traffic Volumes

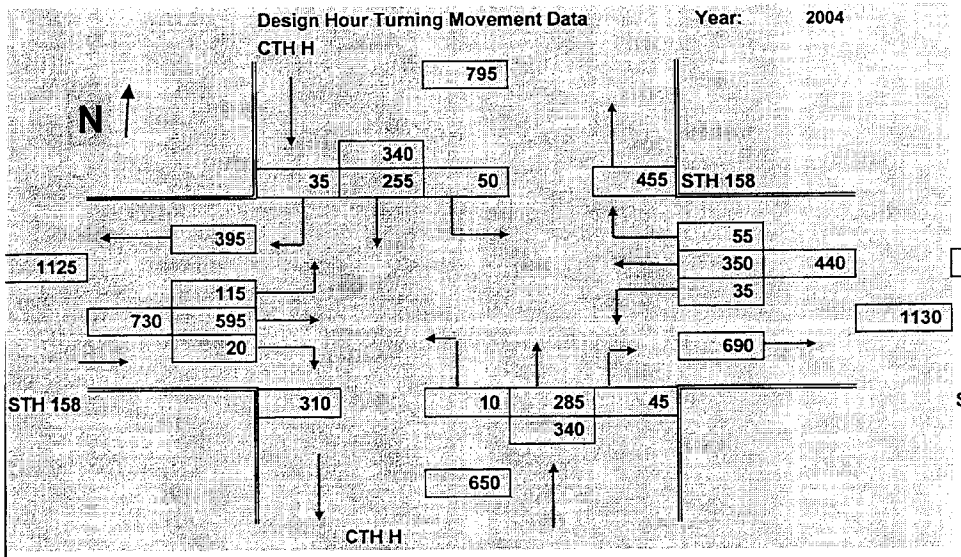
Design Hour: Weekday PM

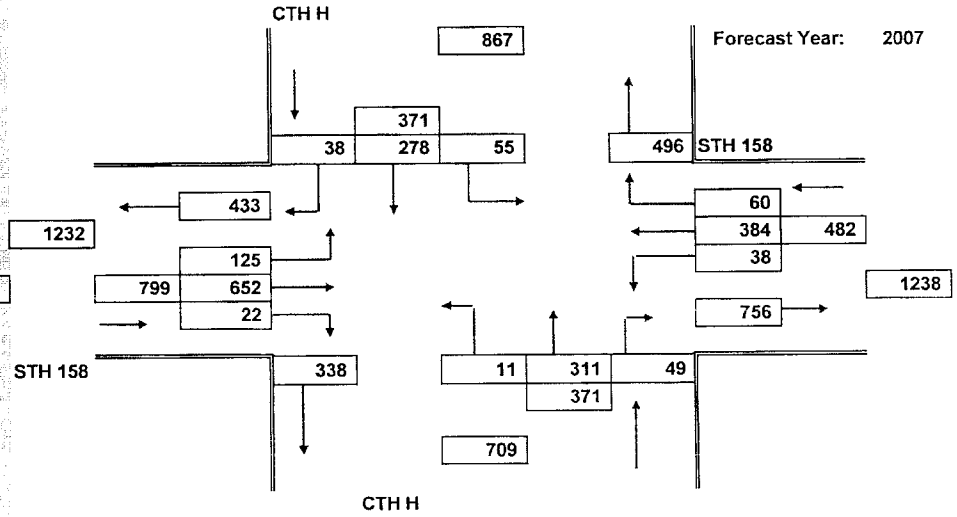
Forecast Completed: 12/16/04

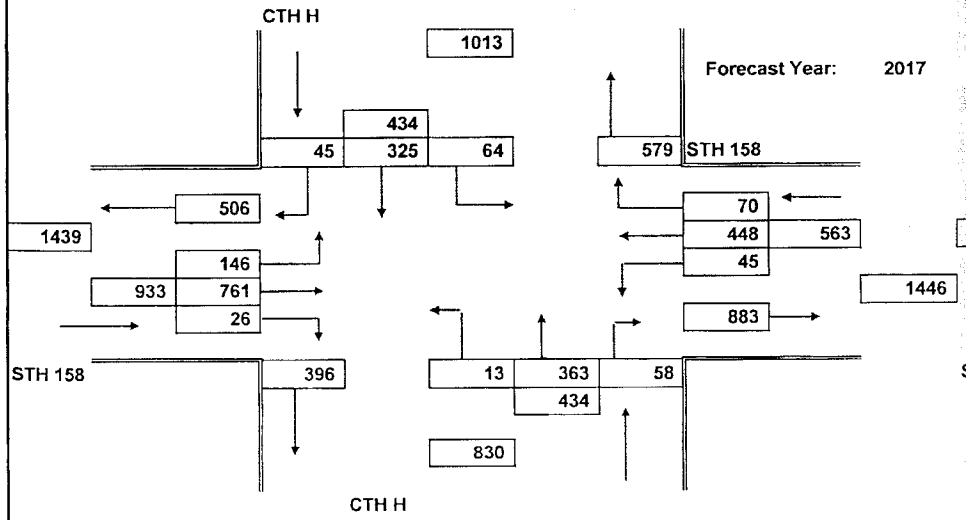
Project Description

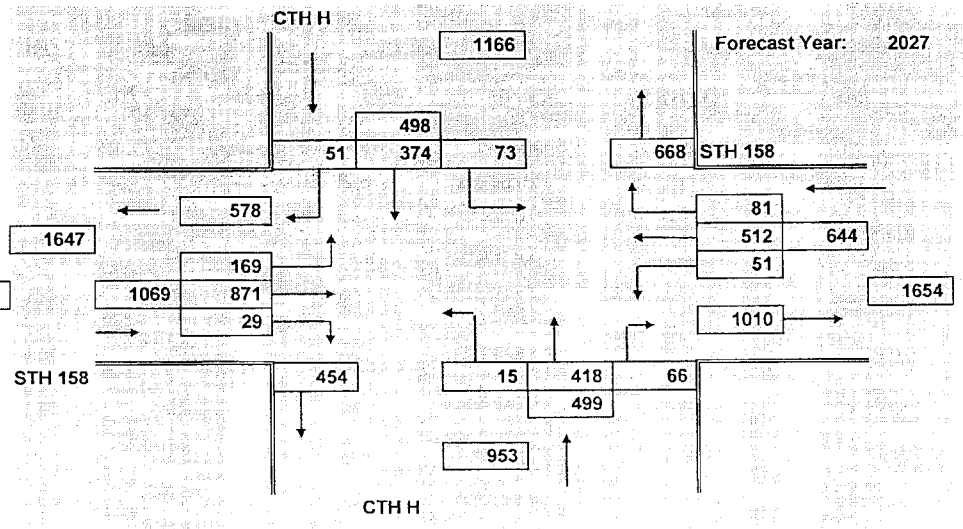
Project ID: N/A
Location: CTH H Intersection

Route: STH 158
County: Kenosha









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Projected AM Design Hour Traffic Volumes

Design Hour: Weekday AM

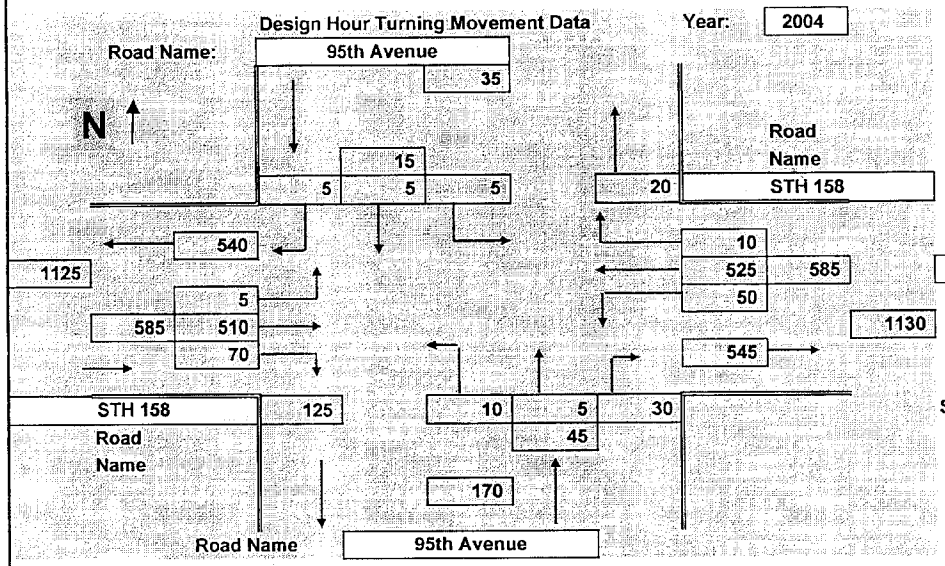
Forecast Completed: 12/16/04

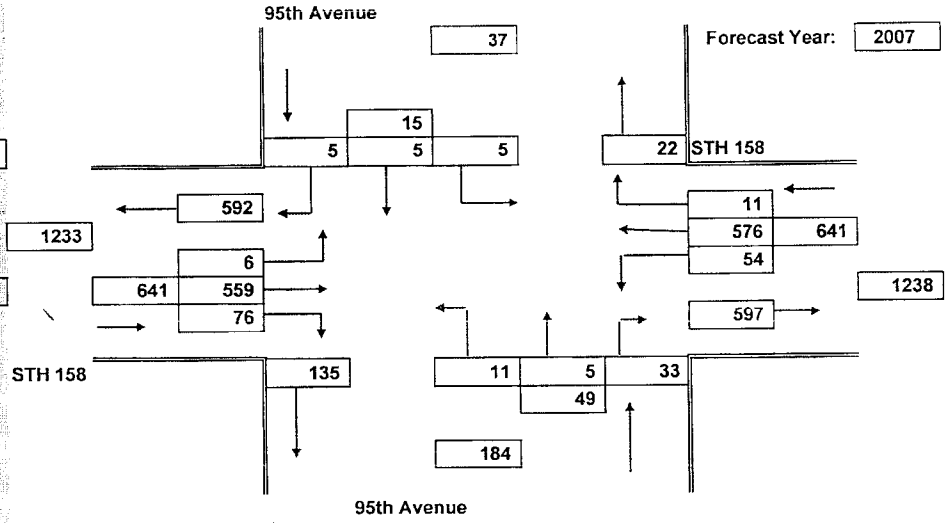
Project Description

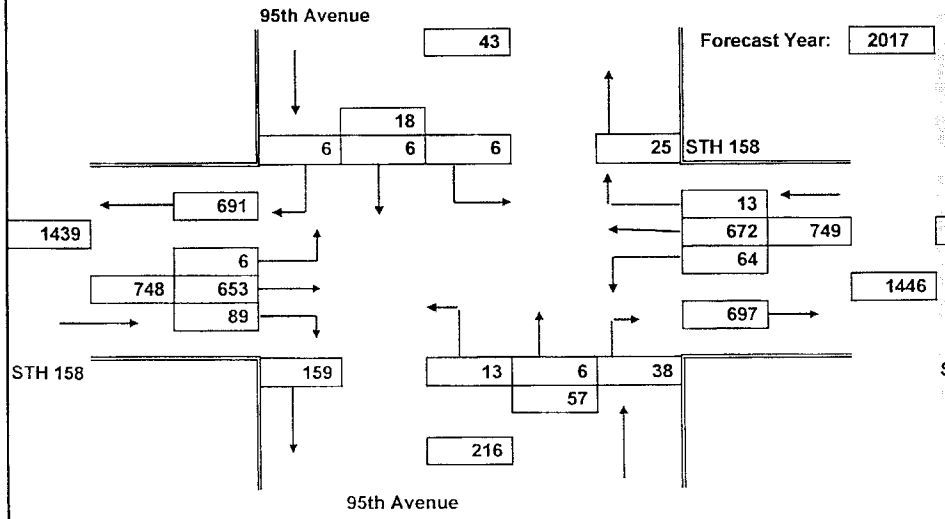
Project ID: N/A
Location: 95th Avenue Intersection

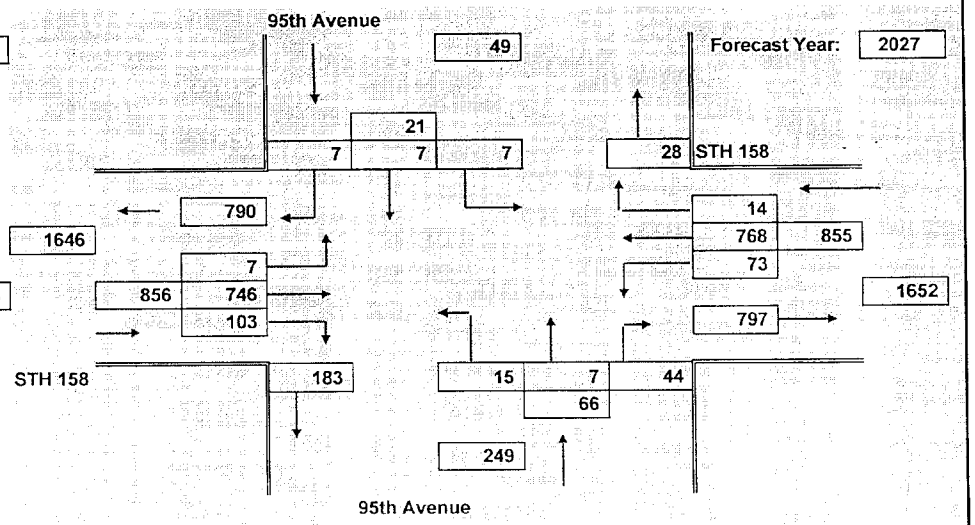
Route: STH 158
County: Kenosha

Design Hour Turning Movement Data — Year: 2004









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Projected PM Design Hour Traffic Volumes

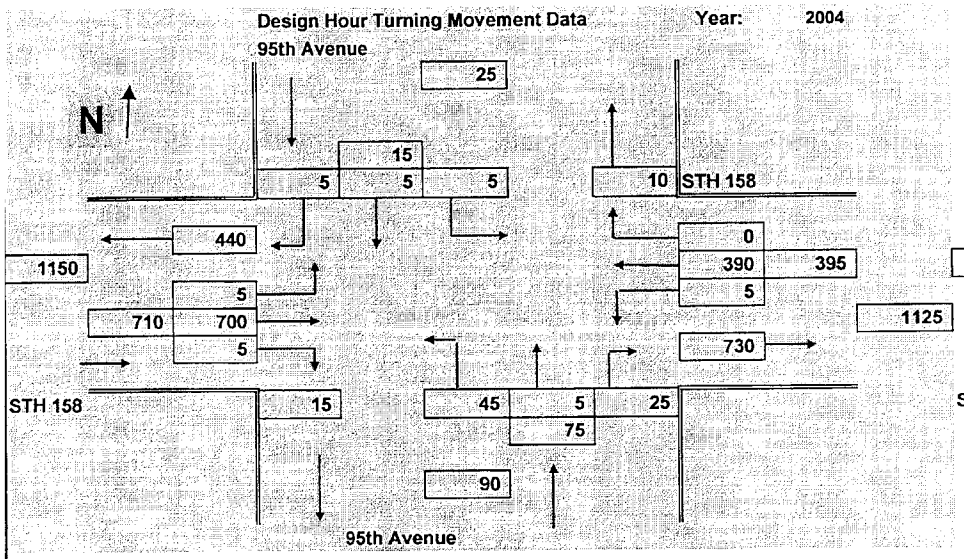
Design Hour: Weekday PM

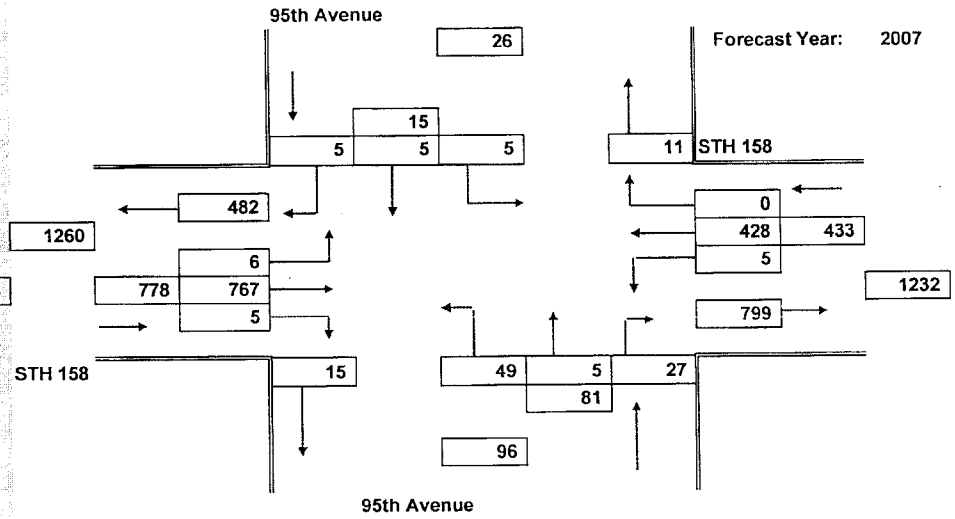
Forecast Completed: 12/16/04

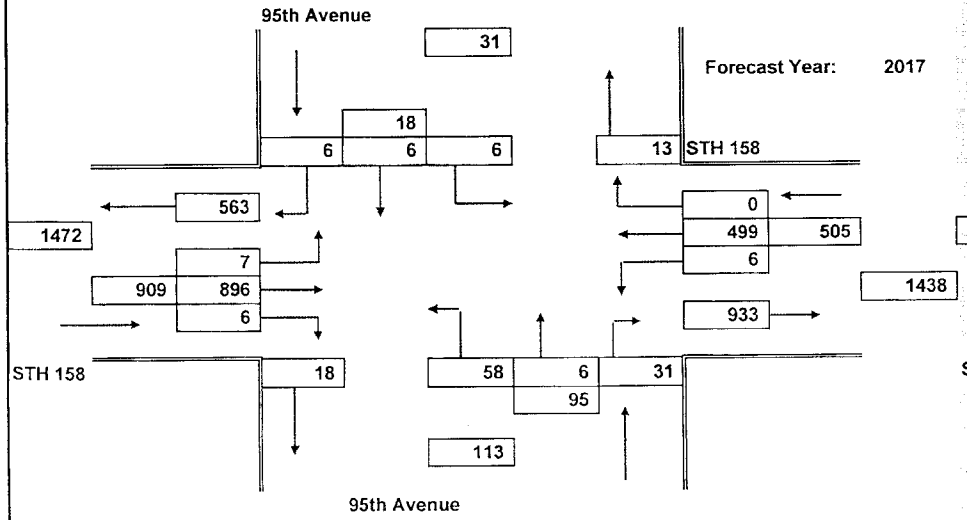
Project Description

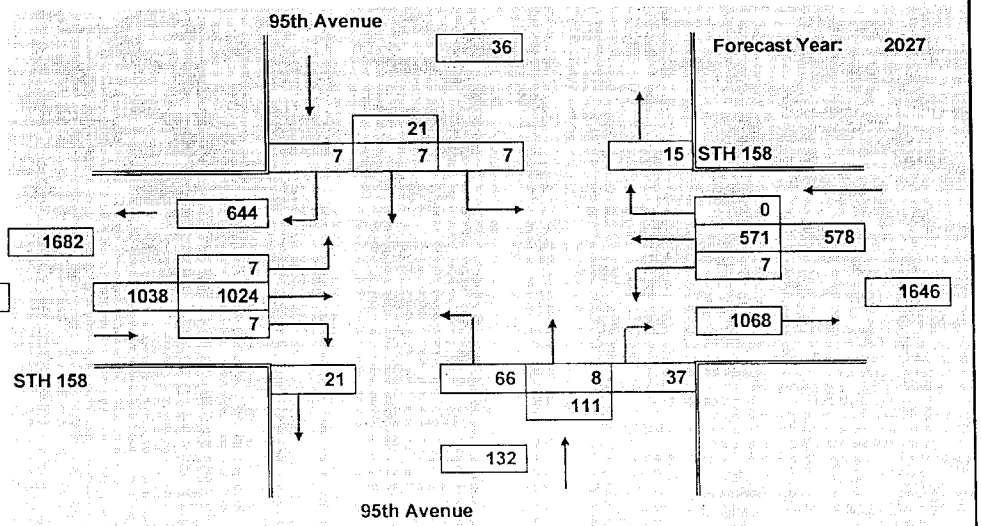
Project ID: N/A
Location: 95th Avenue Intersection

Route: STH 158
County: Kenosha









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Projected AM Design Hour Traffic Volumes

Design Hour: Weekday AM

Forecast Completed: 12/16/04

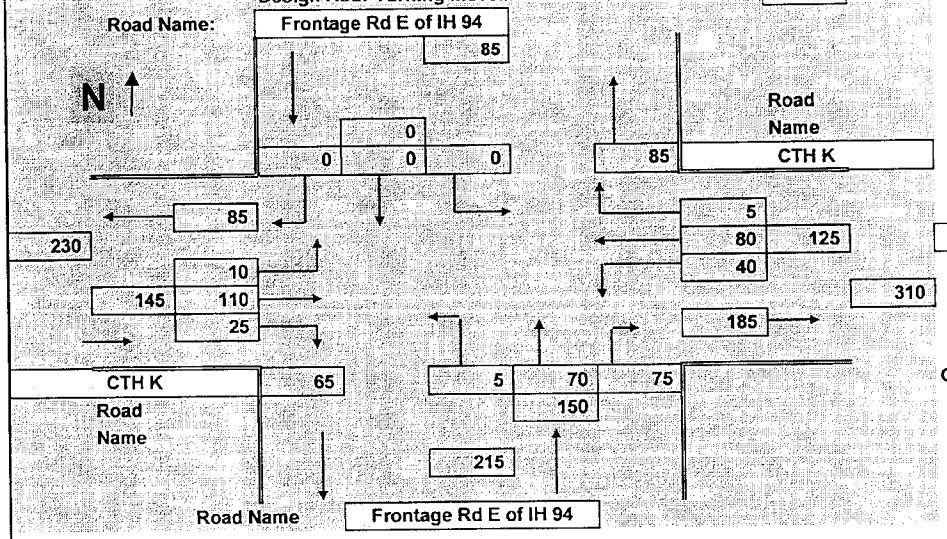
Project Description

Project ID: N/A
Location: CTH K

Route: Frontage Rd E of IH 94
County: Kenosha

Design Hour Turning Movement Data

Year: 2004



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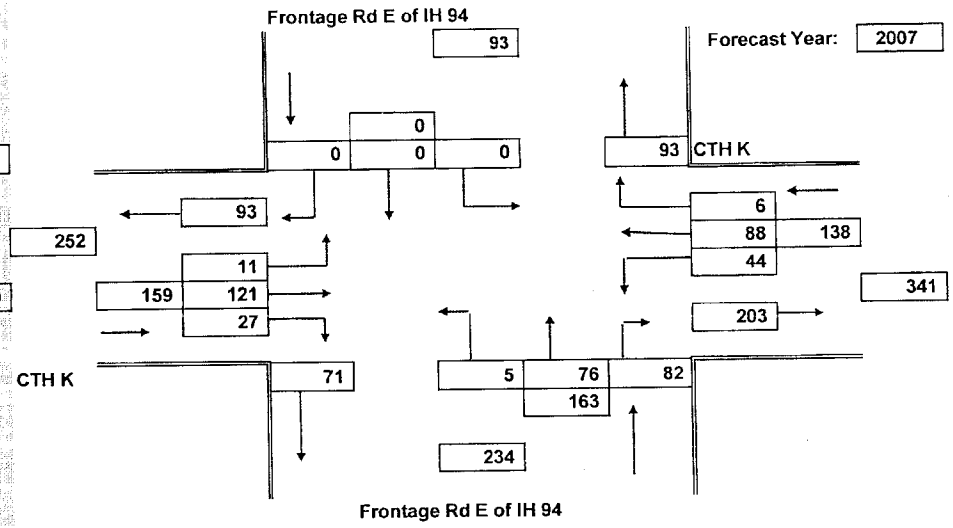

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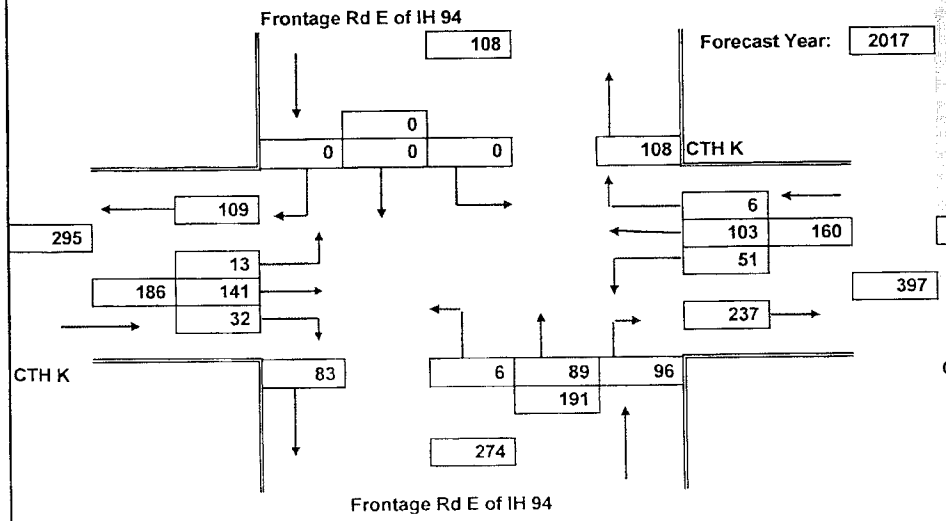

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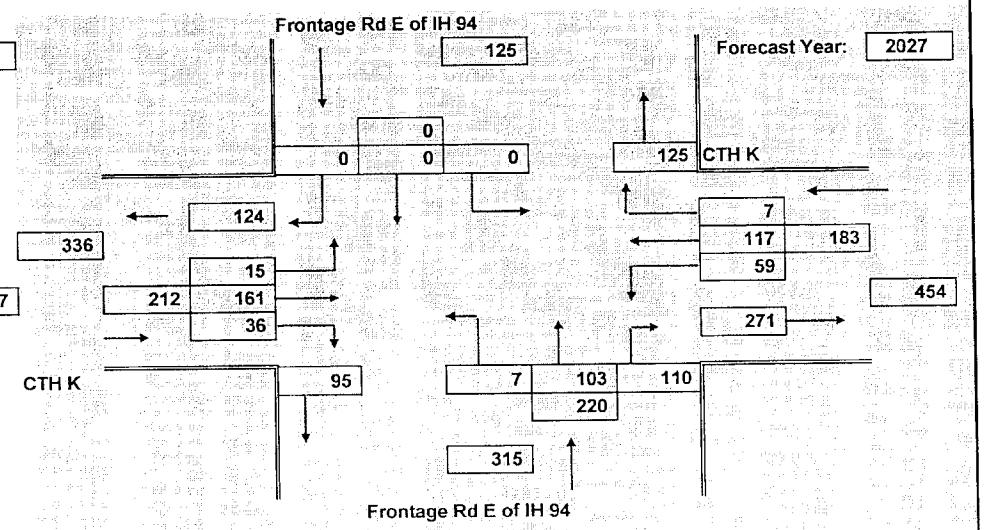

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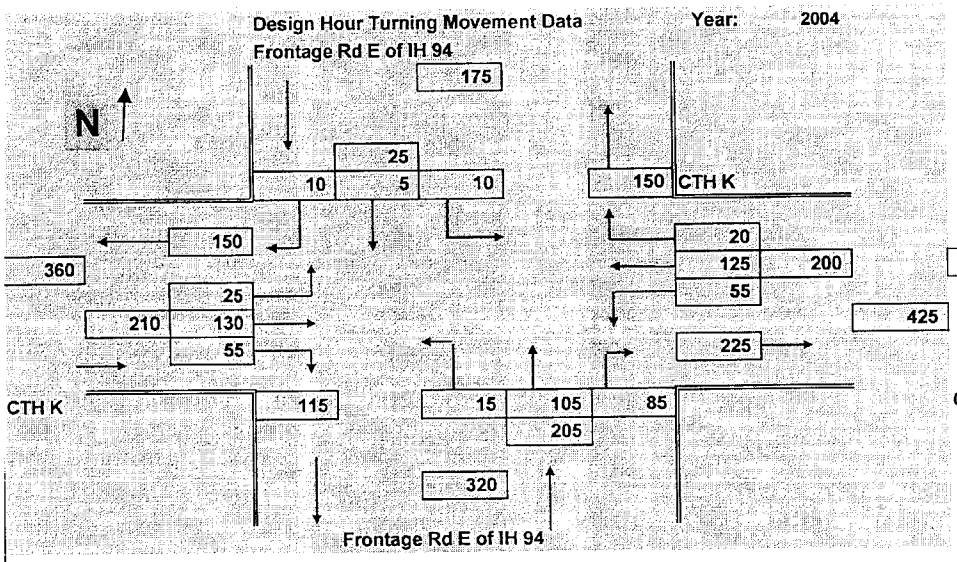

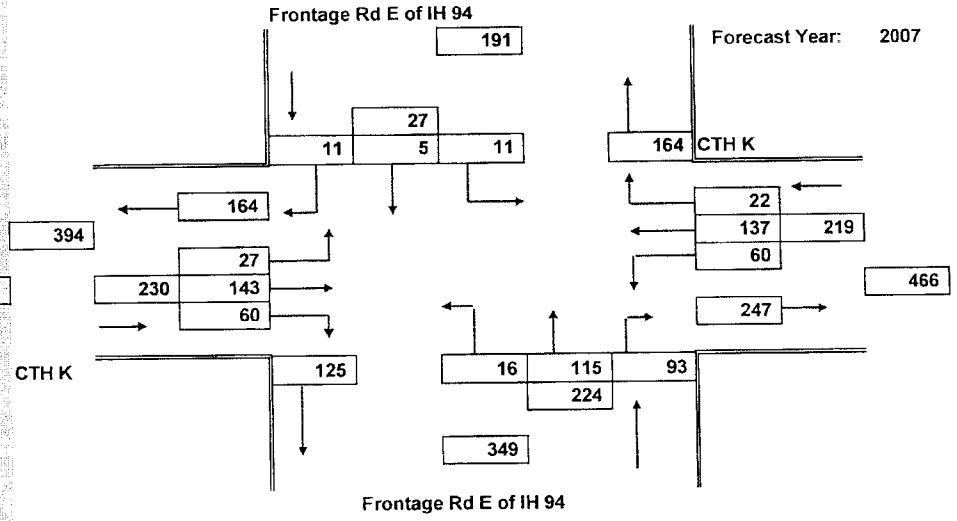

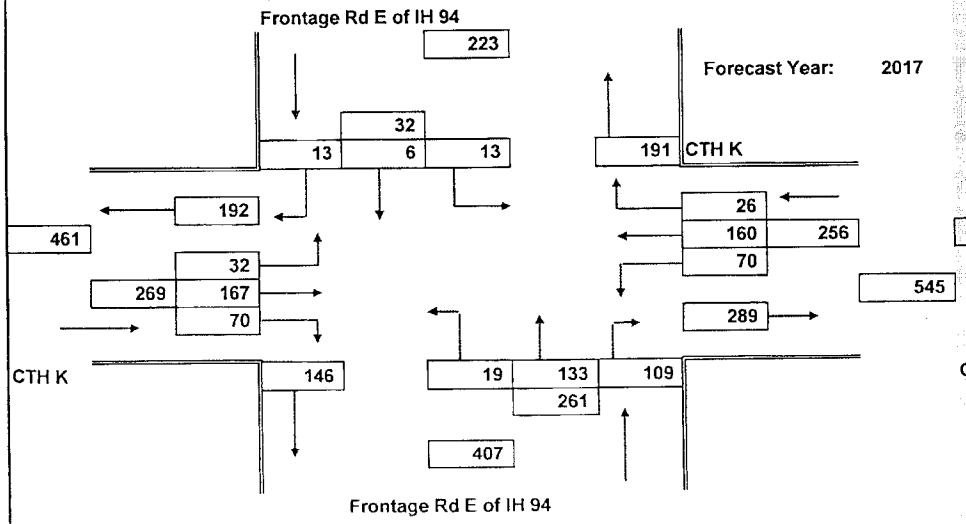

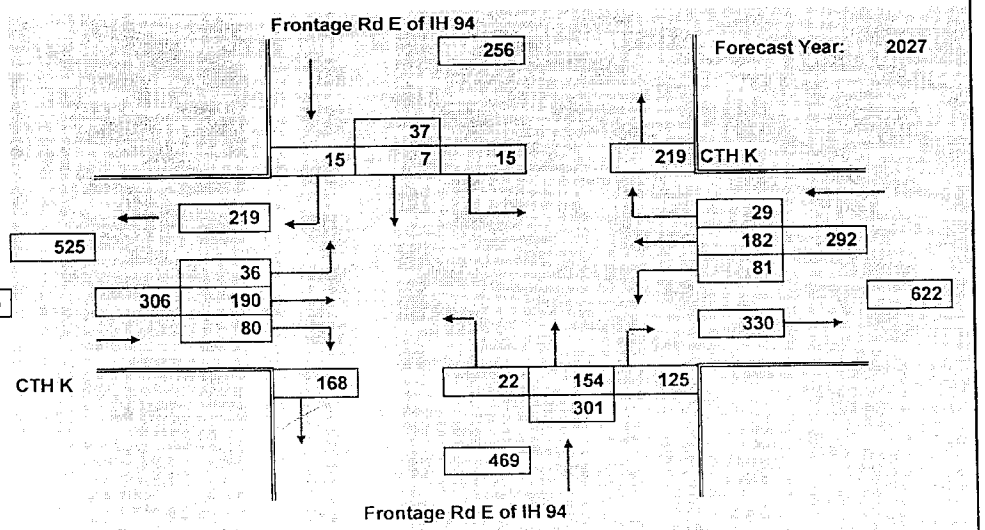

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Projected AM Design Hour Traffic Volumes

Design Hour: Weekday AM

Forecast Completed: 12/16/04

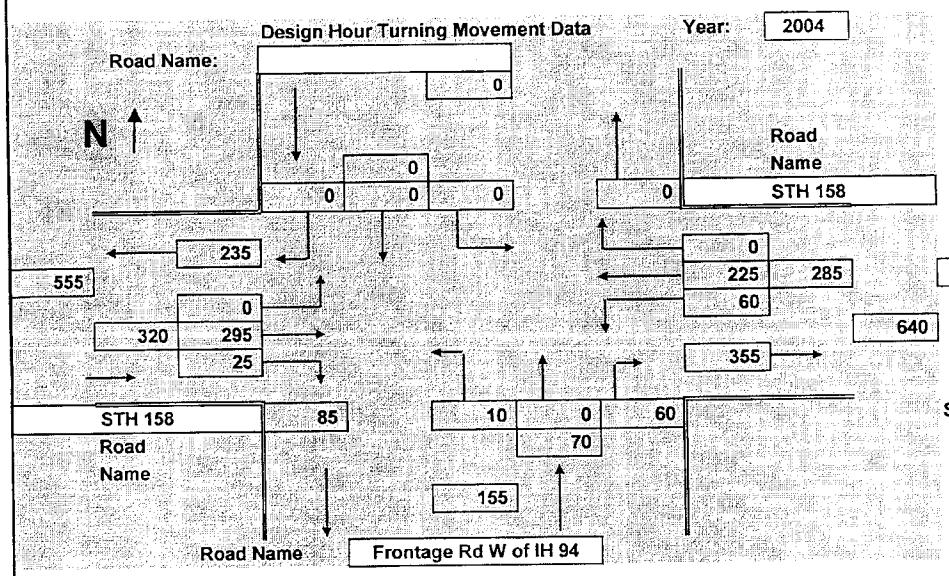
Project Description

Project ID: N/A
Location: Frontage Rd W of IH 94

Route: STH 158
County: Kenosha

Design Hour Turning Movement Data

Year: 2004



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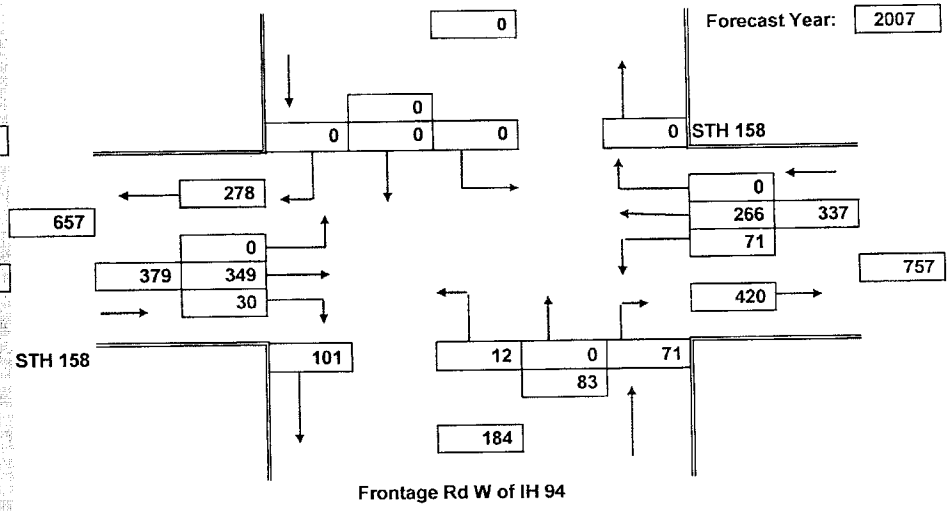

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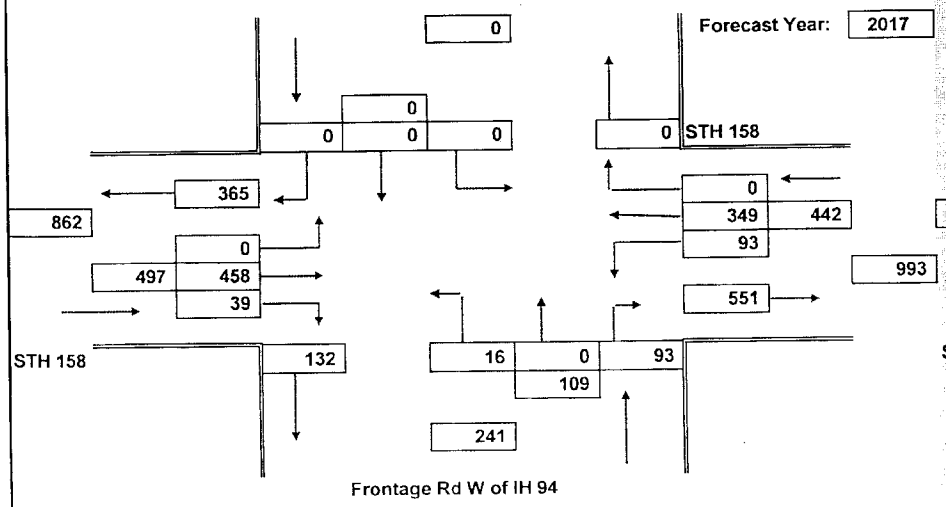

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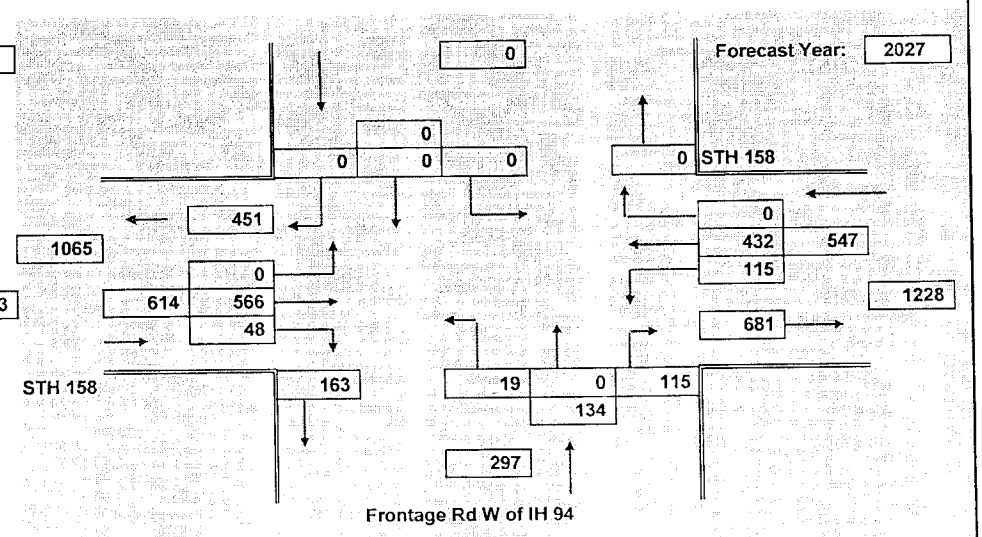

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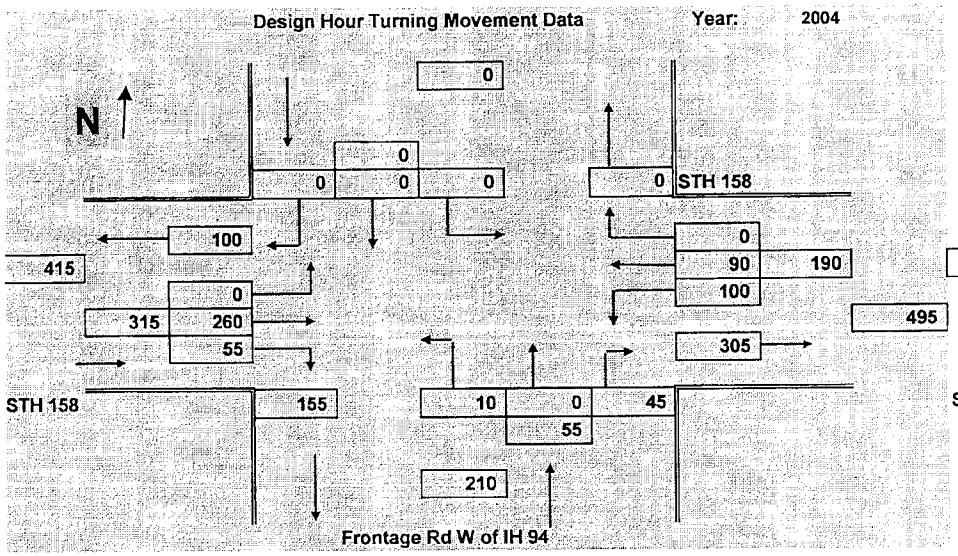
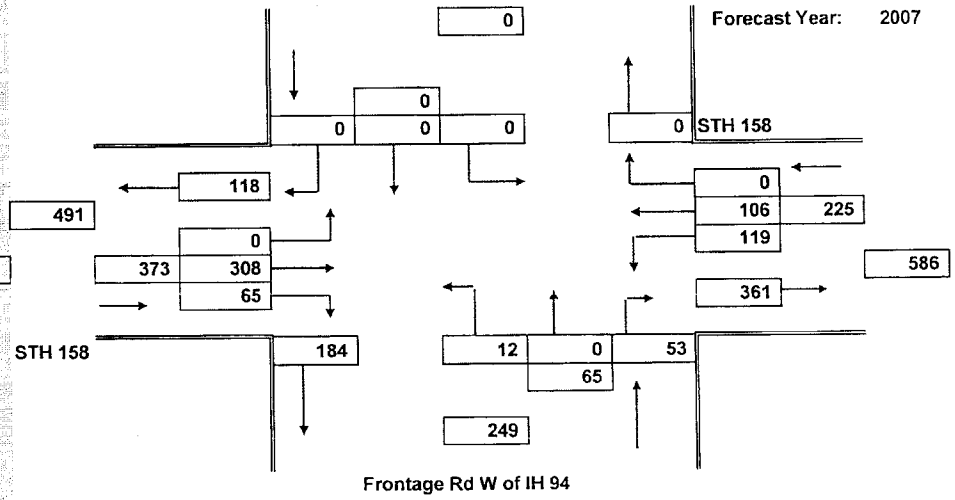
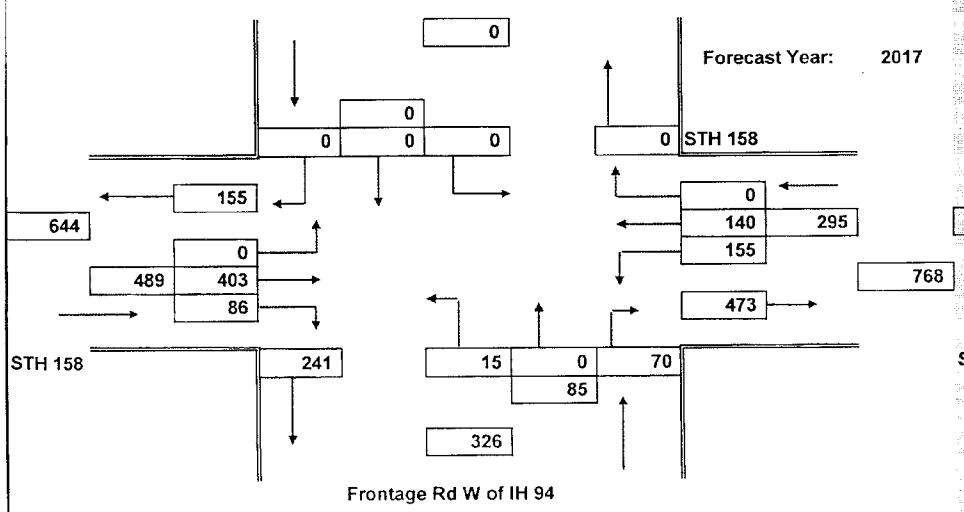
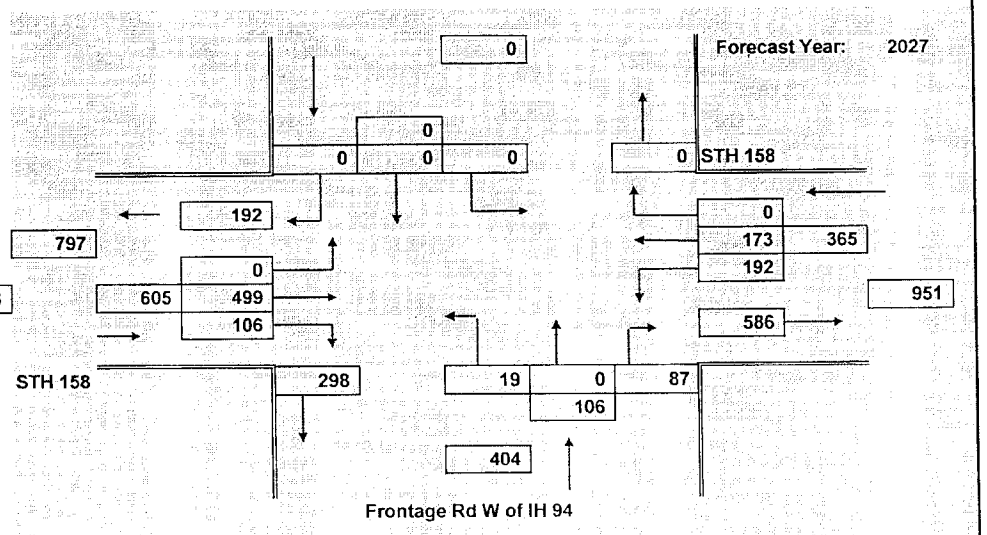
County: Kenosha









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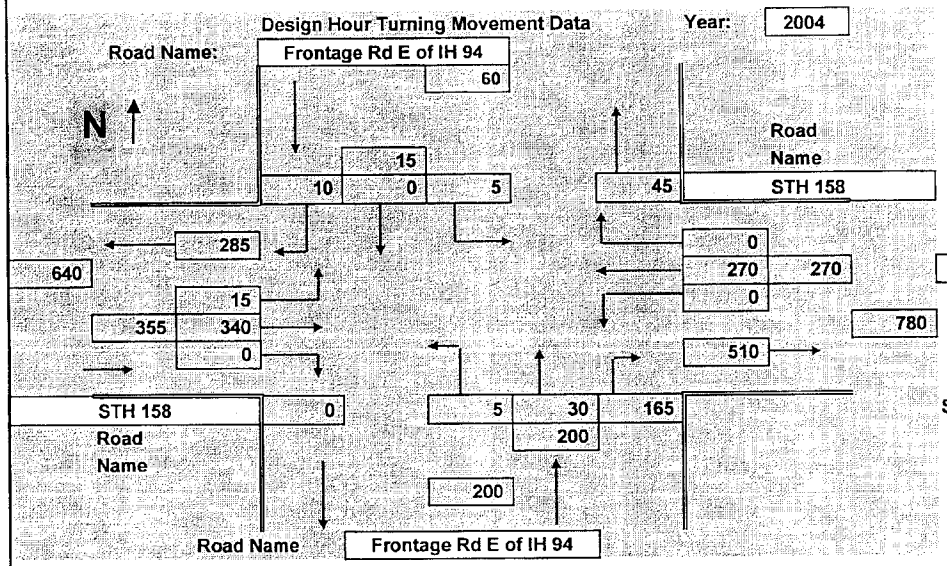

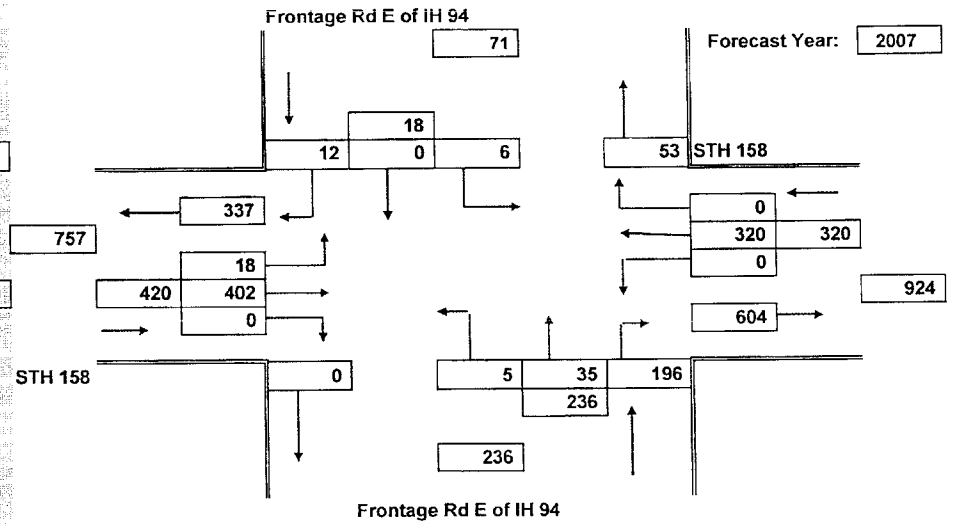

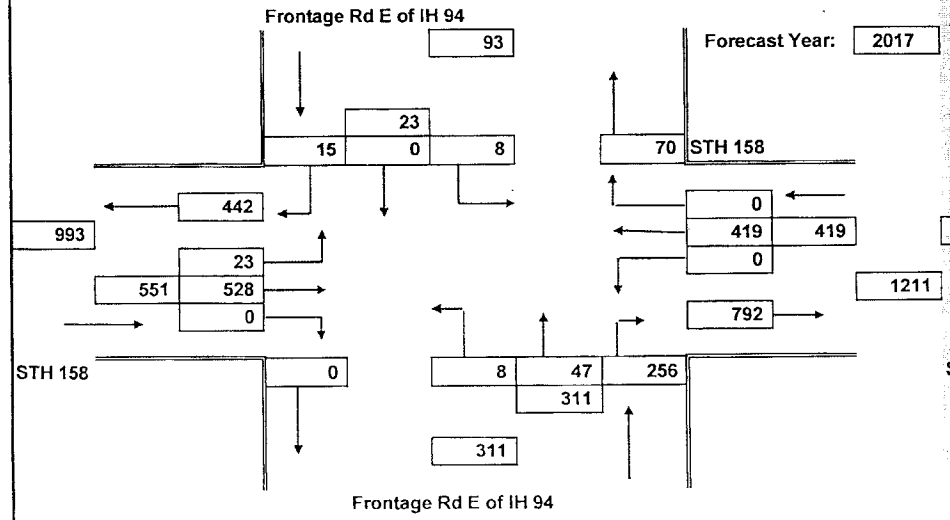

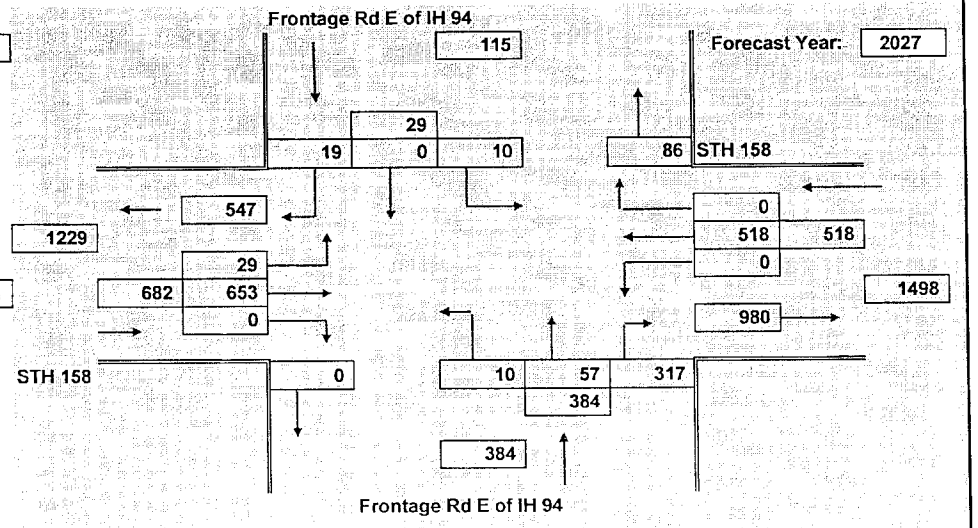

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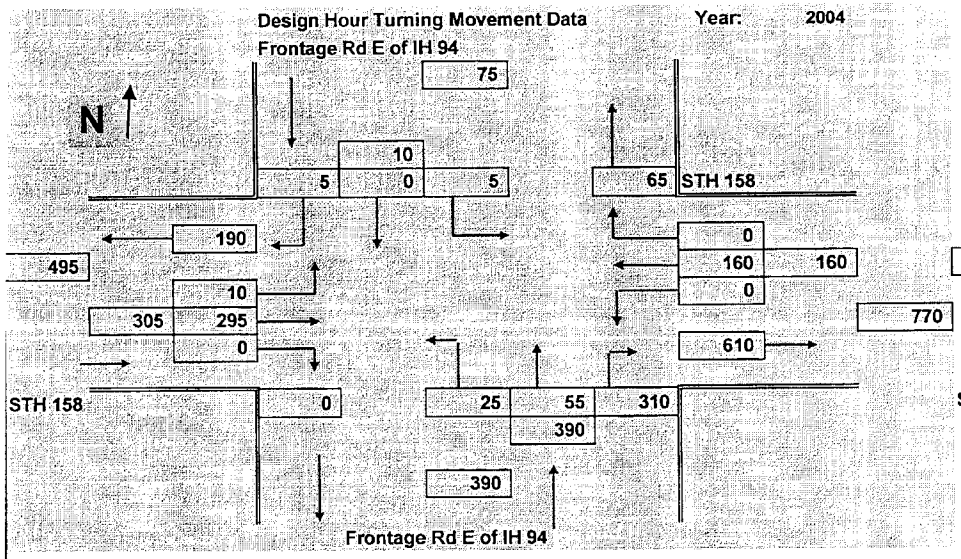
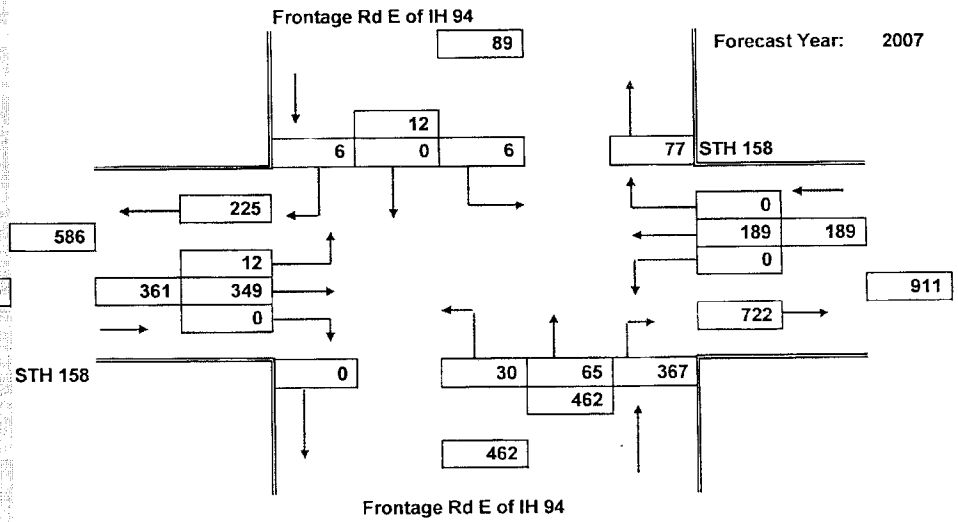
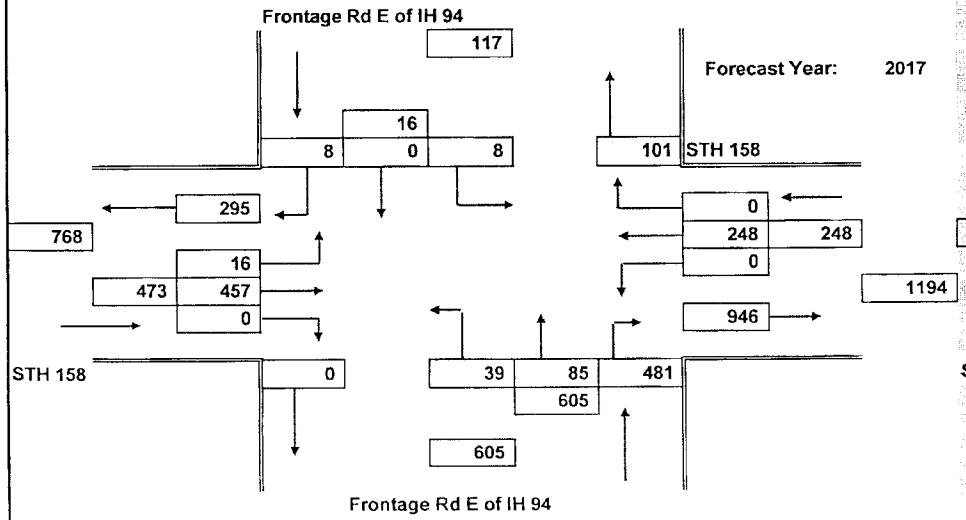
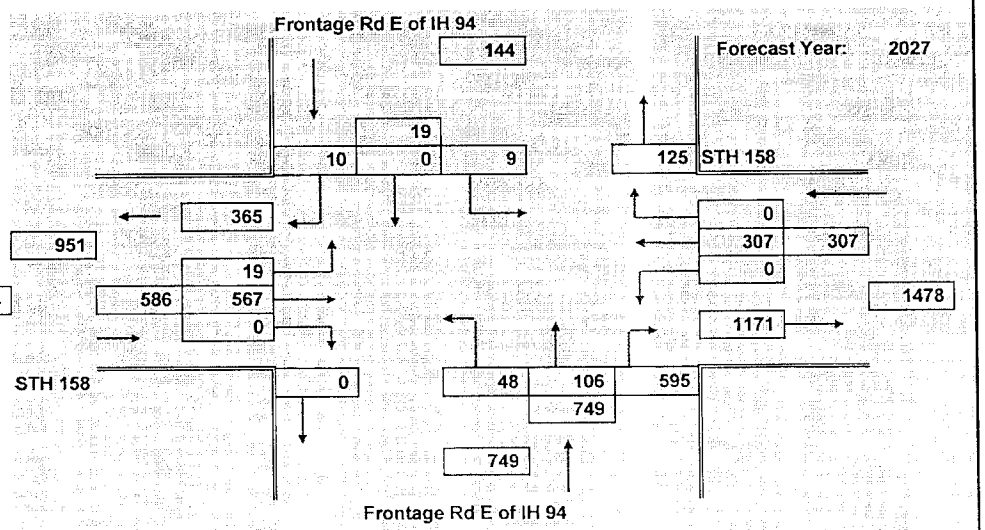
Route: STH 158
County: Kenosha









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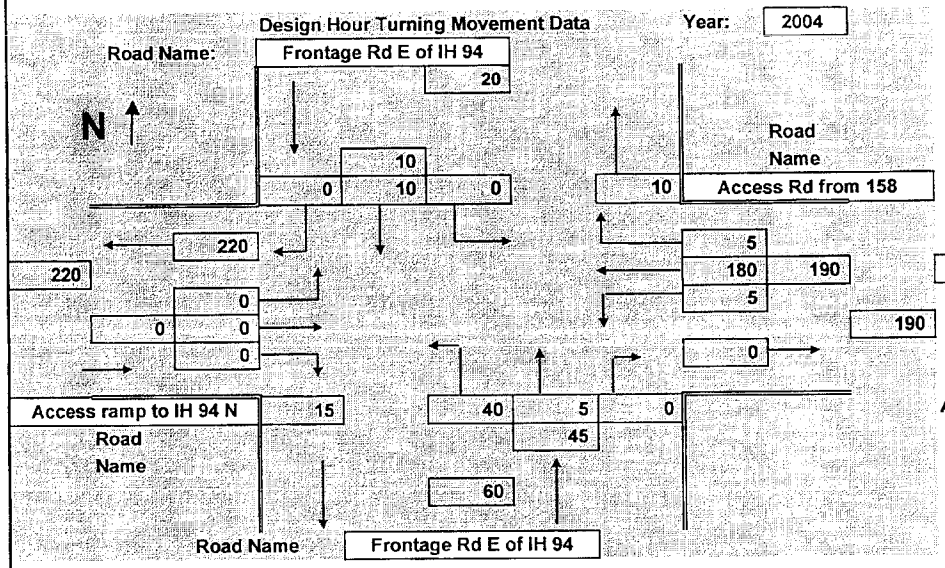
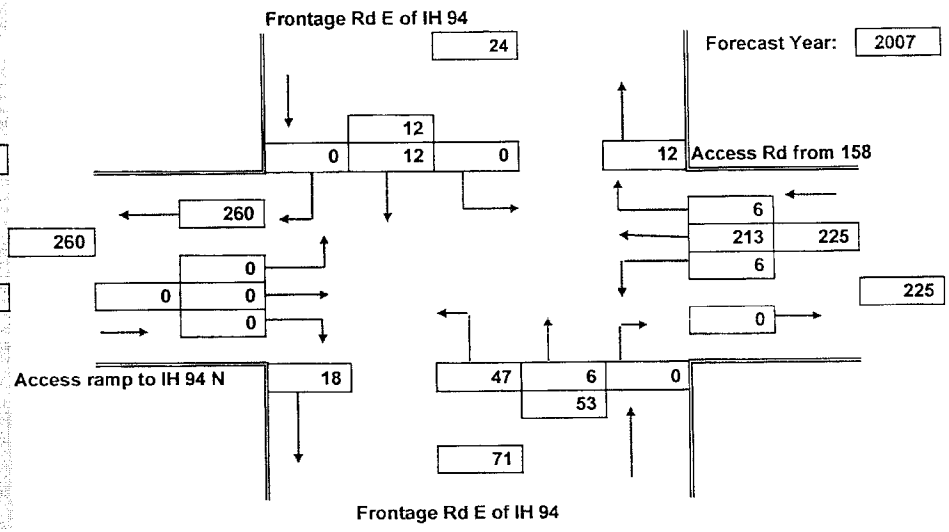
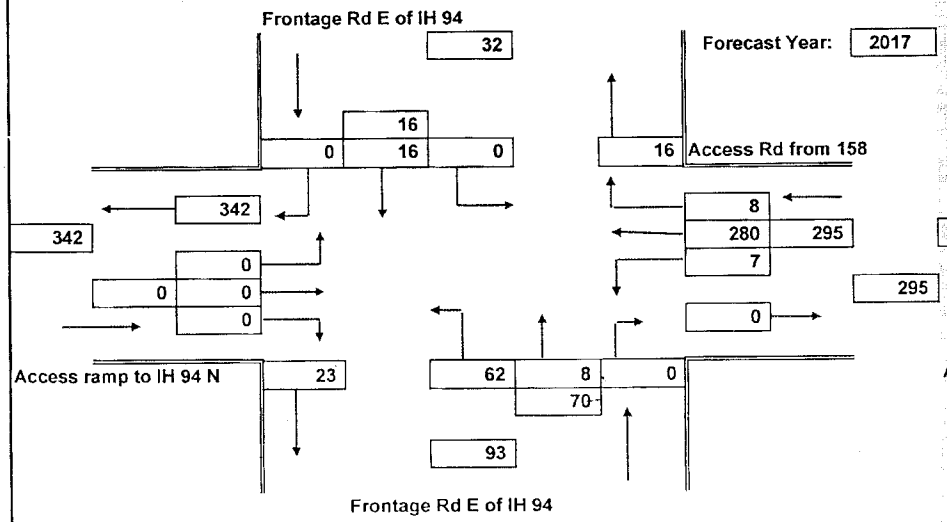
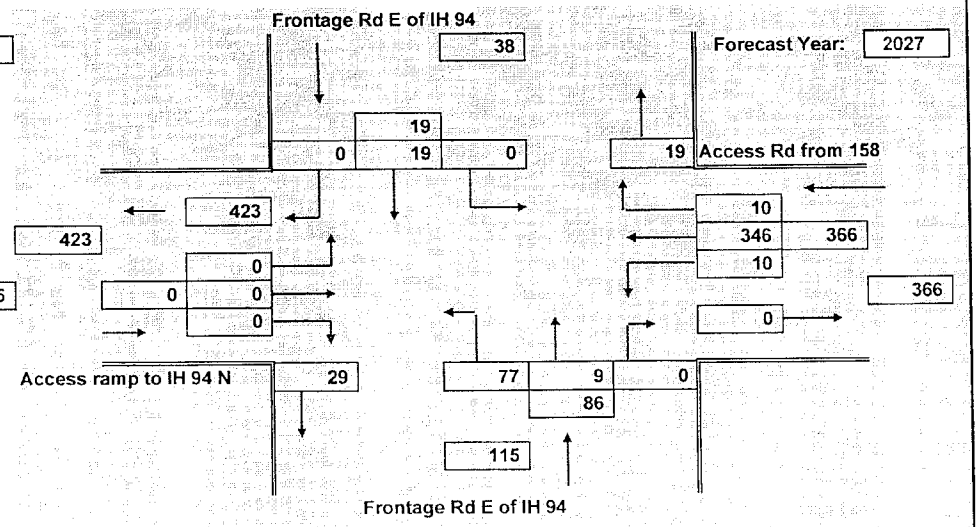
Design Hour Turning Movement Data

Year: 2004









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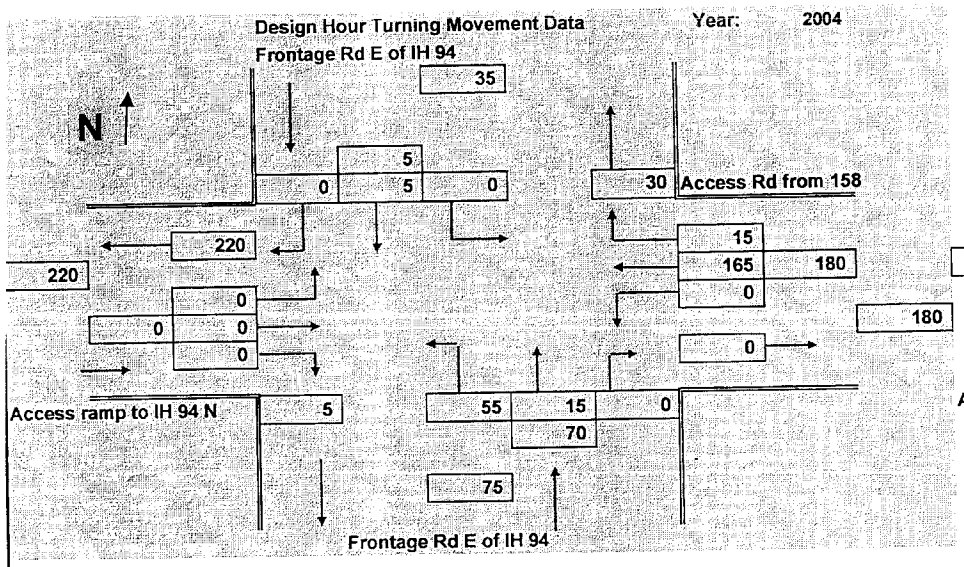
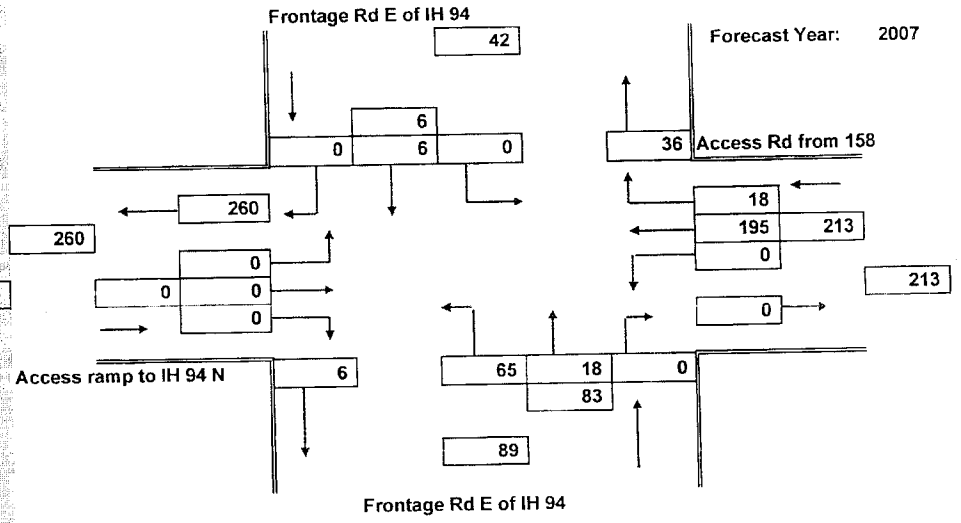
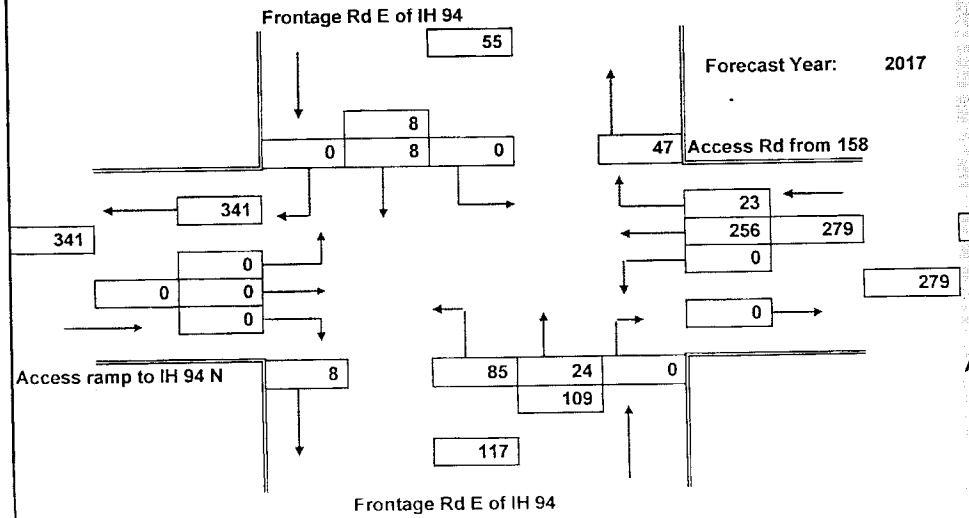
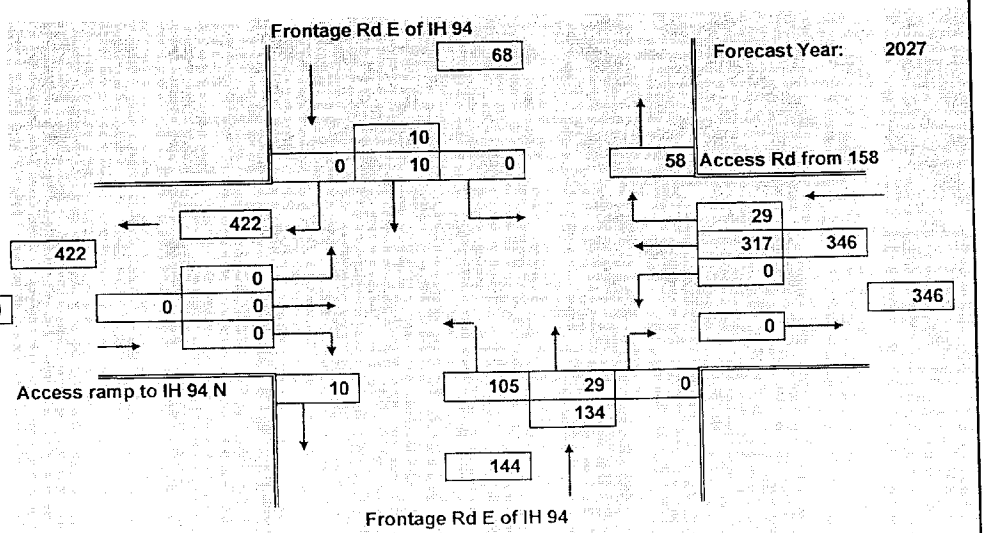








TRIP GENERATION STUDY

Recalibration of Trip Generation Model for Las Vegas Hotel/Casinos

AN UPDATED TRIP GENERATION STUDY FOR LAS VEGAS HOTEL/CASINOS IS PRESENTED IN THIS FEATURE USING THE NUMBER OF GAMING POSITIONS AS AN INDEPENDENT VARIABLE. REGRESSION ANALYSIS USING GAMING POSITIONS AND PREVIOUS INDEPENDENT VARIABLES (EMPLOYEES, CASINO FLOOR AREA AND HOTEL ROOMS) WAS PERFORMED TO DETERMINE THE "BEST" SINGLE OR MULTIVARIABLE EQUATIONS.

BY CURTIS D. ROWE, MOHAMED S. KASEKO AND KENNETH W. ACKERET

INTRODUCTION

The hotel/casinos of Las Vegas, NV, USA, provide an attraction destination for visitors from locations worldwide. Many of the world's largest hotels providing more than 3,000 rooms at a single facility are located in Las Vegas. The number and proximity of these resorts provide Las Vegas with thousands of hotel rooms and gaming positions unlike anywhere else in the world. Understanding the trip generation characteristics of these facilities is key to determining associated traffic impacts and roadway mitigation measures.

This trip generation study was motivated by the work conducted by Kenneth W. Ackeret and Robert C. Hosea III as presented in the May 1992 issue of *ITE Journal* in "Trip Generation Rates for Las Vegas Area Hotel-Casinos."[1] Ackeret and Hosea calibrated the number of vehicle trips generated by a hotel/casino as a function of casino floor area, number of hotel rooms and employees. The results of their study are the basis for the current method of estimating the number of vehicle trips generated by Las Vegas hotel/casinos. However, this method is based on a relatively limited data set. The data used were collected in and prior to 1990 for 21 hotel/casino counts. Since then, numerous hotel/casinos were constructed that conducted facility driveway trip counts within the Las Vegas metropolitan area. This increased data consisting of 46 hotel/casino vehicle generation counts is expected to provide more statistically significant results in trip-making characteristics. Likewise, it is believed that the independent variable of the number of gaming positions would be a good variable for estimation of trip generation. In other areas of the country, gaming positions have been used as an estimator of hotel/casino trips. However, the number of gaming positions as compared with expected trip generation has not been studied within the Las Vegas area. Therefore, one hypothesis tested in this feature is that the number of gaming positions is a good estimator of trips generated by hotel/casinos.

METHODOLOGY

The vehicle trip generation of a hotel/casino is dependent on various factors. Certain factors, such as size, location and type of hotel/casino all contribute to the trip generation of a facility. Facility size characteristics can be identified as the number of hotel rooms or the amount of casino floor area. Likewise, the number of gaming positions within a casino and/or the total number of employees can be factors affecting the number of vehicle trips generated by hotel/casinos.

The conducted study developed a set of regression equations for estimating the number of vehicle trips generated by a typical Las Vegas hotel/casino property, existing or proposed. The regression analysis was conducted using data obtained from various existing hotel/casinos that had vehicle generation counts conducted during the a.m. and p.m. peak hours to determine the number of vehicles entering and exiting individual casino properties. The following independent variables were used in the analysis:

- Number of gaming positions;
- Number of employees;
- Number of hotel rooms; and
- Casino floor area.

Data Collection

To determine equations that accurately estimate the number of peak-hour vehicle trips generated by a hotel/casino, an extensive amount of data was required. The data needed included the typical a.m. and p.m. adjacent-street peak-hour facility driveway count volumes, number of gaming positions,

Table 1. Resort corridor hotel/casino single-variable equations.

Independent variable	Time period	Directional distribution	Equation	R^2	F-statistic	F-critical @ 95% level	Average rate	Range of rates	Standard deviation
Gaming positions	a.m. peak	59% enter 41% exit	T = 0.377 (X) – 109.344 T = a.m. peak-hour trips X = number of gaming positions	0.84	134.21	4.25	0.332	0.047–0.516	0.115
	p.m. peak	48% enter 52% exit	T = 0.000137 (X^2) + 289.769 T = p.m. peak-hour trips X = number of gaming positions	0.91	301.31	4.16	0.463	0.151–0.778	0.171
Employees	a.m. peak	59% enter 41% exit	T = 0.232 (X) + 117.461 T = a.m. peak-hour trips X = number of employees	0.79	94.86	4.25	0.292	0.044–0.534	0.113
	p.m. peak	48% enter 52% exit	T = 0.432 (X) + 89.67 T = p.m. peak-hour trips X = number of employees	0.76	96.88	4.16	0.487	0.144–1.300	0.218
Hotel rooms	a.m. peak	59% enter 41% exit	T = 0.333 (X) + 117.239 T = a.m. peak-hour trips X = number of hotel rooms	0.73	67.39	4.25	0.482	0.096–2.188	0.383
	p.m. peak	48% enter 52% exit	T = 0.638 (X) T = p.m. peak-hour trips X = number of hotel rooms	0.78	109.99	4.16	0.702	0.210–2.801	0.468
Casino floor area	a.m. peak	59% enter 41% exit	T = 8.046 (X) + 174.380 T = a.m. peak-hour trips X = casino floor area (1,000 sf)	0.74	72.57	4.25	12.344	1.968–35.351	6.874
	p.m. peak	48% enter 52% exit	T = 16.991 (X) T = p.m. peak-hour trips X = casino floor area (1,000 sf)	0.81	134.49	4.16	18.374	6.238–52.541	9.708

number of hotel rooms, number of employees and casino floor area of each hotel/casino. The data used by Ackeret and Hosea[1] and the "Trip Generation Analysis Report,"[2] conducted by the University of Nevada–Las Vegas, were supplemented with data collected more recently and used for this study.

Existing Count Data

The first step of the additional data-collection effort involved obtaining count data conducted at facility access driveway locations for existing hotel/casinos. The count data obtained were from counts conducted at all facility driveways during 15-minute intervals on a weekday during the typical a.m. and p.m. peak-hour periods. Therefore, the count volumes collected reflect the highest one-hour period between 7 a.m. to 9 a.m. and 4 p.m. to 6 p.m. on a weekday. It is recognized that the facilities' trip generation may be greater during other hours of the day or week. The typical weekday peak-hour time periods were studied based upon availability of data that was collected in accordance with local requirements for analysis during these time periods. Limited proprietary data exists, which indicates the peak hour of the casino generator generally occurs around 7 p.m. At this time, the trip generation of the hotel/casinos is generally 15 percent greater than during the typical commuter peak hours. This increase should be recognized when analyzing specific traffic demands at intersections comprising primarily hotel/casino traffic. The count data may be obtained by requesting it from the authors.

Independent Variables

The independent variables associated with each of the hotel/casinos were collected for the time period corresponding to the date of the reported field traffic counts. The specific traffic studies reports and *ITE Journal* feature used for the count data were also reviewed to extract information on the number of employees, hotel rooms and casino square footage. Data, other than the number of gaming positions, were also obtained from the *Las Vegas Perspective*,[3] the *Top Rank Nevada 1999, Statewide Book of Lists*[4] and the *Book of Lists*.[5] Data that were still not available from these sources were obtained from telephone surveys with the hotel/casinos management. The gaming position data were obtained from the State of Nevada, Gaming Control Board for the current and historic count periods at each of the hotel/casino sites. The independent-variable data may be obtained by requesting it from the authors. The following are definitions of the key independent variables studied:

- Number of employees: The total number of people employed at a hotel/casino for all shifts;
- Casino floor area: The square footage that contained the gaming positions;
- Number of gaming positions: The number of gaming positions was defined to be the total number of slot machines within a casino plus the number of table games multiplied by seven positions per table. The average of seven gaming positions per table is consistent with the

Table 3. Local hotel/casino single-variable equations.

Independent variable	Time period	Directional distribution	Equation	R^2	F-statistic	F-critical @ 95% level	Average rate	Range of rates	Standard deviation
Gaming positions	a.m. peak	57% enter 43% exit	Ln(T) = 0.604 Ln(X) + 2.147 T = a.m. peak-hour trips X = number of gaming positions	0.72	26.00	4.96	0.470	0.267–0.884	0.191
	p.m. peak	52% enter 48% exit	Ln(T) = 0.794 Ln(X) + 1.278 T = p.m. peak-hour trips X = number of gaming positions	0.83	59.77	4.75	0.788	0.505–1.540	0.246
Employees	a.m. peak	57% enter 43% exit	Ln(T) = 0.710 Ln(X) + 1.506 T = a.m. peak-hour trips X = number of employees	0.77	32.70	4.96	0.566	0.311–0.840	0.160
	p.m. peak	52% enter 48% exit	Ln(T) = 0.847 Ln(X) + 1.086 T = p.m. peak-hour trips X = number of employees	0.72	30.16	4.75	1.021	0.639–1.466	0.313
Hotel rooms	a.m. peak	57% enter 43% exit	Not statistically significant	0.24	3.11	4.96	2.538	0.668–9.300	2.445
	p.m. peak	52% enter 48% exit	Not statistically significant	0.01	0.01	4.75	5.067	0.869–16.200	4.246
Casino floor area	a.m. peak	57% enter 43% exit	Ln(T) = 0.433 Ln(X) + 4.848 T = a.m. peak-hour trips X = casino floor area (1,000 sf)	0.71	24.13	4.96	14.078	4.794–48.091	11.502
	p.m. peak	52% enter 48% exit	Ln(T) = 0.527 Ln(X) + 4.999 T = p.m. peak-hour trips X = casino floor area (1,000 sf)	0.72	30.19	4.75	22.342	6.792–62.591	13.372

Directional Distribution

A directional distribution of entering and exiting trips during the peak hours was calculated based upon the observed data. The average directional distributions were calculated separately for resort corridor and local hotel/casinos, as well as the a.m. and p.m. peak hours.

Average Trip Rates

Based upon the data collected, average trip rates were calculated for both groups of hotel/casinos to determine the average number of vehicle trips expected per independent variable. The average trip rates and standard deviation were calculated for each independent variable. An average trip rate was determined to be acceptable if the standard deviation was less than 110 percent of the average rate as described in the Institute of Transportation Engineers' (ITE) *Trip Generation Handbook, An ITE Proposed Recommended Practice.*[7]

Regression Analysis

Regression analysis was conducted to develop regression equations for estimating the number of trips generated by the casinos as a function of several combinations of independent variables. The stepwise regression procedure was used as outlined in *Basic Econometrics* by Damodar Gujarati.[8]

In this study, regression analysis of the data was used to determine the "best fit" equation of a line that most accurately estimates the number of peak-hour trips for both resort corridor and local hotel/casinos. Both linear and nonlinear equations were evaluated as provided in ITE's *Trip Generation.*[9] For the nonlinear equations, the natural logarithmic and squared polynomials were used to determine which type of equation would best estimate the trip generation of a hotel/casino.

After equations were obtained for the single-variable equations, the t-statistics were first evaluated to determine statistical significance of the coefficients of the variables. A confidence level of 95 percent was used. However, since regression equations that provide intercepts are viewed favorably by practitioners to differentiate between average rates and regression equations, a lower confidence level of 75 percent was utilized for the intercept. If the intercept did not prove to be significant by the t-test, the equation was recalculated with the y-intercept being forced through zero. The resulting equations were compared to determine which type of equation was the "best" model for estimation of the peak-hour trips. An analysis of variance was conducted for each model as provided by Gujarati.[8] To compare the models, the R-squared and F statistics were evaluated. The R-squared value demonstrated how closely the equation fit the data points. In general, R-squared values closest to 1.0 are desirable. Also larger values of the F statistic are desirable. After determination of the best equation for each independent variable, the data, average rate and "best" regression equation were plotted. To determine which independent variable estimated the number of peak-hour trips best, the F statistic was again compared for each equation.

Development of the "best" regression equation was done using the stepwise regression analysis procedure. In this procedure, the effect of adding a variable to an existing equation is evaluated using the

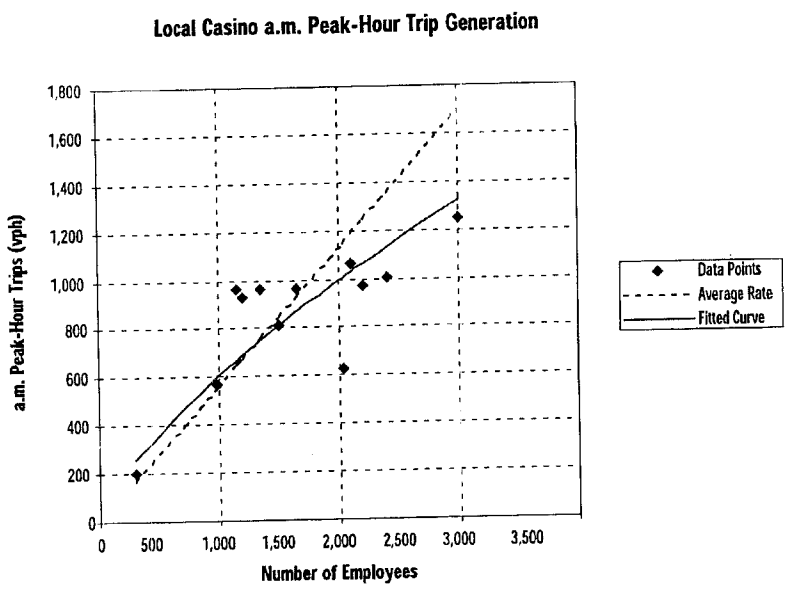
Average Vehicle Trip Ends vs: Number of Employees
On a: Weekday a.m. peak hour

Number of Studies: 12
Average Number of Employees: 1,655
Directional Distribution: 57% entering, 43% exiting

Trip Generation per Number of Employees

Average Rate	Range of Rates	Standard Deviation
0.5657	0.3108–0.8400	0.1597

Data Plot and Equation



Fitted Curve Equation: $Ln(T) = 0.710\ Ln(X) + 1.506$ $F = 32.70$ $R^2 = 0.77$
where: T = number of a.m. peak-hour trips
$F_{crit} = 4.96$ at 95% confidence level
X = number of employees

Figure 1. Local a.m. peak trips vs. employees.

partial F statistic. This statistic evaluates whether the contribution of the additional variable to the accuracy of the model is statistically significant. If different variables are added to the same equation, then the variable with the highest partial F that is statistically significant is selected.

RESORT CORRIDOR HOTEL/CASINOS RESULTS

Directional Distribution

The existing trips generated by the resort corridor hotel/casinos had an average distribution of 59 percent entering and 41 percent exiting during the a.m. peak hour. Likewise, during the p.m. peak hour, the directional distribution was found to be 49 percent entering and 51 percent exiting.

Single-Variable Equations

Table 1 provides the results for average trip rate and regression equations for the a.m. and p.m. peak-hour trips generated by a resort corridor hotel/casino. As these single-variable equations illustrate, all four independent-variable equations are statistically significant during both peak hours based on the critical F value. The equation with the highest F value was considered to be the "best" statistically significant equation to estimate trip generation. For both a.m. and p.m. peak hours, the number of gaming positions is the best estimator of the trip generation for a resort corridor hotel/casino. For the a.m. peak hour, the number of employees is the next best trip generation estimator, followed by casino floor area and, lastly, the number of hotel rooms. For the p.m. peak hour, the casino floor area is the second-best estimator followed by number of hotel rooms and then employees.

Average Trip Rates

The average trip rates were found to be acceptable for estimation of the number of trips generated by a hotel/casino for all studied independent variables, because the standard deviation was less than the established limit of 110 percent of the average rate.

"Best" Multivariable Regression Equations

As discussed earlier, the forward stepwise regression analysis approach was adopted to determine appropriate multivariable equations. Starting with the "best" single-variable equation, containing the variable for the number of gaming positions, partial F statistic analysis was conducted to determine an additional variable that would statistically best improve the accuracy of estimation. The best two variable equations for both the a.m. and p.m. peak hours was found to be combining the variables for the number of gaming positions and number of employees. Therefore, the "best" equations to estimate the number of vehicle trips during the peak hours were found to be as follows:

a.m. peak hour

$T = 0.241\ (X_1) + 0.100\ (X_2) - 68.429$

$R^2 = 0.88$

where

T = number of a.m. peak-hour trips;
X_1 = number of gaming positions; and
X_2 = number of employees.

p.m. peak hour

$T = 0.000108\ (X_1^2) + 0.120\ (X_2) + 184.063$

$R^2 = 0.93$

where

T = number of p.m. peak-hour trips;
X_1 = number of gaming positions; and
X_2 = number of employees.

Determining the Most Appropriate Equation for Practical Use

In practice, there are occasions when certain independent variables are not available for forecasting of trip generation of a facility. Typically, prior to the construction of a hotel/casino, the number of employees and gaming positions is not known. Or if the number of employees is known, it may be an estimate. It is important that the practitioner use caution when using equations with the number of employees prior to the construction of a hotel/casino to ensure the number of employees are estimated most accurately. In such a case, other variables may have to be used for forecasting. Normally in such cases, the number of rooms and casino floor area would be known. Table 2 is provided as a guideline to determine which equations to use depending on which independent-variable data is available. The equations in each row are provided in descending order of their statistical significance. The equation shown in the top row was found to be the most statistically significant equation. Therefore, if these independent variables are known, this equation should be used to make the best trip generation estimation for the facility.

LOCAL HOTEL/CASINOS RESULTS

Directional Distribution

The existing trips from count data at local hotel/casinos had an average distribution of 57 percent entering and 43 percent exiting during the a.m. peak hour. During the p.m. peak hour, the directional distribution was found to be 52 percent entering and 48 percent exiting.

Single-Variable Equations

Table 3 presents the results for single-variable regression analysis for the a.m. and p.m. peak-hour trips generated by a local hotel/casino. From the single independent-variable regression analysis, three of the four variables provide statistically significant models for estimating the expected number of trips generated by a local hotel/casino during the peak hours. The number of hotel rooms was determined not to be a good independent variable for trip estimation. This is likely due to the relatively small number of hotel rooms provided at a local hotel/casino. Likewise, the patrons of a local hotel/casino primarily live in the Las Vegas area, and the patrons of the hotel rooms are not a major proportion of the trips generated.

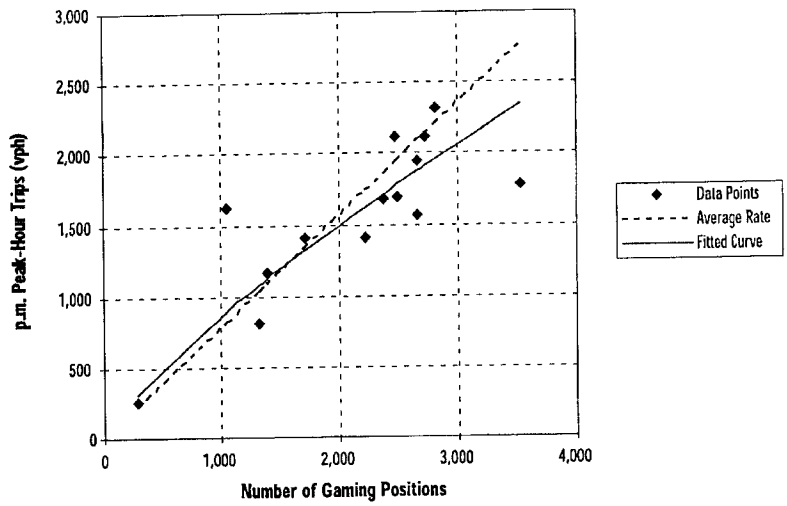
Average Vehicle Trip Ends vs: Number of Gaming Positions
On a: Weekday p.m. peak hour

Number of Studies: 14
Average Number of Gaming Positions: 2,122
Directional Distribution: 52% entering, 48% exiting

Trip Generation per Number of Gaming Positions

Average Rate	Range of Rates	Standard Deviation
0.7877	0.5047–1.5399	0.2462

Data Plot and Equation



Fitted Curve Equation: $Ln(T) = 0.794\ Ln(X) + 1.278$ $F = 59.77$ $R^2 = 0.83$

where: T = Number of p.m. peak-hour trips
$F_{crit} = 4.75$ at 95% confidence level
X = Number of gaming positions

Figure 2. Local p.m. peak trips vs. gaming positions.

Average Trip Rates

The average trip rates were found to be acceptable for estimating the number of trips for all independent variables, because the standard deviation was less than the established limit of 110 percent of the average rate.

"Best" Multivariable Regression Equations

Similar to the resort corridor hotel/casino analysis, the forward stepwise regression analysis approach was adopted to determine appropriate multivariable equations. For both the a.m. and p.m. peak hours, it was determined that no multivariable equations are more significant than the single-variable equations. Therefore, the "best" equations to estimate the number of vehicle trips during the peak hours are as follows:

a.m. peak hour

$Ln(T) = 0.710\ Ln(X) + 1.506$

$R^2 = 0.77$

where

T = number of a.m. peak-hour trips; and

X = number of employees.

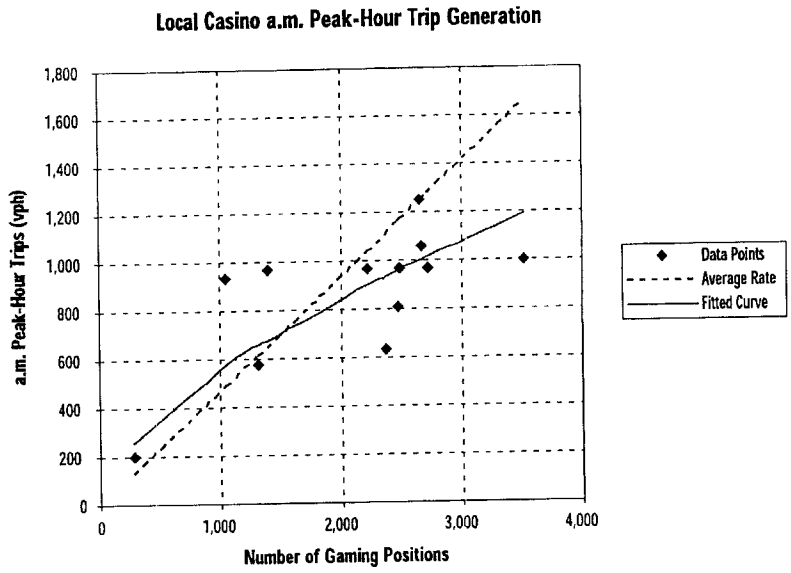
Average Vehicle Trip Ends vs: Number of Gaming Positions
On a: Weekday a.m. peak hour

Number of Studies: 12
Average Number of Gaming Positions: 2,098
Directional Distribution: 57% entering, 43% exiting

Trip Generation per Number of Gaming Positions

Average Rate	Range of Rates	Standard Deviation
0.4701	0.2667–0.8840	0.1913

Data Plot and Equation



Fitted Curve Equation: Ln(T) = 0.604 Ln(X) + 2.147 F = 26.00 R^2 = 0.72
where: T = Number of a.m. peak-hour trips
F_{crit} = 4.96 at 95% confidence level
X = Number of gaming positions

Figure 3. Local a.m. peak trips vs. gaming positions.

p.m. peak hour
Ln(T) = 0.794 Ln(X) + 1.278
R^2 = 0.83
where
T = number of p.m. peak-hour trips; and
X = number of gaming positions.

Figures 1 and 2 illustrate these regression equations as well as the average trip rates, for the a.m. and p.m. peak-hour "best" equations, respectively. Likewise, Figure 3 is shown to provide estimation of trip generation for gaming positions during the a.m. peak hour. Other figures may be obtained by requesting them from the authors.

Determining Most Appropriate Equation

Similar to the resort casinos, for practical use, there are occasions where certain independent variables are not available for estimating the trip generation of a hotel/casino facility. Typically prior to the construction of a hotel/casino, the number of employees and gaming positions is not known. Likewise, the number of employees may be an estimate that may not be accurate to the actual number of employees after completion of the project. Therefore, the equation relating the casino floor area to peak-hour trips is believed to be acceptable for estimating trip generation. However, if certain variables are known, the following list provides the order to use the independent-variable regression equations to determine the best trip generation estimation for a local hotel/casino during each peak hour:

a.m. peak hour (T = peak-hour trips)
– 57% entering and 43% exiting

1 Employees (X)
Ln(T) = 0.710 Ln(X) + 1.506
R^2 = 0.77
$T = 4.509\ X^{0.710}$

2 Gaming Positions (X)
Ln(T) = 0.604 Ln(X) + 2.147
R^2 = 0.72
$T = 8.559\ X^{0.604}$

3 Casino Floor Area (X)
Ln(T) = 0.433 Ln(X) + 4.848
R^2 = 0.71
$T = 127.485\ X^{0.433}$

p.m. peak hour (T = peak-hour trips)
– 52% entering and 48% exiting

1 Gaming Positions (X)
Ln(T) = 0.794 Ln(X) + 1.278
R^2 = 0.83
$T = 3.589\ X^{0.794}$

2 Casino Floor Area (X)
Ln(T) = 0.527 Ln(X) + 4.999
R^2 = 0.72
$T = 148.265\ X^{0.527}$

3 Employees (X)
Ln(T) = 0.847 Ln(X) + 1.086
R^2 = 0.72
$T = 2.962\ X^{0.847}$

Instead of using regression equations, average trip rates may also be used. These rates are as follows:

a.m. peak hour

Trips per gaming position:	0.470
Trips per employee:	0.566
Trips per hotel room:	2.538
Trips per 1,000 square feet (sf) of casino floor area:	14.076

p.m. peak hour

Trips per gaming position:	0.788
Trips per employee:	1.021

Trips per hotel room:	5.067
Trips per 1,000 sf of casino floor area:	22.342

CONCLUSIONS

From this analysis, it was found that the addition of gaming positions as an independent variable was a significant improvement over previous developed equations. It is important to recognize that these trip generation equations were developed using data from Las Vegas hotel/casinos. As previously described, the trip-making characteristics of the resort corridor Las Vegas hotel/casinos are unique based on facility size and proximity to each other. Caution should be used when applying these equations to hotel/casinos outside of Las Vegas. However, the local hotel/casino equations developed may have applications to other gaming establishments throughout the United States. It is recommended that further study be conducted comparing these equations to other regional gaming facilities for the various independent variables. ■

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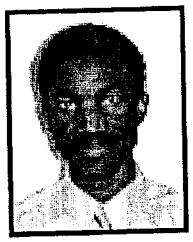

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Partial listing as of press time.

WHO SHOULD ATTEND
★ City, county, state and federal officials
★ Transportation providers
★ Real estate and land developers
★ Consultants
★ Contractors
★ Commerce and transportation officials
★ Chambers of Commerce leaders
★ Civil engineers and contractors
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★ Homeland Defense and Security
★ Mobility and Toll Equity Funding
★ TEA-21 Reauthorization
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IRVING

2007 BACKGROUND TRAFFIC CAPACITY ANALYSIS – WITH IMPROVEMENTS

HCS2000: Signalized Intersections Release 4.1e

Analyst: md
Agency:
Date: 1/4/2005
Period: am
Project ID: 2007 background traffic - with improvements
E/W St: sth 158

Inter.: sth 158/cth h
Area Type: All other areas
Jurisd: wisdot
Year : 2007
N/S St: cth h

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes		1	2	1	1	2	0	0	1	0	0	1	1
LGConfig	L		T	R	L	TR			LTR			LT	R
Volume	70	520	15		65	560	25	5	160	65	55	260	75
Lane Width	12.0	12.0	12.0		12.0	12.0			12.0			12.0	12.0
RTOR Vol			0			0				0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A	A			NB Left		A		
Thru		A			Thru		A		
Right		A			Right		A		
Feds					Feds				
WB Left	A	A			SB Left	A	A		
Thru		A			Thru	A	A		
Right		A			Right	A	A		
Feds					Peds				
NB Right					EB Right				
SB Right	A				WB Right				
Green	5.0	35.0				7.0	25.0		
Yellow	3.0	4.5				3.0	4.5		
All Red	0.0	1.5				0.0	1.5		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	290	1752	0.28	0.48	14.5	B		
T	1311	3370	0.45	0.39	20.6	C	19.8	B
R	628	1615	0.03	0.39	17.0	B		
Westbound								
L	330	1752	0.22	0.48	14.0	B		
TR	1308	3364	0.51	0.39	21.3	C	20.5	C
Northbound								
LTR	493	1774	0.53	0.28	28.6	C	28.6	C
Southbound								
LT	517	1783	0.69	0.39	27.0	C	24.0	C
R	794	1553	0.11	0.51	11.4	B		

Intersection Delay = 22.0 (sec/veh) Intersection LOS = C

HCS2000: Signalized Intersections Release 4.1e

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1700 W Irving Park Road
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Chicago, IL 60618
Phone: 773.305.0800 Fax: 773.305.0805
E-Mail: mdelavergne@landstrategiesinc.com

OPERATIONAL ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/4/2005
Analysis Time Period: am
Intersection: sth 158/cth h
Area Type: All other areas
Jurisdiction: wisdot
Analysis Year: 2007
Project ID: 2007 background traffic - with improvements
East/West Street: sth 158 North/South Street: cth h

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	70	520	15	65	560	25	5	160	65	55	260	75
% Heavy Veh	3	13	0	3	7	4	20	1	3	4	6	4
PHF	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
PK 15 Vol	20	148	4	18	159	7	2	45	18	16	74	21
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	2000	1900	1900	1900			1900			1900	1900
ParkExist												
NumPark												
No. Lanes		1	2	1	1	2	0	0	1	0	0	1	1
LGConfig		L	T	R	L	TR			LTR			LT	R
Lane Width		12.0	12.0	12.0	12.0	12.0			12.0			12.0	12.0
RTOR Vol			0				0			0			0
Adj Flow	80	591	17	74	664			262			358	85
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000			0.023			0.176	
Prop RTs		0.000	1.000		0.042		0.282			0.000	1.000	
Peds Bikes	0			0			0			0		
Buses	0	0	0	0	0			0			0	0
%InProtPhase	0.0			0.0						0.0		

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0	0.0	0.0	0.0			0.0			0.0	0.0
Arriv. Type	3	3	3	3	3			3			3	3
Unit Ext.	3.0	3.0	3.0	3.0	3.0			3.0			3.0	3.0
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0	2.0	2.0	2.0			2.0			2.0	2.0
Ext of g	2.0	2.0	2.0	2.0	2.0			2.0			2.0	2.0
Ped Min g		3.2			3.2			3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A	A			NB Left		A		
Thru		A			Thru		A		
Right		A			Right		A		
Feds					Peds				
WB Left	A	A			SB Left	A	A		
Thru		A			Thru	A	A		
Right		A			Right	A	A		
Feds					Peds				
NB Right					EB Right				
SB Right	A				WB Right				
Green	5.0	35.0				7.0	25.0		
Yellow	3.0	4.5				3.0	4.5		
All Red	0.0	1.5				0.0	1.5		

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	70	520	15	65	560	25	5	160	65	55	260	75
PHF	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Adj flow	80	591	17	74	636	28	6	182	74	63	295	85
No. Lanes		1	2	1	1	2	0	0	1	0	0	1	1
Lane group		L	T	R	L	TR			LTR			LT	R
Adj flow		80	591	17	74	664			262			358	85
Prop LTs		1.000	0.000		1.000	0.000			0.023			0.176	
Prop RTs			0.000	1.000		0.042		0.282			0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L	T	R	L	TR			LTR			LT	R
So	1900	2000	1900	1900	1900			1900			1900	1900
Lanes	1	2	1	1	2	0	0	1	0	0	1	1
fW	1.000	1.000	1.000	1.000	1.000			1.000			1.000	1.000
fHV	0.971	0.885	1.000	0.971	0.936			0.980			0.947	0.962
fG	1.000	1.000	1.000	1.000	1.000			1.000			1.000	1.000
fP	1.000	1.000	1.000	1.000	1.000			1.000			1.000	1.000
fBB	1.000	1.000	1.000	1.000	1.000			1.000			1.000	1.000
fA	1.000	1.000	1.000	1.000	1.000			1.000			1.000	1.000
fLU	1.000	0.952	1.000	1.000	0.952			1.000			1.000	1.000
fRT		1.000	0.850		0.994			0.962			1.000	0.850
fLT	0.950	1.000		0.950	1.000			0.990			0.991	
Sec.	0.248			0.300							0.676	
fLpb	1.000	1.000		1.000	1.000			1.000			1.000	
fRpb		1.000	1.000		1.000			1.000			1.000	1.000
S	1752	3370	1615	1752	3364			1774			1783	1553
Sec.	457			553							1215	

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		80	1752	# 0.05	0.056	97	0.82
Perm		0	457	0.00	0.422	193	0.00
Left	L	80			0.48	290	0.28
Prot							
Perm							
Thru	T	591	3370	0.18	0.39	1311	0.45
Right	R	17	1615	0.01	0.39	628	0.03
Westbound							
Prot		74	1752	0.04	0.056	97	0.76
Perm		0	553	0.00	0.422	233	0.00
Left	L	74			0.48	330	0.22
Prot							
Perm							
Thru	TR	664	3364	# 0.20	0.39	1308	0.51
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	262	1774	0.15	0.28	493	0.53
Right							
Southbound							
Prot							
Perm							
Left							
Prot		139	1783	# 0.08	0.078	139	1.00
Perm		219	1215	# 0.18	0.311	378	0.58
Thru	LT	358			0.39	517	0.69
Right	R	85	1553	0.05	0.51	794	0.11

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.50
Total lost time per cycle, L = 18.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.63

Control Delay and LOS Determination

Appr/ Lane Grp	v/c	g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	0.28	0.48	14.0	1.000	290	0.11	0.5	0.0	14.5	B		
T	0.45	0.39	20.4	1.000	1311	0.11	0.2	0.0	20.6	C	19.8	B
R	0.03	0.39	17.0	1.000	628	0.11	0.0	0.0	17.0	B		
Westbound												
L	0.22	0.48	13.6	1.000	330	0.11	0.3	0.0	14.0	B		
TR	0.51	0.39	20.9	1.000	1308	0.12	0.3	0.0	21.3	C	20.5	C
Northbound												
LTR	0.53	0.28	27.5	1.000	493	0.13	1.1	0.0	28.6	C	28.6	C
Southbound												

LT	0.69	0.39	23.0	1.000	517	0.26	4.0	0.0	27.0	C	24.0	C
R	0.11	0.51	11.4	1.000	794	0.11	0.1	0.0	11.4	B		

Intersection delay = 22.0 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M		
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	43.0	43.0		
Effective permitted green time for LT lane group, g(s)	38.0	38.0		
Opposing effective green time, go (s)	35.0	35.0		
Number of lanes in LT lane group, N	1	1		
Number of lanes in opposing approach, No	2	2		
Adjusted LT flow rate, VLT (veh/h)	80	74		
Proportion of LT in LT lane group, PLT	1.000	1.000		
Proportion of LT in opposing flow, PLTo	0.00	0.00		
Adjusted opposing flow rate, Vo (veh/h)	664	591		
Lost time for LT lane group, tL	6.00	6.00		
Computation				
LT volume per cycle, LTC=VLTC/3600	2.00	1.85		
Opposing lane util. factor, fLUo	0.952	0.952	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	8.72	7.76		
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g	0.0	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.61	0.61		
gq, (see Exhibit C16-4,5,6,7,8)	13.22	11.46		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	24.78	26.54		
n=Max(gq-gf)/2,0)	6.61	5.73		
PTHo=1-PLTo	1.00	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00		
EL1 (refer to Exhibit C16-3)	2.63	2.33		
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.11	0.11		
gdiff=max(gq-gf,0)	0.00	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.25	0.30		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.248	0.300		

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach			M	S
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)			25.0	35.0
Effective permitted green time for LT lane group, g(s)			25.0	28.0
Opposing effective green time, go (s)			35.0	25.0
Number of lanes in LT lane group, N			1	1
Number of lanes in opposing approach, No			1	1
Adjusted LT flow rate, VLT (veh/h)			6	63
Proportion of LT in LT lane group, PLT	0.000	0.000	0.023	0.176
Proportion of LT in opposing flow, PLTo			0.18	0.02
Adjusted opposing flow rate, Vo (veh/h)			358	262
Lost time for LT lane group, tL			6.00	6.00
Computation				
LT volume per cycle, LTC=VLTC/3600			0.15	1.58
Opposing lane util. factor, fLUo	0.952	0.952	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			8.95	6.55
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g			13.9	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.61	0.72
gq, (see Exhibit C16-4,5,6,7,8)			0.00	14.66
gu=g-gq if gq>=gf, or = g-gf if gq<gf			11.06	13.34
n=Max(gq-gf)/2,0)			0.00	7.33
PTHo=1-PLTo			0.82	0.98
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			0.02	0.18
EL1 (refer to Exhibit C16-3)			2.00	1.81
EL2=Max((1-Ptho**n)/Plto, 1.0)			1.00	6.82
fmin=2(1+PL)/g or fmin=2(1+Pl)/g			0.08	0.08
gdiff=max(gq-gf,0)			0.00	14.66
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.99	0.68
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.990	0.676

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 90.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v	80	74		
v/c ratio from Capacity Worksheet, X	0.28	0.22		
Protected phase effective green interval, g (s)	5.0	5.0		
Opposing queue effective green interval, gq	13.22	11.46		
Unopposed green interval, gu	24.78	26.54		
Red time r=(C-g-gq-gu)	47.0	47.0		
Arrival rate, qa=v/(3600(max[X,1.0]))	0.02	0.02		
Protected ph. departure rate, Sp=s/3600	0.487	0.487		
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.19	0.22		
XPerm	0.18	0.13		
XProt	0.47	0.44		
Case	1	1		
Queue at beginning of green arrow, Qa	1.04	0.97		
Queue at beginning of unsaturated green, Qu	0.29	0.24		
Residual queue, Qr	0.00	0.00		
Uniform Delay, d1	14.0	13.6		

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 22.0 sec/veh Intersection LOS C

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	T	R	L	TR		LTR			LT	R	
Init Queue	0.0	0.0	0.0	0.0	0.0		0.0			0.0	0.0	
Flow Rate	80	310	17	74	348		262			358	85	
So	1900	2000	1900	1900	1900		1900			1900	1900	
No.Lanes	1	2	1	1	2	0	0 1	0	0	1	1	
SL	608	1769	1615	692	1766		1774			1328	1553	
LnCapacity	290	688	628	330	686		493			517	794	
Flow Ratio	0.13	0.18	0.01	0.11	0.20		0.15			0.27	0.05	
v/c Ratio	0.28	0.45	0.03	0.22	0.51		0.53			0.69	0.11	
Grn Ratio	0.48	0.39	0.39	0.48	0.39		0.28			0.39	0.51	
I Factor		1.000			1.000		1.000			1.000		
AT or PVG	3	3	3	3	3		3			3	3	
Fltn Ratio	1.00	1.00	1.00	1.00	1.00		1.00			1.00	1.00	
FF2	1.00	1.00	1.00	1.00	1.00		1.00			1.00	1.00	
Q1	1.1	5.7	0.3	1.0	6.6		5.5			5.8	1.1	
XB	0.3	0.6	0.5	0.4	0.6		0.5			0.5	0.6	
Q2	0.1	0.4	0.0	0.1	0.6		0.5			1.0	0.1	
Q Average	1.2	6.2	0.3	1.1	7.2		6.1			6.8	1.2	
Q Spacing	25.0	25.0	25.0	25.0	25.0		25.0			25.0	25.0	
Q Storage	0	0	0	0	0		0			0	0	
Q S Ratio												
70th Percentile Output:												
fB%	1.2	1.2	1.2	1.2	1.2		1.2			1.2	1.2	
BOQ	1.4	7.3	0.3	1.3	8.5		7.2			8.0	1.4	
QSRatio												
85th Percentile Output:												
fB%	1.6	1.5	1.6	1.6	1.5		1.5			1.5	1.6	
BOQ	1.9	9.6	0.4	1.7	11.0		9.4			10.4	1.9	
QSRatio												
90th Percentile Output:												
fB%	1.8	1.7	1.8	1.8	1.7		1.7			1.7	1.8	
BOQ	2.1	10.5	0.5	1.9	12.1		10.3			11.4	2.1	
QSRatio												
95th Percentile Output:												
fB%	2.1	1.9	2.1	2.1	1.9		1.9			1.9	2.1	
BOQ	2.4	11.9	0.6	2.2	13.7		11.7			13.0	2.4	
QSRatio												
98th Percentile Output:												
fB%	2.6	2.3	2.7	2.6	2.3		2.3			2.3	2.6	
BOQ	3.1	14.4	0.7	2.8	16.3		14.1			15.5	3.1	
QSRatio												

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: md
Agency:
Date: 1/4/2005
Period: pm
Project ID: 2007 background traffic - with improvements
E/W St: sth 158

Inter.: sth 158/cth h
Area Type: All other areas
Jurisd: wisdot
Year : 2007
N/S St: cth h

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	2	1	1	2	0	0	1	0	0	1	1
LGConfig	L	T	R	L	TR			LTR			LT	R
Volume	125	655	20	40	385	60	10	310	50	55	280	40
Lane Width	12.0	12.0	12.0	12.0	12.0			12.0			12.0	12.0
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A	A			NB Left		A		
Thru		A			Thru		A		
Right		A			Right		A		
Peds					Peds				
WB Left	A	A			SB Left	A	A		
Thru		A			Thru	A	A		
Right		A			Right	A	A		
Peds					Peds				
NB Right					EB Right				
SB Right	A				WB Right				
Green	6.0	30.0				7.0	29.0		
Yellow	3.0	4.5				3.0	4.5		
All Red	0.0	1.5				0.0	1.5		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	332	1805	0.43	0.43	17.3	B		
T	1209	3627	0.62	0.33	26.1	C	24.6	C
R	538	1615	0.04	0.33	20.3	C		
Westbound								
L	248	1805	0.18	0.43	16.8	B		
TR	1152	3455	0.44	0.33	23.7	C	23.1	C
Northbound								
LTR	579	1796	0.73	0.32	31.5	C	31.5	C
Southbound								
LT	538	1847	0.71	0.43	25.1	C	23.4	C
R	824	1455	0.05	0.57	8.7	A		

Intersection Delay = 25.3 (sec/veh) Intersection LOS = C

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/4/2005
Analysis Time Period: pm
Intersection: sth 158/cth h
Area Type: All other areas
Jurisdiction: wisdot
Analysis Year: 2007
Project ID: 2007 background traffic - with improvements
East/West Street: sth 158 North/South Street: cth h

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	125	655	20	40	385	60	10	310	50	55	280	40
% Heavy Veh	0	5	0	0	3	0	10	2	4	2	2	11
PHF	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
PK 15 Vol	36	186	6	11	109	17	3	88	14	16	80	11
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	2000	1900	1900	1900			1900			1900	1900
ParkExist												
NumPark												
No. Lanes	1	2	1	1	2	0	0	1	0	0	1	1
LGConfig	L	T	R	L	TR			LTR			LT	R
Lane Width	12.0	12.0	12.0	12.0	12.0			12.0			12.0	12.0
RTOR Vol			0			0			0			0
Adj Flow	142	744	23	45	506			420			381	45
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000			0.026			0.165	
Prop RTs		0.000	1.000		0.134		0.136			0.000		1.000
Peds Bikes	0			0			0			0		
Buses	0	0	0	0	0		0			0	0	0
%InProtPhase	0.0			0.0						0.0		

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0	0.0	0.0	0.0			0.0			0.0	0.0
Arriv. Type	3	3	3	3	3			3			3	3
Unit Ext.	3.0	3.0	3.0	3.0	3.0			3.0			3.0	3.0
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0	2.0	2.0	2.0			2.0			2.0	2.0
Ext of g	2.0	2.0	2.0	2.0	2.0			2.0			2.0	2.0

Ped Min g	3.2	3.2	3.2	3.2

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A	A			NB Left		A		
Thru		A			Thru		A		
Right		A			Right		A		
Peds					Peds				
WB Left	A	A			SB Left	A	A		
Thru		A			Thru	A	A		
Right		A			Right	A	A		
Peds					Peds				
NB Right					EB Right				
SB Right	A				WB Right				
Green	6.0	30.0				7.0	29.0		
Yellow	3.0	4.5				3.0	4.5		
All Red	0.0	1.5				0.0	1.5		

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	125	655	20	40	385	60	10	310	50	55	280	40
PHF	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Adj flow	142	744	23	45	438	68	11	352	57	63	318	45
No. Lanes	1	2	1	1	2	0	0	1	0	0	1	1
Lane group	L	T	R	L	TR			LTR			LT	R
Adj flow	142	744	23	45	506			420			381	45
Prop LTs	1.000	0.000		1.000	0.000			0.026			0.165	
Prop RTs		0.000	1.000		0.134		0.136			0.000		1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L	T	R	L	TR			LTR			LT	R
So	1900	2000	1900	1900	1900			1900			1900	1900
Lanes	1	2	1	1	2	0	0	1	0	0	1	1
fW	1.000	1.000	1.000	1.000	1.000			1.000			1.000	1.000
fHV	1.000	0.952	1.000	1.000	0.975			0.976			0.980	0.901
fG	1.000	1.000	1.000	1.000	1.000			1.000			1.000	1.000
fP	1.000	1.000	1.000	1.000	1.000			1.000			1.000	1.000
fBB	1.000	1.000	1.000	1.000	1.000			1.000			1.000	1.000
fA	1.000	1.000	1.000	1.000	1.000			1.000			1.000	1.000
fLU	1.000	0.952	1.000	1.000	0.952			1.000			1.000	1.000
fRT		1.000	0.850		0.980			0.982			1.000	0.850
fLT	0.950	1.000		0.950	1.000			0.987			0.992	
Sec.	0.304			0.183							0.595	
fLpb	1.000	1.000		1.000	1.000			1.000			1.000	
fRpb		1.000	1.000		1.000			1.000			1.000	1.000
S	1805	3627	1615	1805	3455			1796			1847	1455
Sec.	577			348							1108	

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		120	1805	# 0.07	0.067	120	1.00
Perm		22	577	0.04	0.367	212	0.10
Left	L	142			0.43	332	0.43
Prot							
Perm							
Thru	T	744	3627	# 0.21	0.33	1209	0.62
Right	R	23	1615	0.01	0.33	538	0.04
Westbound							
Prot		45	1805	0.02	0.067	120	0.38
Perm		0	348	0.00	0.367	128	0.00
Left	L	45			0.43	248	0.18
Prot							
Perm							
Thru	TR	506	3455	0.15	0.33	1152	0.44
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	420	1796	# 0.23	0.32	579	0.73
Right							
Southbound							
Prot							
Perm							
Left							
Prot		144	1847	# 0.08	0.078	144	1.00
Perm		237	1108	0.21	0.356	394	0.60
Thru	LT	381			0.43	538	0.71
Right	R	45	1455	0.03	0.57	824	0.05

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.58
Total lost time per cycle, L = 24.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.80

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	0.43	0.43	16.4	1.000	332	0.11	0.9	0.0	17.3	B		
T	0.62	0.33	25.2	1.000	1209	0.20	0.9	0.0	26.1	C	24.6	C
R	0.04	0.33	20.3	1.000	538	0.11	0.0	0.0	20.3	C		
Westbound												
L	0.18	0.43	16.5	1.000	248	0.11	0.4	0.0	16.8	B		
TR	0.44	0.33	23.4	1.000	1152	0.11	0.3	0.0	23.7	C	23.1	C
Northbound												
LTR	0.73	0.32	27.0	1.000	579	0.29	4.5	0.0	31.5	C	31.5	C
Southbound												

LT	0.71	0.43	20.8	1.000	538	0.27	4.3	0.0	25.1	C	23.4	C
R	0.05	0.57	8.7	1.000	824	0.11	0.0	0.0	8.7	A		

Intersection delay = 25.3 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M		
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	39.0	39.0		
Effective permitted green time for LT lane group, g(s)	33.0	33.0		
Opposing effective green time, go (s)	30.0	30.0		
Number of lanes in LT lane group, N	1	1		
Number of lanes in opposing approach, No	2	2		
Adjusted LT flow rate, VLT (veh/h)	142	45		
Proportion of LT in LT lane group, PLT	1.000	1.000		
Proportion of LT in opposing flow, PLTo	0.00	0.00		
Adjusted opposing flow rate, Vo (veh/h)	506	744		
Lost time for LT lane group, tL	6.00	6.00		
Computation				
LT volume per cycle, LTC=VLTC/3600	3.55	1.13		
Opposing lane util. factor, fLUo	0.952	0.952	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	6.64	9.77		
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g	0.0	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.67	0.67		
gq, (see Exhibit C16-4,5,6,7,8)	10.39	16.64		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	22.61	16.36		
n=Max(gq-gf)/2,0)	5.20	8.32		
PTHo=1-PLTo	1.00	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00		
EL1 (refer to Exhibit C16-3)	2.26	2.70		
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.12	0.12		
gdiff=max(gq-gf,0)	0.00	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.30	0.18		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.304	0.183		

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach			M	S
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)			29.0	39.0
Effective permitted green time for LT lane group, g(s)			29.0	32.0
Opposing effective green time, go (s)			39.0	29.0
Number of lanes in LT lane group, N			1	1
Number of lanes in opposing approach, No			1	1
Adjusted LT flow rate, VLT (veh/h)			11	63
Proportion of LT in LT lane group, PLT	0.000	0.000	0.026	0.165
Proportion of LT in opposing flow, PLTo			0.17	0.03
Adjusted opposing flow rate, Vo (veh/h)			381	420
Lost time for LT lane group, tL			6.00	6.00
Computation				
LT volume per cycle, LTC=VLTC/3600			0.28	1.58
Opposing lane util. factor, fLUo	0.952	0.952	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			9.52	10.50
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g			14.4	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.57	0.68
gq, (see Exhibit C16-4,5,6,7,8)			0.00	19.63
gu=g-gq if gq>=gf, or = g-gf if gq<gf			14.55	12.37
n=Max(gq-gf)/2,0)			0.00	9.82
PTHo=1-PLTo			0.83	0.97
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			0.03	0.17
EL1 (refer to Exhibit C16-3)			2.04	2.12
EL2=Max((1-Ptho**n)/Plto, 1.0)			1.00	8.76
fmin=2(1+PL)/g or fmin=2(1+Pl)/g			0.07	0.07
gdiff=max(gq-gf,0)			0.00	19.63
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.99	0.59
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.987	0.595

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 90.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v	142	45		
v/c ratio from Capacity Worksheet, X	0.43	0.18		
Protected phase effective green interval, g (s)	6.0	6.0		
Opposing queue effective green interval, gq	10.39	16.64		
Unopposed green interval, gu	22.61	16.36		
Red time r=(C-g-gq-gu)	51.0	51.0		
Arrival rate, qa=v/(3600(max[X,1.0]))	0.04	0.01		
Protected ph. departure rate, Sp=s/3600	0.501	0.501		
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.23	0.19		
XPerm	0.25	0.13		
XProt	0.75	0.24		
Case	1	1		
Queue at beginning of green arrow, Qa	2.01	0.64		
Queue at beginning of unsaturated green, Qu	0.41	0.21		
Residual queue, Qr	0.00	0.00		
Uniform Delay, d1	16.4	16.5		

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 25.3 sec/veh Intersection LOS C

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	T	R	L	TR		LTR			LT	R	
Init Queue	0.0	0.0	0.0	0.0	0.0		0.0			0.0	0.0	
Flow Rate	142	390	23	45	265		420			381	45	
So	1900	2000	1900	1900	1900		1900			1900	1900	
No.Lanes	1	2	1	1	2	0	0	1	0	1	1	
SL	766	1904	1615	572	1814		1796			1240	1455	
LnCapacity	332	634	538	248	605		579			538	824	
Flow Ratio	0.19	0.20	0.01	0.08	0.15		0.23			0.31	0.03	
v/c Ratio	0.43	0.62	0.04	0.18	0.44		0.73			0.71	0.05	
Grn Ratio	0.43	0.33	0.33	0.43	0.33		0.32			0.43	0.57	
I Factor		1.000			1.000		1.000			1.000		
AT or PVG	3	3	3	3	3		3			3	3	
Pltn Ratio	1.00	1.00	1.00	1.00	1.00		1.00			1.00	1.00	
PF2	1.00	1.00	1.00	1.00	1.00		1.00			1.00	1.00	
Q1	2.1	8.2	0.4	0.6	5.2		9.3			5.7	0.5	
kB	0.4	0.5	0.5	0.3	0.5		0.5			0.5	0.6	
Q2	0.3	0.8	0.0	0.1	0.4		1.2			1.1	0.0	
Q Average	2.3	9.0	0.4	0.7	5.6		10.5			6.8	0.5	
Q Spacing	25.0	25.0	25.0	25.0	25.0		25.0			25.0	25.0	
Q Storage	0	0	0	0	0		0			0	0	
Q S Ratio												
70th Percentile Output:												
fB%	1.2	1.2	1.2	1.2	1.2		1.2			1.2	1.2	
BOQ	2.8	10.6	0.5	0.9	6.6		12.4			8.1	0.6	
QSRatio												
85th Percentile Output:												
fB%	1.6	1.5	1.6	1.6	1.5		1.5			1.5	1.6	
BOQ	3.7	13.7	0.7	1.1	8.6		15.9			10.5	0.9	
QSRatio												
90th Percentile Output:												
fB%	1.8	1.7	1.8	1.8	1.7		1.6			1.7	1.8	
BOQ	4.1	14.9	0.7	1.3	9.5		17.2			11.5	1.0	
QSRatio												
95th Percentile Output:												
fB%	2.0	1.9	2.1	2.1	1.9		1.8			1.9	2.1	
BOQ	4.7	16.8	0.9	1.5	10.8		19.3			13.0	1.1	
QSRatio												
98th Percentile Output:												
fB%	2.5	2.2	2.7	2.6	2.4		2.1			2.3	2.7	
BOQ	5.9	19.8	1.1	1.9	13.1		22.6			15.6	1.4	
QSRatio												

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: md
Agency:
Date: 1/10/2005
Period: am
Project ID: 2007 background traffic - with improvements
E/W St: STH 158

Inter.: STH 158/104th
Area Type: All other areas
Jurisd: WisDOT
Year : 2007
N/S St: 104th Ave

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes		1	2	1	1	2	1	1	1	1	1	0
LGConfig		L	T	R	L	T	R	L	LT	R	L	TR
Volume		5	535	20	125	460	5	30	5	105	5	10 5
Lane Width		12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0
RTOR Vol				0			0			0		0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4			5	6	7	8
EB Left	A		A		NB	Left	A			
Thru			A			Thru	A			
Right			A			Right	A			
Peds						Peds				
WB Left	A	A	A		SB	Left		A		
Thru		A	A			Thru		A		
Right		A	A			Right		A		
Peds						Peds				
NB Right		A			EB	Right	A			
SB Right					WB	Right				
Green	5.0	5.0	24.0				21.0	11.0		
Yellow	3.0	3.0	4.5				4.5	4.5		
All Red	0.0	0.0	1.5				1.5	1.5		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	308	1770	0.02	0.32	20.8	C		
T	883	3311	0.73	0.27	33.2	C	32.2	C
R	897	1583	0.03	0.57	8.6	A		
Westbound								
L	350	1770	0.43	0.44	17.7	B		
T	1254	3526	0.44	0.36	22.4	C	21.4	C
R	563	1583	0.01	0.36	18.8	B		
Northbound								
L	421	1805	0.04	0.23	26.8	C		
LT	427	1831	0.06	0.23	26.9	C	25.5	C
R	462	1599	0.27	0.29	25.0	C		
Southbound								
L	216	1770	0.03	0.12	34.8	C		
TR	216	1770	0.08	0.12	35.2	D	35.1	D

Intersection Delay = 26.7 (sec/veh) Intersection LOS = C

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HCS2000: Signalized Intersections Release 4.1e

OPERATIONAL ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/10/2005
Analysis Time Period: am
Intersection: STH 158/104th
Area Type: All other areas
Jurisdiction: WisDOT
Analysis Year: 2007
Project ID: 2007 background traffic - with improvements
East/West Street: STH 158 North/South Street: 104th Ave

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	5	535	20	125	460	5	30	5	105	5	10	5
% Heavy Veh	2	15	2	2	8	2	0	0	1	2	2	2
PHF	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83
PK 15 Vol	2	161	6	38	139	2	9	2	32	2	3	2
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	2000	1900	1900	2000	1900	1900	1900	1900	1900	1900	
ParkExist												
NumPark												
No. Lanes		1	2	1	1	2	1	1	1	1	1	0
LGConfig		L	T	R	L	T	R	L	LT	R	L	TR
Lane Width		12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	
RTOR Vol				0			0			0		0
Adj Flow		6	645	24	151	554	6	18	24	127	6	18
%InSharedLn								50				
Prop LTs		1.000	0.000		1.000	0.000			0.750			0.000
Prop RTs			0.000	1.000		0.000	1.000	0.000		1.000	0.333	
Peds	Bikes	0				0		0			0	
Buses		0	0	0	0	0	0	0	0	0	0	0
%InProtPhase		0.0				0.0						

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Arriv. Type	3	3	3	3	3	3	3	3	3	3	3	
Unit Ext.	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	
Ext of g	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	

Ped Min g	3.2	3.2	3.2	3.2

PHASE DATA

Phase Combination	1	2	3	4			5	6	7	8
EB Left	A		A		NB	Left	A			
Thru			A			Thru	A			
Right			A			Right	A			
Peds						Peds				
WB Left	A	A	A		SB	Left		A		
Thru		A	A			Thru		A		
Right		A	A			Right		A		
Peds						Peds				
NB Right		A			EB	Right	A			
SB Right					WB	Right				
Green	5.0	5.0	24.0				21.0	11.0		
Yellow	3.0	3.0	4.5				4.5	4.5		
All Red	0.0	0.0	1.5				1.5	1.5		

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	5	535	20	125	460	5	30	5	105	5	10	5
PHF	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83
Adj flow	6	645	24	151	554	6	36	6	127	6	12	6
No. Lanes		1	2	1	1	2	1	1	1	1	1	0
Lane group		L	T	R	L	T	R	L	LT	R	L	TR
Adj flow		6	645	24	151	554	6	18	24	127	6	18
Prop LTs		1.000	0.000		1.000	0.000			0.750			0.000
Prop RTs			0.000	1.000		0.000	1.000		0.000	1.000	0.333	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L	T	R	L	T	R	L	LT	R	L	TR	
So	1900	2000	1900	1900	2000	1900	1900	1900	1900	1900	1900	
Lanes	1	2	1	1	2	1	1	1	1	1	1	0
fW	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
fHV	0.980	0.870	0.980	0.980	0.926	0.980	1.000	1.000	0.990	0.980	0.980	
fG	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
fP	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
fBB	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
fA	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
fLU	1.000	0.952	1.000	1.000	0.952	1.000	1.000	1.000	1.000	1.000	1.000	
fRT		1.000	0.850		1.000	0.850		1.000	0.850		0.950	
fLT	0.950	1.000		0.950	1.000		0.950	0.964		0.950	1.000	
Sec.	0.423			0.168								
fLpb	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fRpb		1.000	1.000		1.000	1.000		1.000	1.000		1.000	
S	1770	3311	1583	1770	3526	1583	1805	1831	1599	1770	1770	
Sec.	788			312								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		6	1770	0.00	0.056	98	0.06
Perm		0	788	0.00	0.267	210	0.00
Left	L	6			0.32	308	0.02
Prot							
Perm							
Thru	T	645	3311	# 0.19	0.27	883	0.73
Right	R	24	1583	0.02	0.57	897	0.03
Westbound							
Prot		151	1770	# 0.09	0.144	256	0.59
Perm		0	312	0.00	0.300	94	0.00
Left	L	151			0.44	350	0.43
Prot							
Perm							
Thru	T	554	3526	0.16	0.36	1254	0.44
Right	R	6	1583	0.00	0.36	563	0.01
Northbound							
Prot							
Perm							
Left	L	18	1805	0.01	0.23	421	0.04
Prot							
Perm							
Thru	LT	24	1831	# 0.01	0.23	427	0.06
Right	R	127	1599	0.08	0.29	462	0.27
Southbound							
Prot							
Perm							
Left	L	6	1770	0.00	0.12	216	0.03
Prot							
Perm							
Thru	TR	18	1770	# 0.01	0.12	216	0.08
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.30
Total lost time per cycle, L = 24.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.41

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	0.02	0.32	20.7	1.000	308	0.11	0.0	0.0	20.8	C		
T	0.73	0.27	30.1	1.000	883	0.29	3.1	0.0	33.2	C	32.2	C
R	0.03	0.57	8.6	1.000	897	0.11	0.0	0.0	8.6	A		
Westbound												
L	0.43	0.44	16.8	1.000	350	0.11	0.9	0.0	17.7	B		
T	0.44	0.36	22.2	1.000	1254	0.11	0.2	0.0	22.4	C	21.4	C
R	0.01	0.36	18.8	1.000	563	0.11	0.0	0.0	18.8	B		
Northbound												
L	0.04	0.23	26.7	1.000	421	0.11	0.0	0.0	26.8	C		
LT	0.06	0.23	26.8	1.000	427	0.11	0.1	0.0	26.9	C	25.5	C
R	0.27	0.29	24.7	1.000	462	0.11	0.3	0.0	25.0	C		
Southbound												
L	0.03	0.12	34.8	1.000	216	0.11	0.1	0.0	34.8	C		

TR	0.08	0.12	35.0	1.000	216	0.11	0.2	0.0	35.2	D	35.1	D

Intersection delay = 26.7 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M		
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	29.0	40.0		
Effective permitted green time for LT lane group, g(s)	24.0	27.0		
Opposing effective green time, go (s)	32.0	24.0		
Number of lanes in LT lane group, N	1	1		
Number of lanes in opposing approach, No	2	2		
Adjusted LT flow rate, VLT (veh/h)	6	151		
Proportion of LT in LT lane group, PLT	1.000	1.000		
Proportion of LT in opposing flow, PLTo	0.00	0.00		
Adjusted opposing flow rate, Vo (veh/h)	554	645		
Lost time for LT lane group, tL	9.00	6.00		
Computation				
LT volume per cycle, LTC=VLTC/3600	0.15	3.78		
Opposing lane util. factor, fLUo	0.952	0.952	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	7.27	8.47		
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g	0.0	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.64	0.73		
gq, (see Exhibit C16-4,5,6,7,8)	0.00	15.30		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	24.00	11.70		
n=Max(gq-gf)/2,0)	0.00	7.65		
PTHo=1-PLTo	1.00	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00		
EL1 (refer to Exhibit C16-3)	2.36	2.58		
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.17	0.15		
gdiff=max(gq-gf,0)	0.00	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.42	0.17		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.423	0.168		

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000	0.750	0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	0.952	0.952	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 90.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v	6	151		
v/c ratio from Capacity Worksheet, X	0.02	0.43		
Protected phase effective green interval, g (s)	5.0	13.0		
Opposing queue effective green interval, gq	0.00	15.30		
Unopposed green interval, gu	24.00	11.70		
Red time r=(C-g-gq-gu)	61.0	50.0		
Arrival rate, qa=v/(3600(max[X,1.0]))	0.00	0.04		
Protected ph. departure rate, Sp=s/3600	0.492	0.492		
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.22	0.20		
XPerm	0.01	0.48		
XProt	0.04	0.41		
Case	1	1		
Queue at beginning of green arrow, Qa	0.10	2.10		
Queue at beginning of unsaturated green, Qu	0.00	0.64		
Residual queue, Qr	0.00	0.00		
Uniform Delay, d1	20.7	16.8		

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 26.7 sec/veh Intersection LOS C

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	T	R	L	T	R	L	LT	R	L	TR	
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Flow Rate	6	338	24	151	290	6	18	24	127	6	18	
So	1900	2000	1900	1900	2000	1900	1900	1900	1900	1900	1900	
No.Lanes	1	2	1	1	2	1	1	1	1	1	1	0
SL	957	1738	1583	786	1851	1583	1805	1831	1599	1770	1770	
LnCapacity	308	463	897	350	658	563	421	427	462	216	216	
Flow Ratio	0.01	0.19	0.02	0.19	0.16	0.00	0.01	0.01	0.08	0.00	0.01	
v/c Ratio	0.02	0.73	0.03	0.43	0.44	0.01	0.04	0.06	0.27	0.03	0.08	
Grn Ratio	0.32	0.27	0.57	0.44	0.36	0.36	0.23	0.23	0.29	0.12	0.12	
I Factor		1.000			1.000			1.000			1.000	
AT or PVG	3	3	3	3	3	3	3	3	3	3	3	
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
PF2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Q1	0.1	7.7	0.3	2.2	5.5	0.1	0.3	0.5	2.5	0.1	0.4	
kB	0.3	0.4	0.6	0.4	0.5	0.5	0.4	0.4	0.4	0.3	0.3	
Q2	0.0	1.1	0.0	0.3	0.4	0.0	0.0	0.0	0.2	0.0	0.0	
Q Average	0.1	8.8	0.3	2.5	6.0	0.1	0.4	0.5	2.6	0.1	0.4	
Q Spacing	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	
Q Storage	0	0	0	0	0	0	0	0	0	0	0	
Q S Ratio												
70th Percentile Output:												
fB%	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	
BOQ	0.1	10.4	0.3	3.0	7.1	0.1	0.4	0.6	3.1	0.2	0.5	
QSRatio												
85th Percentile Output:												
fB%	1.6	1.5	1.6	1.6	1.5	1.6	1.6	1.6	1.6	1.6	1.6	
BOQ	0.2	13.4	0.5	4.0	9.2	0.2	0.6	0.8	4.1	0.2	0.7	
QSRatio												
90th Percentile Output:												
fB%	1.8	1.7	1.8	1.8	1.7	1.8	1.8	1.8	1.8	1.8	1.8	
BOQ	0.2	14.6	0.5	4.4	10.1	0.2	0.7	0.9	4.6	0.3	0.8	
QSRatio												
95th Percentile Output:												
fB%	2.1	1.9	2.1	2.0	1.9	2.1	2.1	2.1	2.0	2.1	2.1	
BOQ	0.2	16.4	0.6	5.1	11.5	0.2	0.8	1.0	5.3	0.3	0.9	
QSRatio												
98th Percentile Output:												
fB%	2.7	2.2	2.7	2.5	2.3	2.7	2.7	2.7	2.5	2.7	2.7	
BOQ	0.3	19.4	0.8	6.3	13.9	0.3	1.0	1.3	6.6	0.4	1.1	
QSRatio												

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: md
Agency:
Date: 12/10/2004
Period: pm
Project ID: 2007 background traffic - with improvements
E/W St: STH 158

Inter.: STH 158/104th
Area Type: All other areas
Jurisd: WisDOT
Year : 2007
N/S St: 104th Ave

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes		1	2	1	1	2	1	1	1	1	1	0
LGConfig	L	T	R	L	T	R	L	LT	R	L	TR	
Volume	5	610	20	120	360	5	20	5	160	10	5	10
Lane Width	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A	A			NB Left	A			
Thru		A			Thru	A			
Right		A			Right	A			
Peds					Peds				
WB Left	A	A			SB Left		A		
Thru		A			Thru		A		
Right		A			Right		A		
Peds					Peds				
NB Right	A				EB Right	A			
SB Right					WB Right		A		
Green	6.0	28.0				29.0	6.0		
Yellow	3.0	4.5				4.5	4.5		
All Red	0.0	1.5				1.5	1.5		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	339	1770	0.02	0.41	16.1	B		
T	1150	3697	0.62	0.31	27.6	C	26.7	C
R	1130	1615	0.02	0.70	4.1	A		
Westbound								
L	231	1805	0.61	0.41	23.5	C		
T	1118	3592	0.38	0.31	24.4	C	24.1	C
R	598	1583	0.01	0.38	17.5	B		
Northbound								
L	582	1805	0.02	0.32	20.8	C		
LT	593	1839	0.03	0.32	20.9	C	19.5	B
R	622	1599	0.30	0.39	19.3	B		
Southbound								
L	118	1770	0.10	0.07	39.8	D		
TR	112	1676	0.16	0.07	40.3	D	40.1	D

Intersection Delay = 25.0 (sec/veh) Intersection LOS = C

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 12/10/2004
Analysis Time Period: pm
Intersection: STH 158/104th
Area Type: All other areas
Jurisdiction: WisDOT
Analysis Year: 2007
Project ID: 2007 background traffic - with improvements
East/West Street: STH 158 North/South Street: 104th Ave

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	5	610	20	120	360	5	20	5	160	10	5	10
% Heavy Veh	2	3	0	0	6	2	0	0	1	2	2	2
PHF	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
PK 15 Vol	2	179	6	35	106	2	6	2	47	3	2	3
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	2000	1900	1900	2000	1900	1900	1900	1900	1900	1900	
ParkExist												
NumPark												
No. Lanes		1	2	1	1	2	1	1	1	1	1	0
LGConfig	L	T	R	L	T	R	L	LT	R	L	TR	
Lane Width	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	
RTOR Vol			0			0			0			0
Adj Flow	6	718	24	141	424	6	12	18	188	12	18	
%InSharedLn							50					
Prop LTs	1.000	0.000		1.000	0.000			0.667			0.000	
Prop RTs		0.000	1.000		0.000	1.000	0.000	1.000		0.667		
Peds Bikes	0			0			0			0		
Buses	0	0	0	0	0	0	0	0	0	0	0	
%InProtPhase	0.0			0.0								

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Arriv. Type	3	3	3	3	3	3	3	3	3	3	3	
Unit Ext.	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	
Ext of g	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	

Ped Min g	3.2	3.2	3.2	3.2

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A	A			NB Left	A			
Thru		A			Thru	A			
Right		A			Right	A			
Peds					Peds				
WB Left	A	A			SB Left		A		
Thru		A			Thru		A		
Right		A			Right		A		
Peds					Peds				
NB Right	A				EB Right	A			
SB Right					WB Right		A		
Green	6.0	28.0				29.0	6.0		
Yellow	3.0	4.5				4.5	4.5		
All Red	0.0	1.5				1.5	1.5		

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	5	610	20	120	360	5	20	5	160	10	5	10
PHF	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Adj flow	6	718	24	141	424	6	24	6	188	12	6	12
No. Lanes		1	2	1	1	2	1	1	1	1	1	0
Lane group	L	T	R	L	T	R	L	LT	R	L	TR	
Adj flow	6	718	24	141	424	6	12	18	188	12	18	
Prop LTs	1.000	0.000		1.000	0.000			0.667			0.000	
Prop RTs		0.000	1.000		0.000	1.000	0.000	1.000		0.667		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L	T	R	L	T	R	L	LT	R	L	TR	
So	1900	2000	1900	1900	2000	1900	1900	1900	1900	1900	1900	
Lanes	1	2	1	1	2	1	1	1	1	1	1	0
fW	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
fHV	0.980	0.971	1.000	1.000	0.943	0.980	1.000	1.000	0.990	0.980	0.980	
fG	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
fP	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
fBB	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
fA	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
fLU	1.000	0.952	1.000	1.000	0.952	1.000	1.000	1.000	1.000	1.000	1.000	
fRT		1.000	0.850		1.000	0.850		1.000	0.850		0.900	
fLT	0.950	1.000		0.950	1.000		0.950	0.968		0.950	1.000	
Sec.	0.344			0.169								
fLpb	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fRpb		1.000	1.000		1.000	1.000		1.000	1.000		1.000	
S	1770	3697	1615	1805	3592	1583	1805	1839	1599	1770	1676	
Sec.	641			322								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		6	1770	0.00	0.067	118	0.05
Perm		0	641	0.00	0.344	221	0.00
Left	L	6			0.41	339	0.02
Prot							
Perm							
Thru	T	718	3697	# 0.19	0.31	1150	0.62
Right	R	24	1615	0.01	0.70	1130	0.02
Westbound							
Prot		120	1805	0.07	0.067	120	1.00
Perm		21	322	0.07	0.344	111	0.19
Left	L	141			0.41	231	0.61
Prot							
Perm							
Thru	T	424	3592	0.12	0.31	1118	0.38
Right	R	6	1583	0.00	0.38	598	0.01
Northbound							
Prot							
Perm							
Left	L	12	1805	0.01	0.32	582	0.02
Prot							
Perm							
Thru	LT	18	1839	0.01	0.32	593	0.03
Right	R	188	1599	# 0.12	0.39	622	0.30
Southbound							
Prot							
Perm							
Left	L	12	1770	0.01	0.07	118	0.10
Prot							
Perm							
Thru	TR	18	1676	# 0.01	0.07	112	0.16
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.32
Total lost time per cycle, L = 21.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.42

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	0.02	0.41	16.1	1.000	339	0.11	0.0	0.0	16.1	B		
T	0.62	0.31	26.5	1.000	1150	0.21	1.1	0.0	27.6	C	26.7	C
R	0.02	0.70	4.1	1.000	1130	0.11	0.0	0.0	4.1	A		
Westbound												
L	0.61	0.41	18.8	1.000	231	0.20	4.7	0.0	23.5	C		
T	0.38	0.31	24.2	1.000	1118	0.11	0.2	0.0	24.4	C	24.1	C
R	0.01	0.38	17.5	1.000	598	0.11	0.0	0.0	17.5	B		
Northbound												
L	0.02	0.32	20.8	1.000	582	0.11	0.0	0.0	20.8	C		
LT	0.03	0.32	20.9	1.000	593	0.11	0.0	0.0	20.9	C	19.5	B
R	0.30	0.39	19.0	1.000	622	0.11	0.3	0.0	19.3	B		
Southbound												
L	0.10	0.07	39.5	1.000	118	0.11	0.4	0.0	39.8	D		

TR	0.16	0.07	39.6	1.000	112	0.11	0.7	0.0	40.3	D	40.1	D

Intersection delay = 25.0 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M		
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	37.0	37.0		
Effective permitted green time for LT lane group, g(s)	31.0	31.0		
Opposing effective green time, go (s)	28.0	28.0		
Number of lanes in LT lane group, N	1	1		
Number of lanes in opposing approach, No	2	2		
Adjusted LT flow rate, VLT (veh/h)	6	141		
Proportion of LT in LT lane group, PLT	1.000	1.000		
Proportion of LT in opposing flow, PLTo	0.00	0.00		
Adjusted opposing flow rate, Vo (veh/h)	424	718		
Lost time for LT lane group, tL	6.00	6.00		
Computation				
LT volume per cycle, LTC=VLTC/3600	0.15	3.53		
Opposing lane util. factor, fLUo	0.952	0.952	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	5.57	9.43		
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g	0.0	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.69	0.69		
gq, (see Exhibit C16-4,5,6,7,8)	8.75	16.43		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	22.25	14.57		
n=Max(gq-gf)/2,0)	4.38	8.22		
PTHo=1-PLTo	1.00	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00		
EL1 (refer to Exhibit C16-3)	2.08	2.78		
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.13	0.13		
gdiff=max(gq-gf,0)	0.00	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.34	0.17		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.344	0.169		

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000	0.667	0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	0.952	0.952	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 90.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v	6	141		
v/c ratio from Capacity Worksheet, X	0.02	0.61		
Protected phase effective green interval, g (s)	6.0	6.0		
Opposing queue effective green interval, gq	8.75	16.43		
Unopposed green interval, gu	22.25	14.57		
Red time r=(C-g-gq-gu)	53.0	53.0		
Arrival rate, qa=v/(3600(max[X,1.0]))	0.00	0.04		
Protected ph. departure rate, Sp=s/3600	0.492	0.501		
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.25	0.19		
XPerm	0.01	0.44		
XProt	0.03	0.77		
Case	1	1		
Queue at beginning of green arrow, Qa	0.09	2.08		
Queue at beginning of unsaturated green, Qu	0.01	0.64		
Residual queue, Qr	0.00	0.00		
Uniform Delay, d1	16.1	18.8		

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Dur. Unmet Demand Q veh	Initial Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 25.0 sec/veh Intersection LOS C

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	T	R	L	T	R	L	LT	R	L	TR	
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Flow Rate	6	377	24	141	222	6	12	18	188	12	18	
So	1900	2000	1900	1900	2000	1900	1900	1900	1900	1900	1900	
No.Lanes	1	2	1	1	2	1	1	1	1	1	1	0
SL	824	1941	1615	562	1886	1583	1805	1839	1599	1770	1676	
LnCapacity	339	603	1130	231	587	598	582	593	622	118	112	
Flow Ratio	0.01	0.19	0.01	0.25	0.12	0.00	0.01	0.01	0.12	0.01	0.01	
v/c Ratio	0.02	0.63	0.02	0.61	0.38	0.01	0.02	0.03	0.30	0.10	0.16	
Grn Ratio	0.41	0.31	0.70	0.41	0.31	0.38	0.32	0.32	0.39	0.07	0.07	
I Factor		1.000			1.000			1.000			1.000	
AT or PVG	3	3	3	3	3	3	3	3	3	3	3	
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
PF2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Q1	0.1	8.1	0.2	2.2	4.3	0.1	0.2	0.3	3.3	0.3	0.4	
kB	0.4	0.5	0.7	0.3	0.5	0.5	0.5	0.5	0.5	0.2	0.2	
Q2	0.0	0.8	0.0	0.4	0.3	0.0	0.0	0.0	0.2	0.0	0.0	
Q Average	0.1	8.9	0.2	2.6	4.6	0.1	0.2	0.3	3.5	0.3	0.5	
Q Spacing	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	
Q Storage	0	0	0	0	0	0	0	0	0	0	0	
Q 3 Ratio												
70th Percentile Output:												
fB%	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	
BOQ	0.1	10.5	0.2	3.1	5.5	0.1	0.3	0.4	4.1	0.4	0.6	
QSRatio												
85th Percentile Output:												
fB%	1.6	1.5	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	
BOQ	0.2	13.5	0.3	4.1	7.2	0.2	0.3	0.5	5.5	0.5	0.7	
QSRatio												
90th Percentile Output:												
fB%	1.8	1.7	1.8	1.8	1.7	1.8	1.8	1.8	1.7	1.8	1.8	
BOQ	0.2	14.7	0.4	4.5	8.0	0.2	0.4	0.6	6.0	0.5	0.8	
QSRatio												
95th Percentile Output:												
fB%	2.1	1.9	2.1	2.0	2.0	2.1	2.1	2.1	2.0	2.1	2.1	
BOQ	0.2	16.6	0.4	5.2	9.1	0.2	0.5	0.7	6.9	0.6	1.0	
QSRatio												
98th Percentile Output:												
fB%	2.7	2.2	2.7	2.5	2.4	2.7	2.7	2.7	2.5	2.7	2.7	
BOQ	0.3	19.6	0.5	6.5	11.1	0.3	0.6	0.9	8.6	0.8	1.2	
QSRatio												

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: md
Agency:
Date: 1/3/2005
Period: am
Project ID: 2007 background traffic - with improvements
E/W St: sth 158

Inter.: sth 158/greyhound access
Area Type: All other areas
Jurisd: wisdot
Year : 2007
N/S St: greyhound access

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	1	2	0	2	0	1	0	0	0
LGConfig		T		L	T		L		R			
Volume		555		1	495		5		5			
Lane Width		12.0		12.0	12.0		12.0		12.0			
RTOR Vol									0			

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left					NB Left	A			
Thru		A			Thru				
Right					Right	A			
Peds					Peds				
WB Left	A	A			SB Left				
Thru	A	A			Thru				
Right					Right				
Peds					Peds				
NB Right	A				EB Right				
SB Right					WB Right				
Green	15.0	49.0				11.0			
Yellow	3.0	4.5				4.5			
All Red	0.0	1.5				1.5			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
T	1803	3311	0.32	0.54	11.4	B	11.4	B
Westbound								
L	685	1805	0.00	0.74	3.3	A		
T	2625	3526	0.19	0.74	3.5	A	3.5	A
Northbound								
L	428	3505	0.01	0.12	34.7	C	26.7	C
R	574	1615	0.01	0.36	18.8	B		
Southbound								

Intersection Delay = 7.8 (sec/veh) Intersection LOS = A

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/3/2005
Analysis Time Period: am
Intersection: sth 158/greyhound access
Area Type: All other areas
Jurisdiction: wisdot
Analysis Year: 2007
Project ID: 2007 background traffic - with improvements
East/West Street: sth 158 North/South Street: greyhound access

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume		555		1	495		5		5			
% Heavy Veh		15		0	8		0		0			
PHF		0.97		0.97	0.97		0.97		0.97			
PK 15 Vol		143		1	128		2		2			
Hi Ln Vol								0				
% Grade		0			0							
Ideal Sat		2000		1900	2000		1900		1900			
ParkExist												
NumPark												
No. Lanes	0	2	0	1	2	0	2	0	1	0	0	0
LGConfig		T		L	T		L		R			
Lane Width		12.0		12.0	12.0		12.0		12.0			
RTOR Vol									0			
Adj Flow		572		1	510		5		5			
%InSharedLn												
Prop LTs		0.000		1.000	0.000				1.000			
Prop RTs	0.000				0.000							
Peds	0						0			0		
Bikes												
Buses		0		0	0		0		0			
%InProtPhase				0.0								

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0		0.0	0.0		0.0		0.0			
Arriv. Type		3		3	3		3		3			
Unit Ext.		3.0		3.0	3.0		3.0		3.0			
I Factor		1.000			1.000			1.000				
Lost Time		2.0		2.0	2.0		2.0		2.0			
Ext of g		2.0		2.0	2.0		2.0		2.0			
Ped Min g		3.2						3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left					NB Left	A			
Thru		A			Thru				
Right					Right	A			
Peds					Peds				
WB Left	A	A			SB Left				
Thru	A	A			Thru				
Right					Right				
Peds					Peds				
NB Right	A				EB Right				
SB Right					WB Right				
Green	15.0	49.0				11.0			
Yellow	3.0	4.5				4.5			
All Red	0.0	1.5				1.5			

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V		555		1	495		5		5			
PHF		0.97		0.97	0.97		0.97		0.97			
Adj flow		572		1	510		5		5			
No. Lanes	0	2	0	1	2	0	2	0	1	0	0	0
Lane group		T		L	T		L		R			
Adj flow		572		1	510		5		5			
Prop LTs		0.000		1.000	0.000				1.000			
Prop RTs	0.000				0.000							

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG		T		L	T		L		R			
So		2000		1900	2000		1900		1900			
Lanes	0	2	0	1	2	0	2	0	1	0	0	0
fW		1.000		1.000	1.000		1.000		1.000			
fHV		0.870		1.000	0.926		1.000		1.000			
fG		1.000		1.000	1.000		1.000		1.000			
fP		1.000		1.000	1.000		1.000		1.000			
fBB		1.000		1.000	1.000		1.000		1.000			
fA		1.000		1.000	1.000		1.000		1.000			
fLU		0.952		1.000	0.952		0.971		1.000			
fRT		1.000			1.000				0.850			
fLT		1.000		0.950	1.000		0.950					
Sec.				0.350								
fLpb		1.000		1.000	1.000		1.000					
fRpb		1.000			1.000				1.000			
S		3311		1805	3526		3505		1615			
Sec.				665								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	572	3311	# 0.17	0.54	1803	0.32
Right							
Westbound							
Prot		1	1805	0.00	0.167	301	0.00
Perm		0	665	0.00	0.578	384	0.00
Left	L	1			0.74	685	0.00
Prot							
Perm							
Thru	T	510	3526	0.14	0.74	2625	0.19
Right							
Northbound							
Prot							
Perm							
Left	L	5	3505	0.00	0.12	428	0.01
Prot							
Perm							
Thru							
Right	R	5	1615	# 0.00	0.36	574	0.01
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.18
Total lost time per cycle, L = 9.00 sec
Critical lane rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.20

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
T	0.32	0.54	11.3	1.000	1803	0.11	0.1	0.0	11.4	B	11.4	B
Westbound												
L	0.00	0.74	3.3	1.000	685	0.11	0.0	0.0	3.3	A		
T	0.19	0.74	3.4	1.000	2625	0.11	0.0	0.0	3.5	A	3.5	A
Northbound												
L	0.01	0.12	34.7	1.000	428	0.11	0.0	0.0	34.7	C		
R	0.01	0.36	18.7	1.000	574	0.11	0.0	0.0	18.8	B	26.7	C
Southbound												

Intersection delay = 7.8 (sec/veh) Intersection LOS = A

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach		M		
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)		67.0		
Effective permitted green time for LT lane group, g(s)		52.0		
Opposing effective green time, go (s)		49.0		
Number of lanes in LT lane group, N		1		
Number of lanes in opposing approach, No		2		
Adjusted LT flow rate, VLT (veh/h)		1		
Proportion of LT in LT lane group, PLT		1.000		
Proportion of LT in opposing flow, PLTo		0.00		
Adjusted opposing flow rate, Vo (veh/h)		572		
Lost time for LT lane group, tL		6.00		
Computation				
LT volume per cycle, LTC=VLTC/3600		0.03		
Opposing lane util. factor, fLUo	0.952	0.952		
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		7.51		
gf=G[exp(- a * (LTC ** b)]-tl, gf<=g		0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.46		
qq, (see Exhibit C16-4,5,6,7,8)		8.21		
gu=g-gq if gq>=gf, or = g-gf if gq<gf		43.79		
n=Max(gq-gf)/2,0)		4.11		
PTHo=1-PLTo		1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00		
EL1 (refer to Exhibit C16-3)		2.41		
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.08		
gdiff=max(gq-gf,0)		0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.35		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.350		

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT		0.000	0.000	
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo		0.952	0.952	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b)]-tl, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
qq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 90.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v		1		
v/c ratio from Capacity Worksheet, X		0.00		
Protected phase effective green interval, g (s)		15.0		
Opposing queue effective green interval, gq		8.21		
Unopposed green interval, gu		43.79		
Red time r=(C-g-gq-gu)		23.0		
Arrival rate, qa=v/(3600(max[X,1.0]))		0.00		
Protected ph. departure rate, Sp=s/3600		0.501		
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)		0.22		
XPerm		0.00		
XProt		0.00		
Case		1		
Queue at beginning of green arrow, Qa		0.01		
Queue at beginning of unsaturated green, Qu		0.00		
Residual queue, Qr		0.00		
Uniform Delay, d1		3.3		

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Dur. Unmet Demand Q veh	Unmet Demand t hrs.	Uniform Delay Unadj. ds	Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 7.8 sec/veh Intersection LOS A

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup		T		L	T		L	R				
Init Queue		0.0		0.0	0.0		0.0	0.0				
Flow Rate		300		1	267		2	5				
So		2000		1900	2000		1900	1900				
No.Lanes	0	2	0	1	2	0	2 0	1	0	0	0	
SL		1738		920	1851		1805	1615				
LnCapacity		946		685	1378		220	574				
Flow Ratio		0.17		0.00	0.14		0.00	0.00				
v/c Ratio		0.32		0.00	0.19		0.01	0.01				
Grn Ratio		0.54		0.74	0.74		0.12	0.36				
I Factor		1.000			1.000		1.000					
AT or PVG		3		3	3		3	3				
Pltn Ratio		1.00		1.00	1.00		1.00	1.00				
PF2		1.00		1.00	1.00		1.00	1.00				
Q1		4.1		0.0	2.0		0.0	0.1				
kB		0.7		0.5	0.8		0.3	0.5				
Q2		0.3		0.0	0.2		0.0	0.0				
Q Average		4.4		0.0	2.2		0.0	0.1				
Q Spacing		25.0		25.0	25.0		25.0	25.0				
Q Storage		0		0	0		0	0				
Q S Ratio												
70th Percentile Output:												
fB%		1.2		1.2	1.2		1.2	1.2				
BOQ		5.3		0.0	2.6		0.1	0.1				
QSRatio												
85th Percentile Output:												
fB%		1.6		1.6	1.6		1.6	1.6				
BOQ		6.9		0.0	3.5		0.1	0.1				
QSRatio												
90th Percentile Output:												
fB%		1.7		1.8	1.8		1.8	1.8				
BOQ		7.6		0.0	3.9		0.1	0.2				
QSRatio												
95th Percentile Output:												
fB%		2.0		2.1	2.0		2.1	2.1				
BOQ		8.7		0.0	4.5		0.1	0.2				
QSRatio												
98th Percentile Output:												
fB%		2.4		2.7	2.5		2.7	2.7				
BOQ		10.7		0.0	5.6		0.1	0.2				
QSRatio												

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: md
Agency:
Date: 1/3/2005
Period: pm
Project ID: 2007 background traffic - with improvements
E/W St: sth 158

Inter.: sth 158/greyhound access
Area Type: All other areas
Jurisd: wisdot
Year : 2007
N/S St: greyhound access

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	1	2	0	2	0	1	0	0	0
LGConfig		T		L	T		L		R			
Volume		630		25	365		10		5			
Lane Width		12.0		12.0	12.0		12.0		12.0			
RTOR Vol									0			

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left					NB Left	A			
Thru		A			Thru				
Right					Right	A			
Peds					Peds				
WB Left	A	A			SB Left				
Thru	A	A			Thru				
Right					Right				
Peds					Peds				
NB Right	A				EB Right				
SB Right					WB Right				
Green	19.0	45.0				11.0			
Yellow	3.0	4.5				4.5			
All Red	0.0	1.5				1.5			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
T	1814	3627	0.37	0.50	14.0	B	14.0	B
Westbound								
L	673	1805	0.04	0.74	3.7	A		
T	2674	3592	0.15	0.74	3.3	A	3.3	A
Northbound								
L	428	3505	0.03	0.12	34.8	C	29.0	C
R	646	1615	0.01	0.40	16.3	B		
Southbound								

Intersection Delay = 10.2 (sec/veh) Intersection LOS = B

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/3/2005
Analysis Time Period: pm
Intersection: sth 158/greyhound access
Area Type: All other areas
Jurisdiction: wisdot
Analysis Year: 2007
Project ID: 2007 background traffic - with improvements
East/West Street: sth 158 North/South Street: greyhound access

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume		630		25	365		10		5			
% Heavy Veh		5		0	6		0		0			
PHF		0.93		0.93	0.93		0.93		0.93			
PK 15 Vol		169		7	98		3		2			
Hi Ln Vol												
% Grade		0			0			0				
Ideal Sat		2000		1900	2000		1900		1900			
ParkExist												
NumPark												
No. Lanes	0	2	0	1	2	0	2	0	1	0	0	0
LGConfig		T		L	T		L		R			
Lane Width		12.0		12.0	12.0		12.0		12.0			
RTOR Vol									0			
Adj Flow		677		27	392		11		5			
%InSharedLn												
Prop LTs		0.000		1.000	0.000							
Prop RTs									1.000			
Peds	0.000				0.000						0	
Bikes	0						0					
Buses		0		0	0		0		0			
%InProtPhase				0.0								

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0		0.0	0.0		0.0		0.0			
Arriv. Type		3		3	3		3		3			
Unit Ext.		3.0		3.0	3.0		3.0		3.0			
I Factor		1.000			1.000			1.000				
Lost Time		2.0		2.0	2.0		2.0		2.0			
Ext of g		2.0		2.0	2.0		2.0		2.0			
Ped Min g		3.2						3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left					NB Left	A			
Thru		A			Thru				
Right					Right	A			
Peds					Peds				
WB Left	A	A			SB Left				
Thru	A	A			Thru				
Right					Right				
Peds					Peds				
NB Right	A				EB Right				
SB Right					WB Right				
Green	19.0	45.0				11.0			
Yellow	3.0	4.5				4.5			
All Red	0.0	1.5				1.5			

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V		630		25	365		10		5			
PHF		0.93		0.93	0.93		0.93		0.93			
Adj flow		677		27	392		11		5			
No. Lanes	0	2	0	1	2	0	2	0	1	0	0	0
Lane group		T		L	T		L		R			
Adj flow		677		27	392		11		5			
Prop LTs		0.000		1.000	0.000							
Prop RTs	0.000				0.000				1.000			

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG		T		L	T		L		R			
So		2000		1900	2000		1900		1900			
Lanes	0	2	0	1	2	0	2	0	1	0	0	0
fW		1.000		1.000	1.000		1.000		1.000			
fHV		0.952		1.000	0.943		1.000		1.000			
fG		1.000		1.000	1.000		1.000		1.000			
fP		1.000		1.000	1.000		1.000		1.000			
fBB		1.000		1.000	1.000		1.000		1.000			
fA		1.000		1.000	1.000		1.000		1.000			
fLU		0.952		1.000	0.952		0.971		1.000			
fRT		1.000			1.000				0.850			
fLT		1.000		0.950	1.000		0.950					
Sec.				0.289								
fLpb		1.000		1.000	1.000		1.000					
fRpb		1.000			1.000				1.000			
S		3627		1805	3592		3505		1615			
Sec.				548								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	677	3627	# 0.19	0.50	1814	0.37
Right							
Westbound							
Prot		27	1805	# 0.01	0.211	381	0.07
Perm		0	548	0.00	0.533	292	0.00
Left	L	27			0.74	673	0.04
Prot							
Perm							
Thru	T	392	3592	0.11	0.74	2674	0.15
Right							
Northbound							
Prot							
Perm							
Left	L	11	3505	# 0.00	0.12	428	0.03
Prot							
Perm							
Thru							
Right	R	5	1615	0.00	0.40	646	0.01
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.20
Total lost time per cycle, L = 18.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.26

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
T	0.37	0.50	13.8	1.000	1814	0.11	0.1	0.0	14.0	B	14.0	B
Westbound												
L	0.04	0.74	3.7	1.000	673	0.11	0.0	0.0	3.7	A		
T	0.15	0.74	3.3	1.000	2674	0.11	0.0	0.0	3.3	A	3.3	A
Northbound												
L	0.03	0.12	34.8	1.000	428	0.11	0.0	0.0	34.8	C	29.0	C
R	0.01	0.40	16.3	1.000	646	0.11	0.0	0.0	16.3	B		
Southbound												

Intersection delay = 10.2 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach		M		
Cycle length, C	90.0 sec			
Total actual green time for LT lane group, G (s)		67.0		
Effective permitted green time for LT lane group, g(s)		48.0		
Opposing effective green time, go (s)		45.0		
Number of lanes in LT lane group, N		1		
Number of lanes in opposing approach, No		2		
Adjusted LT flow rate, VLT (veh/h)		27		
Proportion of LT in LT lane group, PLT		1.000		
Proportion of LT in opposing flow, PLTo		0.00		
Adjusted opposing flow rate, Vo (veh/h)		677		
Lost time for LT lane group, tL		6.00		
Computation				
LT volume per cycle, LTC=VLTC/3600		0.68		
Opposing lane util. factor, fLUo	0.952	0.952		
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		8.89		
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.50		
gq, (see Exhibit C16-4,5,6,7,8)		11.08		
gu=g-gq if gq>=gf, or = g-gf if gq<gf		36.92		
n=Max(gq-gf)/2,0)		5.54		
PTHo=1-PLTo		1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00		
EL1 (refer to Exhibit C16-3)		2.67		
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.08		
gdiff=max(gq-gf,0)		0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.29		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.289		

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0 sec			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT		0.000	0.000	
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo		0.952	0.952	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0 sec			
Adj. LT vol from Vol Adjustment Worksheet, v		27		
v/c ratio from Capacity Worksheet, X		0.04		
Protected phase effective green interval, g (s)		19.0		
Opposing queue effective green interval, gq		11.08		
Unopposed green interval, gu		36.92		
Red time r=(C-g-gq-gu)		23.0		
Arrival rate, qa=v/(3600(max[X,1.0]))		0.01		
Protected ph. departure rate, Sp=s/3600		0.501		
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)		0.20		
XPerm		0.05		
XProt		0.03		
Case		1		
Queue at beginning of green arrow, Qa		0.17		
Queue at beginning of unsaturated green, Qu		0.08		
Residual queue, Qr		0.00		
Uniform Delay, d1		3.7		

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 10.2 sec/veh Intersection LOS B

BACK OF QUEUE WORKSHEET

LaneGroup	Eastbound			Westbound			Northbound			Southbound		
		T		L	T		L		R			
Init Queue		0.0		0.0	0.0		0.0		0.0			
Flow Rate		355		27	205		5		5			
So		2000		1900	2000		1900		1900			
No.Lanes	0	2	0	1	2	0	2	0	1	0	0	0
SL		1904		904	1886		1805		1615			
LnCapacity		952		673	1404		220		646			
Flow Ratio		0.19		0.03	0.11		0.00		0.00			
v/c Ratio		0.37		0.04	0.15		0.02		0.01			
Grn Ratio		0.50		0.74	0.74		0.12		0.40			
I Factor		1.000			1.000			1.000				
AT or PVG		3		3	3		3		3			
Pltn Ratio		1.00		1.00	1.00		1.00		1.00			
PF2		1.00		1.00	1.00		1.00		1.00			
Q1		5.5		0.2	1.5		0.1		0.1			
kB		0.7		0.5	0.8		0.3		0.5			
Q2		0.4		0.0	0.1		0.0		0.0			
Q Average		5.9		0.2	1.6		0.1		0.1			
Q Spacing		25.0		25.0	25.0		25.0		25.0			
Q Storage		0		0	0		0		0			
Q S Ratio												
70th Percentile Output:												
fB%		1.2		1.2	1.2		1.2		1.2			
BOQ		6.9		0.2	1.9		0.1		0.1			
QSRatio												
85th Percentile Output:												
fB%		1.5		1.6	1.6		1.6		1.6			
BOQ		9.1		0.3	2.6		0.2		0.1			
QSRatio												
90th Percentile Output:												
fB%		1.7		1.8	1.8		1.8		1.8			
BOQ		9.9		0.4	2.9		0.2		0.1			
QSRatio												
95th Percentile Output:												
fB%		1.9		2.1	2.0		2.1		2.1			
BOQ		11.3		0.4	3.3		0.2		0.2			
QSRatio												
98th Percentile Output:												
fB%		2.3		2.7	2.6		2.7		2.7			
BOQ		13.7		0.5	4.2		0.3		0.2			
QSRatio												

ERROR MESSAGES

No errors to report.

HCS2000: Unsignalized Intersections Release 4.1d

TWO-WAY STOP CONTROL SUMMARY

Analyst: md
Agency/Co.:
Date Performed: 1/4/2005
Analysis Time Period: am
Intersection: sth 158/eastern frontage road
Jurisdiction: wisdot
Units: U. S. Customary
Analysis Year: 2007
Project ID: 2007 background traffic - with improvements
East/West Street: sth 158
North/South Street: eastern frontage road
Intersection Orientation: EW
Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1 L	2 T	3 R	4 L	5 T	6 R
Volume	20	400			320	1
Peak-Hour Factor, PHF	1.00	1.00			1.00	1.00
Hourly Flow Rate, HFR	20	400			320	1
Percent Heavy Vehicles	0	--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes	0	1			1	0
Configuration	LT					TR
Upstream Signal?		No			No	

Minor Street: Approach	Northbound			Southbound		
Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume	5	35		5		10
Peak Hour Factor, PHF	1.00	1.00		1.00		1.00
Hourly Flow Rate, HFR	5	35		5		10
Percent Heavy Vehicles	0	0		0		0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/		No	/
Lanes	0	1		0	0	
Configuration	LT				LR	

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound		Southbound	
Movement	1	4	7	8	9	10	11	12
Lane Config	LT		LT			LR		
v (vph)	20		40			15		
C(m) (vph)	1250		328			480		
v/c	0.02		0.12			0.03		
95% queue length	0.05		0.41			0.10		
Control Delay	7.9		17.5			12.7		
LOS	A		C			B		
Approach Delay				17.5		12.7		
Approach LOS				C		B		

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TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/4/2005
Analysis Time Period: am
Intersection: sth 158/eastern frontage road
Jurisdiction: wisdot
Units: U. S. Customary
Analysis Year: 2007
Project ID: 2007 background traffic - with improvements
East/West Street: sth 158
North/South Street: eastern frontage road
Intersection Orientation: EW
Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume	20	400			320	1
Peak-Hour Factor, PHF	1.00	1.00			1.00	1.00
Peak-15 Minute Volume	5	100			80	0
Hourly Flow Rate, HFR	20	400			320	1
Percent Heavy Vehicles	0	--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes	0	1			1	0
Configuration	LT					TR
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume	5	35		5		10
Peak Hour Factor, PHF	1.00	1.00		1.00		1.00
Peak-15 Minute Volume	1	9		1		2
Hourly Flow Rate, HFR	5	35		5		10
Percent Heavy Vehicles	0	0		0		0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/		No	/
RT Channelized?						
Lanes	0	1		0	0	
Configuration	LT				LR	

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn							
Through							
S5 Left-Turn							
Through							

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2 V(t)	Movement 2 V(1,prot)	Movement 5 V(t)	Movement 5 V(1,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p		0.000		0.000

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:	400	
Shared ln volume, major rt vehicles:	0	
Sat flow rate, major th vehicles:	1700	
Sat flow rate, major rt vehicles:	1700	
Number of major street through lanes:	1	

Computation 3-Platoon Event Periods

	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)	4.1		7.1	6.5		7.1		6.2
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)	0		0	0		0		0
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Grade/100			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)	0.00		0.00	0.00		0.00		0.00
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage	4.1		7.1	6.5		7.1		6.2
2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20		3.50	4.00		3.50		3.30
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)	0		0	0		0		0
t(f)	2.2		3.5	4.0		3.5		3.3

Computation 4 and 5

Single-Stage Process

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x	321		766	761		778		320
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Worksheet 5-Effect of Upstream Signals

Two-Stage Process

	7	8	10	11

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2 V(t)	Movement 2 V(1,prot)	Movement 5 V(t)	Movement 5 V(1,prot)
V prog				

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		1500		1500		1500		
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		320
Potential Capacity		725
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		725
Probability of Queue free St.	1.00	0.99

Step 2: LT from Major St.	4	1
Conflicting Flows		321
Potential Capacity		1250
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		1250
Probability of Queue free St.	1.00	0.98
Maj L-Shared Prob Q free St.		0.98

Step 3: TH from Minor St.	8	11
Conflicting Flows	761	
Potential Capacity	337	
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.98	0.98
Movement Capacity	330	
Probability of Queue free St.	0.89	1.00

Step 4: LT from Minor St.	7	10
Conflicting Flows	766	778
Potential Capacity	322	316
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.98	0.88
Maj. L, Min T Adj. Imp Factor.	0.98	0.90
Cap. Adj. factor due to Impeding mvmnt	0.97	0.90
Movement Capacity	312	286

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	761	
Potential Capacity	337	
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.98	0.98
Movement Capacity	330	
Result for 2 stage process:		
a		
y		
C t	330	
Probability of Queue free St.	0.89	1.00

Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	766	778
Potential Capacity	322	316
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.98	0.88
Maj. L, Min T Adj. Imp Factor.	0.98	0.90
Cap. Adj. factor due to Impeding mvmnt	0.97	0.90
Movement Capacity	312	286
Results for Two-stage process:		
a		
y		
C t	312	286

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	5	35		5		10
Movement Capacity (vph)	312	330		286		725
Shared Lane Capacity (vph)	328				480	

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	312	330		286		725
Volume	5	35		5		10
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh	328				480	
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	LT		LT				LR	
v (vph)	20		40				15	
C(m) (vph)	1250		328				480	
v/c	0.02		0.12				0.03	
95% queue length	0.05		0.41				0.10	
Control Delay	7.9		17.5				12.7	
LOS	A		C				B	
Approach Delay				17.5			12.7	
Approach LOS				C			B	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.98	1.00
v(i1), Volume for stream 2 or 5	400	
v(i2), Volume for stream 3 or 6	0	
s(i1), Saturation flow rate for stream 2 or 5	1700	
s(i2), Saturation flow rate for stream 3 or 6	1700	
P*(oj)	0.98	
d(M,LT), Delay for stream 1 or 4	7.9	
N, Number of major street through lanes	1	
d(rank,1) Delay for stream 2 or 5	0.2	

HCS2000: Unsignalized Intersections Release 4.1d

TWO-WAY STOP CONTROL SUMMARY

Analyst: md
Agency/Co.:
Date Performed: 1/4/2005
Analysis Time Period: pm
Intersection: sth 158/eastern frontage road
Jurisdiction: wisdot
Units: U. S. Customary
Analysis Year: 2007
Project ID: 2007 background traffic - with improvements
East/West Street: sth 158
North/South Street: eastern frontage road
Intersection Orientation: EW
Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1 L	2 T	3 R	4 L	5 T	6 R
Volume	15	350			190	1
Peak-Hour Factor, PHF	1.00	1.00			1.00	1.00
Hourly Flow Rate, HFR	15	350			190	1
Percent Heavy Vehicles	0	--	--		--	--
Median Type/Storage	Undivided		/			
RT Channelized?					1	0
Lanes	0	1				TR
Configuration	LT				No	
Upstream Signal?		No				

Minor Street: Approach	Northbound			Southbound		
Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume	30	65		5		5
Peak Hour Factor, PHF	1.00	1.00		1.00		1.00
Hourly Flow Rate, HFR	30	65		5		5
Percent Heavy Vehicles	0	0		0		0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/		No	/
Lanes	0	1		0	0	
Configuration	LT				LR	

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound	
Movement	1	4	7	8	9	10	11	12
Lane Config	LT		LT				LR	
v (vph)	15		95				10	
C(m) (vph)	1395		427				509	
v/c	0.01		0.22				0.02	
95% queue length	0.03		0.84				0.06	
Control Delay	7.6		15.8				12.2	
LOS	A		C				B	
Approach Delay				15.8			12.2	
Approach LOS				C			B	

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TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/4/2005
Analysis Time Period: pm
Intersection: sth 158/eastern frontage road
Jurisdiction: wisdot
Units: U. S. Customary
Analysis Year: 2007
Project ID: 2007 background traffic - with improvements
East/West Street: sth 158
North/South Street: eastern frontage road
Intersection Orientation: EW
Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume	15	350			190	1
Peak-Hour Factor, PHF	1.00	1.00			1.00	1.00
Peak-15 Minute Volume	4	88			48	0
Hourly Flow Rate, HFR	15	350			190	1
Percent Heavy Vehicles	0		--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?					1	0
Lanes	0	1				TR
Configuration	LT				No	
Upstream Signal?		No				

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume	30	65		5		5
Peak Hour Factor, PHF	1.00	1.00		1.00		1.00
Peak-15 Minute Volume	8	16		1		1
Hourly Flow Rate, HFR	30	65		5		5
Percent Heavy Vehicles	0	0		0		0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/		No	/
RT Channelized?				0	0	
Lanes	0	1			LR	
Configuration	LT					

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0
Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn							
Through							
S5 Left-Turn							
Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:	350	
Shared ln volume, major rt vehicles:	0	
Sat flow rate, major th vehicles:	1700	
Sat flow rate, major rt vehicles:	1700	
Number of major street through lanes:	1	

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1		7.1	6.5		7.1		6.2
t(c,hv)		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		0		0	0		0		0
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Grade/100				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00		0.00	0.00		0.00		0.00
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage	4.1		7.1	6.5		7.1		6.2
	2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20		3.50	4.00		3.50		3.30
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)	0		0	0		0		0
t(f)	2.2		3.5	4.0		3.5		3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2 V(t)	Movement 2 V(1,prot)	Movement 5 V(t)	Movement 5 V(1,prot)
V prog				
Total Saturation Flow Rate, s (vph)				
Arrival Type				
Effective Green, g (sec)				
Cycle Length, C (sec)				
Rp (from Exhibit 16-11)				
Proportion vehicles arriving on green P				
g(q1)				
g(q2)				
g(q)				

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2 V(t)	Movement 2 V(1,prot)	Movement 5 V(t)	Movement 5 V(1,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p		0.000		0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x	191		573	571		602		190
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		1500		1500		1500		
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		190
Potential Capacity		857
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		857
Probability of Queue free St.	1.00	0.99

Step 2: LT from Major St.	4	1
Conflicting Flows		191
Potential Capacity		1395
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		1395
Probability of Queue free St.	1.00	0.99
Maj L-Shared Prob Q free St.		0.99

Step 3: TH from Minor St.	8	11
Conflicting Flows	571	
Potential Capacity	434	
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.99	0.99
Movement Capacity	428	
Probability of Queue free St.	0.85	1.00

Step 4: LT from Minor St.	7	10
Conflicting Flows	573	602
Potential Capacity	433	414
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.99	0.84
Maj. L, Min T Adj. Imp Factor.	0.99	0.87
Cap. Adj. factor due to Impeding mvmnt	0.98	0.87
Movement Capacity	426	362

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	571	
Potential Capacity	434	
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.99	0.99
Movement Capacity	428	
Result for 2 stage process:		
a		
y		
C t	428	
Probability of Queue free St.	0.85	1.00

Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	573	602
Potential Capacity	433	414
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.99	0.84
Maj. L, Min T Adj. Imp Factor.	0.99	0.87
Cap. Adj. factor due to Impeding mvmnt	0.98	0.87
Movement Capacity	426	362
Results for Two-stage process:		
a		
y		
C t	426	362

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	30	65		5		5
Movement Capacity (vph)	426	428		362		857
Shared Lane Capacity (vph)	427				509	

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	426	428		362		857
Volume	30	65		5		5
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh	427				509	
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	LT		LT				LR	
v (vph)	15		95				10	
C(m) (vph)	1395		427				509	
v/c	0.01		0.22				0.02	
95% queue length	0.03		0.84				0.06	
Control Delay	7.6		15.8				12.2	
LOS	A		C				B	
Approach Delay				15.8			12.2	
Approach LOS				C			B	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.99	1.00
v(i1), Volume for stream 2 or 5	350	
v(i2), Volume for stream 3 or 6	0	
s(i1), Saturation flow rate for stream 2 or 5	1700	
s(i2), Saturation flow rate for stream 3 or 6	1700	
P*(oj)	0.99	
d(M,LT), Delay for stream 1 or 4	7.6	
N, Number of major street through lanes	1	
d(rank,1) Delay for stream 2 or 5	0.1	

HCS2000: Unsignalized Intersections Release 4.1d

TWO-WAY STOP CONTROL SUMMARY

Analyst: md
Agency/Co.:
Date Performed: 1/4/2005
Analysis Time Period: am
Intersection: sth 158_Western Frontage Road
Jurisdiction: wisdot
Units: U. S. Customary
Analysis Year: 2007
Project ID: 2007 background traffic - with improvements
East/West Street: sth 158
North/South Street: western frontage road
Intersection Orientation: EW
Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1 L	2 T	3 R	4 L	5 T	6 R
Volume		350	30	70	265	
Peak-Hour Factor, PHF		1.00	1.00	1.00	1.00	
Hourly Flow Rate, HFR		350	30	70	265	
Percent Heavy Vehicles		--	--	0	--	--
Median Type/Storage	Undivided			/		
RT Channelized?			No			
Lanes		1	1	0	1	
Configuration		T	R		LT	
Upstream Signal?		No			No	

Minor Street: Approach	Northbound			Southbound		
Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume	10		70			
Peak Hour Factor, PHF	1.00		1.00			
Hourly Flow Rate, HFR	10		70			
Percent Heavy Vehicles	0		0			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No	/		/
Lanes	0		0			
Configuration		LR				

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config		LT		LR				
v (vph)		70		80				
C(m) (vph)		1190		624				
v/c		0.06		0.13				
95% queue length		0.19		0.44				
Control Delay		8.2		11.6				
LOS		A		B				
Approach Delay				11.6				
Approach LOS				B				

HCS2000: Unsignalized Intersections Release 4.1d

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TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/4/2005
Analysis Time Period: am
Intersection: sth 158_Western Frontage Road
Jurisdiction: wisdot
Units: U. S. Customary
Analysis Year: 2007
Project ID: 2007 background traffic - with improvements
East/West Street: sth 158
North/South Street: western frontage road
Intersection Orientation: EW
Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume		350	30	70	265	
Peak-Hour Factor, PHF		1.00	1.00	1.00	1.00	
Peak-15 Minute Volume		88	8	18	66	
Hourly Flow Rate, HFR		350	30	70	265	
Percent Heavy Vehicles		--	--	0	--	--
Median Type/Storage	Undivided			/		
RT Channelized?			No			
Lanes		1	1	0	1	
Configuration		T	R		LT	
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume	10		70			
Peak Hour Factor, PHF	1.00		1.00			
Peak-15 Minute Volume	2		18			
Hourly Flow Rate, HFR	10		70			
Percent Heavy Vehicles	0		0			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No	/		/
RT Channelized?						
Lanes	0		0			
Configuration		LR				

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn							
Through							
S5 Left-Turn							
Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		265
Shared ln volume, major rt vehicles:		0
Sat flow rate, major th vehicles:		1700
Sat flow rate, major rt vehicles:		1700
Number of major street through lanes:		1

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)			4.1	7.1		6.2			
t(c,hv)		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)			0	0		0			
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Grade/100				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)			0.00	0.70		0.00			
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage		4.1	6.4		6.2			
	2-stage								

Follow-Up Time Calculations Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)		2.20	3.50		3.30			
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)		0	0		0			
t(f)		2.2	3.5		3.3			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2 V(t)	Movement 2 V(1,prot)	Movement 5 V(t)	Movement 5 V(1,prot)
V prog				
Total Saturation Flow Rate, s (vph)				
Arrival Type				
Effective Green, g (sec)				
Cycle Length, C (sec)				
Rp (from Exhibit 16-11)				
Proportion vehicles arriving on green P				
g(q1)				
g(q2)				
g(q)				

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2 V(t)	Movement 2 V(1,prot)	Movement 5 V(t)	Movement 5 V(1,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p		0.000		0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x		380	755		350			
s								
Px								
V c,u,x								

C r,x	
C plat,x	

Two-Stage Process	7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		1500						
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	350	
Potential Capacity	698	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	698	
Probability of Queue free St.	0.90	1.00

Step 2: LT from Major St.	4	1
Conflicting Flows	380	
Potential Capacity	1190	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	1190	
Probability of Queue free St.	0.94	1.00
Maj L-Shared Prob Q free St.	0.93	

Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.93	0.93
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Conflicting Flows	755	
Potential Capacity	379	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.93
Maj. L, Min T Adj. Imp Factor.		0.95
Cap. Adj. factor due to Impeding mvmnt	0.94	0.85
Movement Capacity	357	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.93	0.93
Movement Capacity		
Result for 2 stage process:		
a		
y		
C t		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	755	
Potential Capacity	379	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.93
Maj. L, Min T Adj. Imp Factor.		0.95
Cap. Adj. factor due to Impeding mvmnt	0.94	0.85
Movement Capacity	357	
Results for Two-stage process:		
a		
y		
C t	357	

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	10		70			
Movement Capacity (vph)	357		698			
Shared Lane Capacity (vph)		624				

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	357		698			
Volume	10		70			
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh		624				
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		LT		LR				
v (vph)		70		80				
C(m) (vph)		1190		624				
v/c		0.06		0.13				
95% queue length		0.19		0.44				
Control Delay		8.2		11.6				
LOS		A		B				
Approach Delay				11.6				
Approach LOS				B				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.94
v(i1), Volume for stream 2 or 5		265
v(i2), Volume for stream 3 or 6		0
s(i1), Saturation flow rate for stream 2 or 5		1700
s(i2), Saturation flow rate for stream 3 or 6		1700
P*(oj)		0.93
d(M,LT), Delay for stream 1 or 4		8.2
N, Number of major street through lanes		1
d(rank,1) Delay for stream 2 or 5		0.6

HCS2000: Unsignalized Intersections Release 4.1d

TWO-WAY STOP CONTROL SUMMARY

Analyst: md
Agency/Co.:
Date Performed: 1/4/2005
Analysis Time Period: pm
Intersection: sth 158_Western Frontage Road
Jurisdiction: wisdot
Units: U. S. Customary
Analysis Year: 2007
Project ID: 2007 background traffic - with improvements
East/West Street: sth 158
North/South Street: western frontage road
Intersection Orientation: EW
Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1 L	2 T	3 R	4 L	5 T	6 R
Volume		310	65	120	105	
Peak-Hour Factor, PHF		1.00	1.00	1.00	1.00	
Hourly Flow Rate, HFR		310	65	120	105	
Percent Heavy Vehicles		--	--	0	--	--
Median Type/Storage	Undivided			/		
RT Channelized?			No			
Lanes		1	1		0	1
Configuration		T	R		LT	
Upstream Signal?		No				No

Minor Street: Approach	Northbound			Southbound		
Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume	10		55			
Peak Hour Factor, PHF	1.00		1.00			
Hourly Flow Rate, HFR	10		55			
Percent Heavy Vehicles	0		0			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No	/		/
Lanes	0		0			
Configuration		LR				

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound		Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config		LT		LR				
v (vph)		120		65				
C(m) (vph)		1195		647				
v/c		0.10		0.10				
95% queue length		0.33		0.33				
Control Delay		8.3		11.2				
LOS		A		B				
Approach Delay				11.2				
Approach LOS				B				

HCS2000: Unsignalized Intersections Release 4.1d

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TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/4/2005
Analysis Time Period: pm
Intersection: sth 158_Western Frontage Road
Jurisdiction: wisdot
Units: U. S. Customary
Analysis Year: 2007
Project ID: 2007 background traffic - with improvements
East/West Street: sth 158
North/South Street: western frontage road
Intersection Orientation: EW
Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume		310	65	120	105	
Peak-Hour Factor, PHF		1.00	1.00	1.00	1.00	
Peak-15 Minute Volume		78	16	30	26	
Hourly Flow Rate, HFR		310	65	120	105	
Percent Heavy Vehicles		--	--	0	--	--
Median Type/Storage	Undivided			/		
RT Channelized?			No			
Lanes		1	1		0	1
Configuration		T	R		LT	
Upstream Signal?		No				No

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume	10		55			
Peak Hour Factor, PHF	1.00		1.00			
Peak-15 Minute Volume	2		14			
Hourly Flow Rate, HFR	10		55			
Percent Heavy Vehicles	0		0			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No	/		/
RT Channelized?						
Lanes	0		0			
Configuration		LR				

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn							
Through							
S5 Left-Turn							
Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		105
Shared ln volume, major rt vehicles:		0
Sat flow rate, major th vehicles:		1700
Sat flow rate, major rt vehicles:		1700
Number of major street through lanes:		1

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)			4.1	7.1		6.2			
t(c,hv)		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)			0	0		0			
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Grade/100				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)			0.00	0.70		0.00			
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage		4.1	6.4		6.2			
	2-stage								

Follow-Up Time Calculations Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)		2.20	3.50		3.30			
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)		0	0		0			
t(f)		2.2	3.5		3.3			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2 V(t)	Movement 2 V(1,prot)	Movement 5 V(t)	Movement 5 V(1,prot)
V prog				
Total Saturation Flow Rate, s (vph)				
Arrival Type				
Effective Green, g (sec)				
Cycle Length, C (sec)				
Rp (from Exhibit 16-11)				
Proportion vehicles arriving on green P				
g(q1)				
g(q2)				
g(q)				

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2 V(t)	Movement 2 V(1,prot)	Movement 5 V(t)	Movement 5 V(1,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p		0.000		0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5

Single-Stage Process Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x		375	655		310			
#								
Px								
V c,u,x								

C r,x				
C plat,x				

Two-Stage Process	7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		1500						
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	310	
Potential Capacity	735	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	735	
Probability of Queue free St.	0.93	1.00

Step 2: LT from Major St.	4	1
Conflicting Flows	375	
Potential Capacity	1195	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	1195	
Probability of Queue free St.	0.90	1.00
Maj L-Shared Prob Q free St.	0.89	

Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.89	0.89
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Conflicting Flows	655	
Potential Capacity	434	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.89
Maj. L, Min T Adj. Imp Factor.		0.92
Cap. Adj. factor due to Impeding mvmnt	0.90	0.85
Movement Capacity	390	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.89	0.89
Movement Capacity		
Result for 2 stage process:		
a		
y		
C t		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	655	
Potential Capacity	434	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.89
Maj. L, Min T Adj. Imp Factor.		0.92
Cap. Adj. factor due to Impeding mvmnt	0.90	0.85
Movement Capacity	390	
Results for Two-stage process:		
a		
y		
C t	390	

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	10		55			
Movement Capacity (vph)	390		735			
Shared Lane Capacity (vph)		647				

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	390		735			
Volume	10		55			
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh		647				
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		LT		LR				
v (vph)		120		65				
C(m) (vph)		1195		647				
v/c		0.10		0.10				
95% queue length		0.33		0.33				
Control Delay		8.3		11.2				
LOS		A		B				
Approach Delay				11.2				
Approach LOS				B				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.90
v(i1), Volume for stream 2 or 5		105
v(i2), Volume for stream 3 or 6		0
s(i1), Saturation flow rate for stream 2 or 5		1700
s(i2), Saturation flow rate for stream 3 or 6		1700
P*(oj)		0.89
d(M,LT), Delay for stream 1 or 4		8.3
N, Number of major street through lanes		1
d(rank,1) Delay for stream 2 or 5		0.9

HCS2000: Signalized Intersections Release 4.1e

Analyst: md
Agency:
Date: 1/4/2005
Period: am
Project ID: 2007 background traffic - with improvements
E/W St: cth k

Inter.: cth k/104th ave
Area Type: All other areas
Jurisd: kenosha county
Year : 2007
N/S St: 104th ave

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	1	1	0	1	1	0	1	1	0
LGConfig	L	TR		L	TR		L	TR		L	TR	
Volume	10	160	30	85	110	10	5	110	80	5	130	25
Lane Width	12.0	12.0		12.0	12.0		12.0	12.0		12.0	12.0	
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A	A			NB Left	A	A		
Thru		A			Thru		A		
Right		A			Right		A		
Peds					Peds				
WB Left	A	A			SB Left	A	A		
Thru		A			Thru		A		
Right		A			Right		A		
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	7.0	25.0				7.0	33.0		
Yellow	3.0	4.5				3.0	4.5		
All Red	0.0	1.5				0.0	1.5		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/c	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	439	1770	0.03	0.39	17.2	B		
TR	505	1819	0.48	0.28	27.8	C	27.2	C
Westbound								
L	364	1770	0.30	0.39	19.0	B		
TR	511	1839	0.30	0.28	25.9	C	23.0	C
Northbound								
L	518	1770	0.01	0.48	12.6	B		
TR	640	1745	0.38	0.37	21.3	C	21.1	C
Southbound								
L	482	1770	0.01	0.48	12.8	B		
TR	666	1817	0.30	0.37	20.5	C	20.3	C

Intersection Delay = 23.1 (sec/veh) Intersection LOS = C

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/4/2005
Analysis Time Period: am
Intersection: cth k/104th ave
Area Type: All other areas
Jurisdiction: kenosha county
Analysis Year: 2007
Project ID: 2007 background traffic - with improvements
East/West Street: cth k
North/South Street: 104th ave

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	10	160	30	85	110	10	5	110	80	5	130	25
% Heavy Veh	2	2	2	2	2	2	2	2	2	2	2	2
PHF	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79
PK 15 Vol	3	51	9	27	35	3	2	35	25	2	41	8
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900		1900	1900		1900	1900		1900	1900	
ParkExist												
NumPark												
No. Lanes	1	1	0	1	1	0	1	1	0	1	1	0
LGConfig	L	TR		L	TR		L	TR		L	TR	
Lane Width	12.0	12.0		12.0	12.0		12.0	12.0		12.0	12.0	
RTOR Vol			0			0			0			0
Adj Flow	13	241		108	152		6	240		6	197	
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.158			0.086			0.421			0.162	
Peds	0			0			0			0		
Bikes				0			0			0		
Buses	0	0										
%InProtPhase	0.0			0.0			0.0			0.0		

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Arriv. Type	3	3		3	3		3	3		3	3	
Unit Ext.	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Ext of g	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Ped Min g	3.2			3.2			3.2			3.2		

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A	A			NB Left	A	A		
Thru		A			Thru		A		
Right		A			Right		A		
Peds					Peds				
WB Left	A	A			SB Left	A	A		
Thru		A			Thru		A		
Right		A			Right		A		
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	7.0	25.0				7.0	33.0		
Yellow	3.0	4.5				3.0	4.5		
All Red	0.0	1.5				0.0	1.5		

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	10	160	30	85	110	10	5	110	80	5	130	25
PHF	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79
Adj flow	13	203	38	108	139	13	6	139	101	6	165	32
No. Lanes	1	1	0	1	1	0	1	1	0	1	1	0
Lane group	L	TR		L	TR		L	TR		L	TR	
Adj flow	13	241		108	152		6	240		6	197	
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.158			0.086			0.421			0.162	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L	TR		L	TR		L	TR		L	TR	
So	1900	1900		1900	1900		1900	1900		1900	1900	
Lanes	1	1	0	1	1	0	1	1	0	1	1	0
fW	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fHV	0.980	0.980		0.980	0.980		0.980	0.980		0.980	0.980	
fG	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fP	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fBB	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fA	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fLU	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fRT		0.976			0.987			0.937			0.976	
fLT	0.950	1.000		0.950	1.000		0.950	1.000		0.950	1.000	
Sec.	0.519			0.390			0.511			0.461		
fLpb	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fRpb		1.000			1.000			1.000			1.000	
S	1770	1819		1770	1839		1770	1745		1770	1817	
Sec.	967			727			951			859		

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		13	1770	0.01	0.078	138	0.09
Perm		0	967	0.00	0.311	301	0.00
Left	L	13			0.39	439	0.03
Prot							
Perm							
Thru	TR	241	1819	# 0.13	0.28	505	0.48
Right							
Westbound							
Prot		108	1770	# 0.06	0.078	138	0.78
Perm		0	727	0.00	0.311	226	0.00
Left	L	108			0.39	364	0.30
Prot							
Perm							
Thru	TR	152	1839	0.08	0.28	511	0.30
Right							
Northbound							
Prot		6	1770	0.00	0.078	138	0.04
Perm		0	951	0.00	0.400	380	0.00
Left	L	6			0.48	518	0.01
Prot							
Perm							
Thru	TR	240	1745	# 0.14	0.37	640	0.38
Right							
Southbound							
Prot		6	1770	# 0.00	0.078	138	0.04
Perm		0	859	0.00	0.400	344	0.00
Left	L	6			0.48	482	0.01
Prot							
Perm							
Thru	TR	197	1817	0.11	0.37	666	0.30
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.33
Total lost time per cycle, L = 24.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.46

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	0.03	0.39	17.1	1.000	439	0.11	0.0	0.0	17.2	B		
TR	0.48	0.28	27.1	1.000	505	0.11	0.7	0.0	27.8	C	27.2	C
Westbound												
L	0.30	0.39	18.5	1.000	364	0.11	0.5	0.0	19.0	B		
TR	0.30	0.28	25.6	1.000	511	0.11	0.3	0.0	25.9	C	23.0	C
Northbound												
L	0.01	0.48	12.6	1.000	518	0.11	0.0	0.0	12.6	B		
TR	0.38	0.37	20.9	1.000	640	0.11	0.4	0.0	21.3	C	21.1	C
Southbound												
L	0.01	0.48	12.7	1.000	482	0.11	0.0	0.0	12.8	B		

TR	0.30	0.37	20.2	1.000	666	0.11	0.2	0.0	20.5	C	20.3	C

Intersection delay = 23.1 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M	M	M
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	35.0	35.0	43.0	43.0
Effective permitted green time for LT lane group, g(s)	28.0	28.0	36.0	36.0
Opposing effective green time, go (s)	25.0	25.0	33.0	33.0
Number of lanes in LT lane group, N	1	1	1	1
Number of lanes in opposing approach, No	1	1	1	1
Adjusted LT flow rate, VLT (veh/h)	13	108	6	6
Proportion of LT in LT lane group, PLT	1.000	1.000	1.000	1.000
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	152	241	197	240
Lost time for LT lane group, tL	6.00	6.00	6.00	6.00
Computation				
LT volume per cycle, LTC=VLTC/3600	0.33	2.70	0.15	0.15
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	3.80	6.03	4.93	6.00
gf=G[exp(- a * (LTC ** b)]-tl, gf<=g	0.0	0.0	0.0	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.72	0.72	0.63	0.63
gq, (see Exhibit C16-4,5,6,7,8)	6.00	10.05	7.00	8.77
gu=g-gq if gq>=gf, or = g-gf if gq<gf	22.00	17.95	29.00	27.23
n=Max(gq-gf)/2,0)	3.00	5.02	3.50	4.38
PTHo=1-PLTo	1.00	1.00	1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00	1.00	1.00
EL1 (refer to Exhibit C16-3)	1.51	1.64	1.58	1.64
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.14	0.14	0.11	0.11
gdiff=max(gq-gf,0)	0.00	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.52	0.39	0.51	0.46
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.519	0.390	0.511	0.461

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000	0.000	0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b)]-tl, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 90.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v	13	108	6	6
v/c ratio from Capacity Worksheet, X	0.03	0.30	0.01	0.01
Protected phase effective green interval, g (s)	7.0	7.0	7.0	7.0
Opposing queue effective green interval, gq	6.00	10.05	7.00	8.77
Unopposed green interval, gu	22.00	17.95	29.00	27.23
Red time r=(C-g-gq-gu)	55.0	55.0	47.0	47.0
Arrival rate, qa=v/(3600(max[X,1.0]))	0.00	0.03	0.00	0.00
Protected ph. departure rate, Sp=s/3600	0.492	0.492	0.492	0.492
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.34	0.31	0.33	0.32
XPerm	0.01	0.15	0.01	0.01
XProt	0.07	0.54	0.03	0.03
Case	1	1	1	1
Queue at beginning of green arrow, Qa	0.20	1.65	0.08	0.08
Queue at beginning of unsaturated green, Qu	0.02	0.30	0.01	0.01
Residual queue, Qr	0.00	0.00	0.00	0.00
Uniform Delay, dl	17.1	18.5	12.6	12.7

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. dl sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 23.1 sec/veh Intersection LOS C

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	L	TR	L	TR	L	TR	L	TR
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	13	241	108	152	6	240	6	197
So	1900	1900	1900	1900	1900	1900	1900	1900
No.Lanes	1	1 0	1	1 0	1	1 0	1	1 0
SL	1128	1819	936	1839	1084	1745	1007	1817
LnCapacity	439	505	364	511	518	640	482	666
Flow Ratio	0.01	0.13	0.12	0.08	0.01	0.14	0.01	0.11
v/c Ratio	0.03	0.48	0.30	0.30	0.01	0.38	0.01	0.30
Grn Ratio	0.39	0.28	0.39	0.28	0.48	0.37	0.48	0.37
I Factor		1.000		1.000		1.000		1.000
AT or PVG	3	3	3	3	3	3	3	3
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Q1	0.2	5.0	1.7	3.0	0.1	4.4	0.1	3.5
kB	0.4	0.5	0.4	0.5	0.5	0.5	0.4	0.5
Q2	0.0	0.4	0.2	0.2	0.0	0.3	0.0	0.2
Q Average	0.2	5.4	1.8	3.2	0.1	4.7	0.1	3.7
Q Spacing	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0
Q Storage	0	0	0	0	0	0	0	0
Q S Ratio								
70th Percentile Output:								
fB%	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
BOQ	0.3	6.4	2.2	3.8	0.1	5.6	0.1	4.4
QSRatio								
85th Percentile Output:								
fB%	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
BOQ	0.3	8.4	2.9	5.0	0.1	7.3	0.1	5.8
QSRatio								
90th Percentile Output:								
fB%	1.8	1.7	1.8	1.7	1.8	1.7	1.8	1.7
BOQ	0.4	9.3	3.3	5.5	0.2	8.1	0.2	6.5
QSRatio								
95th Percentile Output:								
fB%	2.1	1.9	2.0	2.0	2.1	2.0	2.1	2.0
BOQ	0.4	10.6	3.8	6.4	0.2	9.3	0.2	7.4
QSRatio								
98th Percentile Output:								
fB%	2.7	2.4	2.6	2.5	2.7	2.4	2.7	2.5
BOQ	0.6	12.8	4.7	7.9	0.2	11.3	0.2	9.1
QSRatio								

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: md
Agency:
Date: 1/4/2005
Period: pm
Project ID: 2007 background traffic - with improvements
E/W St: cth k

Inter.: cth k/104th ave
Area Type: All other areas
Jurisd: kenosha county
Year : 2007
N/S St: 104th ave

SIGNALIZED INTERSECTION SUMMARY

	Eastbound L	Eastbound T	Eastbound R	Westbound L	Westbound T	Westbound R	Northbound L	Northbound T	Northbound R	Southbound L	Southbound T	Southbound R
No. Lanes	1	1	0	1	1	0	1	1	0	1	1	0
LGConfig	L	TR		L	TR		L	TR		L	TR	
Volume	10	215	20	75	175	25	15	140	90	10	115	25
Lane Width	12.0	12.0		12.0	12.0		12.0	12.0		12.0	12.0	
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A	A			NB Left	A	A		
Thru		A			Thru		A		
Right		A			Right		A		
Peds					Peds				
WB Left	A	A			SB Left	A	A		
Thru		A			Thru		A		
Right		A			Right		A		
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	7.0	28.0				7.0	30.0		
Yellow	3.0	4.5				3.0	4.5		
All Red	0.0	1.5				0.0	1.5		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	426	1770	0.03	0.42	15.6	B		
TR	572	1839	0.45	0.31	25.4	C	25.0	C
Westbound								
L	394	1770	0.21	0.42	16.7	B		
TR	569	1828	0.38	0.31	24.7	C	22.5	C
Northbound								
L	507	1770	0.03	0.44	14.2	B		
TR	584	1753	0.43	0.33	23.9	C	23.3	C
Southbound								
L	427	1770	0.03	0.44	14.5	B		
TR	604	1813	0.03	0.44	14.5	B	21.6	C

Intersection Delay = 23.2 (sec/veh) Intersection LOS = C

HCS2000: Signalized Intersections Release 4.1c

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OPERATIONAL ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/4/2005
Analysis Time Period: pm
Intersection: cth k/104th ave
Area Type: All other areas
Jurisdiction: kenosha county
Analysis Year: 2007
Project ID: 2007 background traffic - with improvements

East/West Street: cth k
North/South Street: 104th ave

VOLUME DATA

	Eastbound L	Eastbound T	Eastbound R	Westbound L	Westbound T	Westbound R	Northbound L	Northbound T	Northbound R	Southbound L	Southbound T	Southbound R
Volume	10	215	20	75	175	25	15	140	90	10	115	25
% Heavy Veh	2	2	2	2	2	2	2	2	2	2	2	2
PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
PK 15 Vol	3	59	5	21	48	7	4	38	25	3	32	7
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900		1900	1900		1900	1900		1900	1900	
ParkExist												
NumPark												
No. Lanes	1	1	0	1	1	0	1	1	0	1	1	0
LGConfig	L	TR		L	TR		L	TR		L	TR	
Lane Width	12.0	12.0		12.0	12.0		12.0	12.0		12.0	12.0	
RTOR Vol			0			0			0			0
Adj Flow	11	258		82	219		16	253		11	153	
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.085			0.123			0.391			0.176	
Peds	0			0			0			0		
Bikes												
Buses	0	0		0	0		0	0		0	0	
%InProtPhase	0.0			0.0			0.0			0.0		

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound L	Eastbound T	Eastbound R	Westbound L	Westbound T	Westbound R	Northbound L	Northbound T	Northbound R	Southbound L	Southbound T	Southbound R
Init Unmet	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Arriv. Type	3	3		3	3		3	3		3	3	
Unit Ext.	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Ext of g	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Ped Min g	3.2			3.2			3.2			3.2		

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A	A			NB Left	A	A		
Thru		A			Thru		A		
Right		A			Right		A		
Peds					Peds				
WB Left	A	A			SB Left	A	A		
Thru		A			Thru		A		
Right		A			Right		A		
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	7.0	28.0				7.0	30.0		
Yellow	3.0	4.5				3.0	4.5		
All Red	0.0	1.5				0.0	1.5		

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound L	Eastbound T	Eastbound R	Westbound L	Westbound T	Westbound R	Northbound L	Northbound T	Northbound R	Southbound L	Southbound T	Southbound R
Volume, V	10	215	20	75	175	25	15	140	90	10	115	25
PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Adj flow	11	236	22	82	192	27	16	154	99	11	126	27
No. Lanes	1	1	0	1	1	0	1	1	0	1	1	0
Lane group	L	TR		L	TR		L	TR		L	TR	
Adj flow	11	258		82	219		16	253		11	153	
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.085			0.123			0.391			0.176	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L	TR		L	TR		L	TR		L	TR	
So	1900	1900		1900	1900		1900	1900		1900	1900	
Lanes	1	1	0	1	1	0	1	1	0	1	1	0
fW	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fHV	0.980	0.980		0.980	0.980		0.980	0.980		0.980	0.980	
fG	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fP	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fBB	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fA	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fLU	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fRT		0.987			0.982			0.941			0.974	
fLT	0.950	1.000		0.950	1.000		0.950	1.000		0.950	1.000	
Sec.	0.449			0.399			0.540			0.423		
fLpb	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fRpb		1.000			1.000			1.000			1.000	
S	1770	1839		1770	1828		1770	1753		1770	1813	
Sec.	837			743			1006			788		

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		11	1770	0.01	0.078	138	0.08
Perm		0	837	0.00	0.344	288	0.00
Left	L	11			0.42	426	0.03
Prot							
Perm							
Thru	TR	258	1839	# 0.14	0.31	572	0.45
Right							
Westbound							
Prot		82	1770	# 0.05	0.078	138	0.59
Perm		0	743	0.00	0.344	256	0.00
Left	L	82			0.42	394	0.21
Prot							
Perm							
Thru	TR	219	1828	0.12	0.31	569	0.38
Right							
Northbound							
Prot		16	1770	# 0.01	0.078	138	0.12
Perm		0	1006	0.00	0.367	369	0.00
Left	L	16			0.44	507	0.03
Prot							
Perm							
Thru	TR	253	1753	# 0.14	0.33	584	0.43
Right							
Southbound							
Prot		11	1770	0.01	0.078	138	0.08
Perm		0	788	0.00	0.367	289	0.00
Left	L	11			0.44	427	0.03
Prot							
Perm							
Thru	TR	153	1813	0.08	0.33	604	0.25
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.34
Total lost time per cycle, L = 24.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.46

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	0.03	0.42	15.5	1.000	426	0.11	0.0	0.0	15.6	B		
TR	0.45	0.31	24.8	1.000	572	0.11	0.6	0.0	25.4	C	25.0	C
Westbound												
L	0.21	0.42	16.4	1.000	394	0.11	0.3	0.0	16.7	B		
TR	0.38	0.31	24.3	1.000	569	0.11	0.4	0.0	24.7	C	22.5	C
Northbound												
L	0.03	0.44	14.2	1.000	507	0.11	0.0	0.0	14.2	B		
TR	0.43	0.33	23.4	1.000	584	0.11	0.5	0.0	23.9	C	23.3	C
Southbound												
L	0.03	0.44	14.5	1.000	427	0.11	0.0	0.0	14.5	B		

TR	0.25	0.33	21.8	1.000	604	0.11	0.2	0.0	22.1	C	21.6	C

Intersection delay = 23.2 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M	M	M
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	38.0	38.0	40.0	40.0
Effective permitted green time for LT lane group, g(s)	31.0	31.0	33.0	33.0
Opposing effective green time, go (s)	28.0	28.0	30.0	30.0
Number of lanes in LT lane group, N	1	1	1	1
Number of lanes in opposing approach, No	1	1	1	1
Adjusted LT flow rate, VLT (veh/h)	11	82	16	11
Proportion of LT in LT lane group, PLT	1.000	1.000	1.000	1.000
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	219	258	153	253
Lost time for LT lane group, tL	6.00	6.00	6.00	6.00
Computation				
LT volume per cycle, LTC=VLTC/3600	0.28	2.05	0.40	0.28
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	5.47	6.45	3.83	6.32
gf=G[exp(- a * (LTC ** b)]-tl, gf<=g	0.0	0.0	0.0	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.69	0.69	0.67	0.67
gq, (see Exhibit C16-4,5,6,7,8)	8.59	10.37	6.00	9.81
gu=g-gq if gq>=gf, or = g-gf if gq<gf	22.41	20.63	27.00	23.19
n=Max(gq-gf)/2,0)	4.29	5.19	3.00	4.91
PTHo=1-PLTo	1.00	1.00	1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00	1.00	1.00
EL1 (refer to Exhibit C16-3)	1.61	1.67	1.52	1.66
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.13	0.13	0.12	0.12
gdiff=max(gq-gf,0)	0.00	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.45	0.40	0.54	0.42
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.449	0.399	0.540	0.423

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000	0.000	0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b)]-tl, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 90.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v	11	82	16	11
v/c ratio from Capacity Worksheet, X	0.03	0.21	0.03	0.03
Protected phase effective green interval, g (s)	7.0	7.0	7.0	7.0
Opposing queue effective green interval, gq	8.59	10.37	6.00	9.81
Unopposed green interval, gu	22.41	20.63	27.00	23.19
Red time r=(C-g-gq-gu)	52.0	52.0	50.0	50.0
Arrival rate, qa=v/(3600(max[X,1.0]))	0.00	0.02	0.00	0.00
Protected ph. departure rate, Sp=s/3600	0.492	0.492	0.492	0.492
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.32	0.31	0.34	0.31
XPerm	0.01	0.11	0.02	0.01
XProt	0.05	0.39	0.07	0.05
Case	1	1	1	1
Queue at beginning of green arrow, Qa	0.16	1.18	0.22	0.15
Queue at beginning of unsaturated green, Qu	0.03	0.24	0.03	0.03
Residual queue, Qr	0.00	0.00	0.00	0.00
Uniform Delay, d1	15.5	16.4	14.2	14.5

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Dur. Unmet Demand Q veh	Unmet Demand t hrs.	Uniform Delay Unadj. ds	Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 23.2 sec/veh Intersection LOS C

BACK OF QUEUE WORKSHEET

LaneGroup	Eastbound L	Eastbound TR	Westbound L	Westbound TR	Northbound L	Northbound TR	Southbound L	Southbound TR
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	11	258	82	219	16	253	11	153
So	1900	1900	1900	1900	1900	1900	1900	1900
No.Lanes	1	1 0	1	1 0	1	1 0	1	1 0
SL	1009	1839	932	1828	1140	1753	960	1813
LnCapacity	426	572	394	569	507	584	427	604
Flow Ratio	0.01	0.14	0.09	0.12	0.01	0.14	0.01	0.08
v/c Ratio	0.03	0.45	0.21	0.38	0.03	0.43	0.03	0.25
Grn Ratio	0.42	0.31	0.42	0.31	0.44	0.33	0.44	0.33
I Factor		1.000		1.000		1.000		1.000
AT or PVG	3	3	3	3	3	3	3	3
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PFZ	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Q1	0.2	5.2	1.2	4.3	0.2	4.9	0.2	2.8
kB	0.4	0.5	0.4	0.5	0.5	0.5	0.4	0.5
Q2	0.0	0.4	0.1	0.3	0.0	0.4	0.0	0.2
Q Average	0.2	5.6	1.3	4.6	0.2	5.3	0.2	3.0
Q Spacing	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0
Q Storage	0	0	0	0	0	0	0	0
Q 5 Ratio								
70th Percentile Output:								
fB%	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
BOQ	0.2	6.6	1.6	5.5	0.3	6.3	0.2	3.5
QSRatio								
85th Percentile Output:								
fB%	1.6	1.5	1.6	1.6	1.6	1.6	1.6	1.6
BOQ	0.3	8.6	2.1	7.1	0.4	8.2	0.3	4.6
QSRatio								
90th Percentile Output:								
fB%	1.8	1.7	1.8	1.7	1.8	1.7	1.8	1.7
BOQ	0.3	9.5	2.3	7.9	0.4	9.1	0.3	5.2
QSRatio								
95th Percentile Output:								
fB%	2.1	1.9	2.1	2.0	2.1	1.9	2.1	2.0
BOQ	0.4	10.8	2.7	9.0	0.5	10.3	0.3	5.9
QSRatio								
98th Percentile Output:								
fB%	2.7	2.4	2.6	2.4	2.7	2.4	2.7	2.5
BOQ	0.5	13.1	3.4	11.0	0.6	12.5	0.4	7.4
QSRatio								

ERROR MESSAGES

No errors to report.

HCS2000: Unsignalized Intersections Release 4.1d

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ALL-WAY STOP CONTROL(AWSC) ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/4/2005
Analysis Time Period: am
Intersection: cth k/eastern frontage road
Jurisdiction: kenosha county
Units: U. S. Customary
Analysis Year: 2007
Project ID: 2007 background traffic - with improvements
East/West Street: cth k
North/South Street: eastern frontage road

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	10	120	25	45	60	5	5	75	80	1	1	1
% Thrus Left Lane												

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	LTR		LTR		LTR		LTR	
PHF	1.00		1.00		1.00		1.00	
Flow Rate	155		110		160		3	
% Heavy Veh	0		0		0		0	
No. Lanes		1		1		1		1
Opposing-Lanes		1		1		1		1
Conflicting-lanes		1		1		1		1
Geometry group		1		1		1		1

Duration, T 0.25 hrs.

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	155		110		160		3	
Left-Turn	10		45		5		1	
Right-Turn	25		5		80		1	
Prop. Left-Turns	0.1		0.4		0.0		0.3	
Prop. Right-Turns	0.2		0.0		0.5		0.3	
Prop. Heavy Vehicle	0.0		0.0		0.0		0.0	
Geometry Group		1		1		1		1
Adjustments Exhibit 17-33:								
hLT-adj		0.2		0.2		0.2		0.2
hRT-adj		-0.6		-0.6		-0.6		-0.6
hHV-adj		1.7		1.7		1.7		1.7
hadj, computed	-0.1		0.1		-0.3		-0.1	

Worksheet 4 - Departure Headway and Service Time

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow rate	155		110		160		3	
hd, initial value	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20
x, initial	0.14		0.10		0.14		0.00	
hd, final value	4.31		4.49		4.22		4.56	
x, final value	0.19		0.14		0.19		0.00	
Move-up time, m		2.0		2.0		2.0		2.0
Service Time	2.3		2.5		2.2		2.6	

Worksheet 5 - Capacity and Level of Service

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rate	155		110		160		3	
Service Time	2.3		2.5		2.2		2.6	
Utilization, x	0.19		0.14		0.19		0.00	
Dep. headway, hd	4.31		4.49		4.22		4.56	
Capacity	405		360		410		253	
Delay	8.29		8.21		8.19		7.58	
LOS	A		A		A		A	
Approach:								
Delay		8.29		8.21		8.19		7.58
LOS		A		A		A		A

Intersection Delay 8.23 Intersection LOS A

HCS2000: Unsignalized Intersections Release 4.1d

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ALL-WAY STOP CONTROL(AWSC) ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/4/2005
Analysis Time Period: pm
Intersection: cth k/eastern frontage road
Jurisdiction: kenosha county
Units: U. S. Customary
Analysis Year: 2007
Project ID: 2007 background traffic - with improvements
East/West Street: cth k
North/South Street: eastern frontage road

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	25	145	60	60	135	20	15	115	95	10	5	10
% Thrus Left Lane												

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	LTR		LTR		LTR		LTR	
PHF	1.00		1.00		1.00		1.00	
Flow Rate	230		215		225		25	
% Heavy Veh	0		0		0		0	
No. Lanes		1		1		1		1
Opposing-Lanes		1		1		1		1
Conflicting-lanes		1		1		1		1
Geometry group		1		1		1		1

Duration, T 0.25 hrs.

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	230		215		225		25	
Left-Turn	25		60		15		10	
Right-Turn	60		20		95		10	
Prop. Left-Turns	0.1		0.3		0.1		0.4	
Prop. Right-Turns	0.3		0.1		0.4		0.4	
Prop. Heavy Vehicle	0.0		0.0		0.0		0.0	
Geometry Group		1		1		1		1
Adjustments Exhibit 17-33:								
hLT-adj		0.2		0.2		0.2		0.2
hRT-adj	-0.6		-0.6		-0.6		-0.6	
hHV-adj		1.7		1.7		1.7		1.7
hadj, computed	-0.1		0.0		-0.2		-0.2	

Worksheet 4 - Departure Headway and Service Time

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow rate	230		215		225		25	
hd, initial value	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20
x, initial	0.20		0.19		0.20		0.02	
hd, final value	4.69		4.84		4.78		5.17	
x, final value	0.30		0.29		0.30		0.04	
Move-up time, m		2.0		2.0		2.0		2.0
Service Time	2.7		2.8		2.8		3.2	

Worksheet 5 - Capacity and Level of Service

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rate	230		215		225		25	
Service Time	2.7		2.8		2.8		3.2	
Utilization, x	0.30		0.29		0.30		0.04	
Dep. headway, hd	4.69		4.84		4.78		5.17	
Capacity	480		465		475		275	
Delay	9.68		9.79		9.81		8.36	
LOS	A		A		A		A	
Approach:								
Delay		9.68		9.79		9.81		8.36
LOS		A		A		A		A

Intersection Delay 9.71 Intersection LOS A

2007 BACKGROUND TRAFFIC CAPACITY ANALYSIS – WITHOUT IMPROVEMENTS

HCS2000: Signalized Intersections Release 4.1e

Analyst: md
Agency:
Date: 1/4/2005
Period: am
Project ID: 2007 background traffic - no improvements
E/W St: sth 158

Inter.: sth 158/cth h
Area Type: All other areas
Jurisd: wisdot
Year : 2007
N/S St: cth h

SIGNALIZED INTERSECTION SUMMARY

	Eastbound L	T	R	Westbound L	T	R	Northbound L	T	R	Southbound L	T	R
No. Lanes	1	1	0	1	1	0	0	1	0	0	1	0
LGConfig	L	TR		L	TR		LTR			LTR		
Volume	70	520	15	65	560	25	5	160	65	55	260	75
Lane Width	12.0	12.0		12.0	12.0			12.0			12.0	
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	A	A			NB Left	A		
Thru		A			Thru	A		
Right		A			Right	A		
Peds					Peds			
WB Left	A	A			SB Left	A		
Thru		A			Thru	A		
Right		A			Right	A		
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	6.0	40.0			29.0			
Yellow	3.0	4.5			4.5			
All Red	0.0	1.5			1.5			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	g/C	Lane Group Delay	LOS	Approach Delay	LOS
Eastbound								
L	250	1805	0.31	0.54	15.4	B		
TR	841	1892	0.71	0.44	23.0	C	22.1	C
Westbound								
L	290	1805	0.25	0.54	13.9	B		
TR	839	1888	0.77	0.44	25.8	C	24.6	C
Northbound								
LTR	582	1807	0.44	0.32	24.6	C	24.6	C
Southbound								
LTR	542	1681	0.80	0.32	36.1	D	36.1	D

Intersection Delay = 26.2 (sec/veh) Intersection LOS = C

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/4/2005
Analysis Time Period: am
Intersection: sth 158/cth h
Area Type: All other areas
Jurisdiction: wisdot
Analysis Year: 2007
Project ID: 2007 background traffic - no improvements
East/West Street: sth 158 North/South Street: cth h

VOLUME DATA

	Eastbound L	T	R	Westbound L	T	R	Northbound L	T	R	Southbound L	T	R
Volume	70	520	15	65	560	25	5	160	65	55	260	75
% Heavy Veh	0	0	0	0	0	0	0	0	0	0	0	0
PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
PK 15 Vol	19	144	4	18	156	7	2	44	18	15	72	21
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900		1900	1900			1900			1900	
ParkExist												
NumPark												
No. Lanes	1	1	0	1	1	0	0	1	0	0	1	0
LGConfig	L	TR		L	TR			LTR			LTR	
Lane Width	12.0	12.0		12.0	12.0			12.0			12.0	
RTOR Vol			0			0			0			0
Adj Flow	78	595		72	650			256			433	
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000			0.023			0.141	
Prop RTs		0.029			0.043			0.281			0.192	
Peds	0			0			0			0		
Bikes												
Buses	0	0		0	0		0			0		
%InProtPhase	0.0			0.0								

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound L	T	R	Westbound L	T	R	Northbound L	T	R	Southbound L	T	R
Init Unmet	0.0	0.0		0.0	0.0			0.0			0.0	
Arriv. Type	3	3		3	3			3			3	
Unit Ext.	3.0	3.0		3.0	3.0			3.0			3.0	
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0		2.0	2.0			2.0			2.0	
Ext of g	2.0	2.0		2.0	2.0			2.0			2.0	
Ped Min g	3.2			3.2			3.2			3.2		

PHASE DATA

Phase Combination	1	2	3	4	5	6	7	8
EB Left	A	A			NB Left	A		
Thru		A			Thru	A		
Right		A			Right	A		
Peds					Peds			
WB Left	A	A			SB Left	A		
Thru		A			Thru	A		
Right		A			Right	A		
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	6.0	40.0			29.0			
Yellow	3.0	4.5			4.5			
All Red	0.0	1.5			1.5			

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound L	T	R	Westbound L	T	R	Northbound L	T	R	Southbound L	T	R
Volume, V	70	520	15	65	560	25	5	160	65	55	260	75
PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj flow	78	578	17	72	622	28	6	178	72	61	289	83
No. Lanes	1	1	0	1	1	0	0	1	0	0	1	0
Lane group	L	TR		L	TR			LTR			LTR	
Adj flow	78	595		72	650			256			433	
Prop LTs	1.000	0.000		1.000	0.000			0.023			0.141	
Prop RTs		0.029			0.043			0.281			0.192	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	L	TR	L	TR	LTR		LTR	
So	1900	1900	1900	1900	1900		1900	
Lanes	1	1 0	1	1 0	0	1 0	0	1 0
fW	1.000	1.000	1.000	1.000	1.000		1.000	
fHV	1.000	1.000	1.000	1.000	1.000		1.000	
fG	1.000	1.000	1.000	1.000	1.000		1.000	
fP	1.000	1.000	1.000	1.000	1.000		1.000	
fBB	1.000	1.000	1.000	1.000	1.000		1.000	
fA	1.000	1.000	1.000	1.000	1.000		1.000	
fLU	1.000	1.000	1.000	1.000	1.000		1.000	
fRT		0.996		0.994	0.962		0.974	
fLT	0.950	1.000	0.950	1.000	0.989		0.908	
Sec.	0.143		0.187					
fLpb	1.000	1.000	1.000	1.000	1.000		1.000	
fRpb		1.000		1.000	1.000		1.000	
S	1805	1892	1805	1888	1807		1681	
Sec.	272		356					

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		78	1805	# 0.04	0.067	120	0.65
Perm		0	272	0.00	0.478	130	0.00
Left	L	78			0.54	250	0.31
Prot							
Perm							
Thru	TR	595	1892	0.31	0.44	841	0.71
Right							
Westbound							
Prot		72	1805	0.04	0.067	120	0.60
Perm		0	356	0.00	0.478	170	0.00
Left	L	72			0.54	290	0.25
Prot							
Perm							
Thru	TR	650	1888	# 0.34	0.44	839	0.77
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	256	1807	0.14	0.32	582	0.44
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	433	1681	# 0.26	0.32	542	0.80
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.65
Total lost time per cycle, L = 18.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.81

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group Delay	LOS	Approach Delay	LOS
Eastbound												
L	0.31	0.54	14.7	1.000	250	0.11	0.7	0.0	15.4	B		
TR	0.71	0.44	20.3	1.000	841	0.27	2.8	0.0	23.0	C	22.1	C
Westbound												
L	0.25	0.54	13.4	1.000	290	0.11	0.5	0.0	13.9	B		
TR	0.77	0.44	21.2	1.000	839	0.32	4.6	0.0	25.8	C	24.6	C
Northbound												
LTR	0.44	0.32	24.1	1.000	582	0.11	0.5	0.0	24.6	C	24.6	C
Southbound												

LTR	0.80	0.32	27.8	1.000	542	0.34	8.3	0.0	36.1	D	36.1	D

Intersection delay = 26.2 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M		
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	49.0	49.0		
Effective permitted green time for LT lane group, g(s)	43.0	43.0		
Opposing effective green time, go (s)	40.0	40.0		
Number of lanes in LT lane group, N	1	1		
Number of lanes in opposing approach, No	1	1		
Adjusted LT flow rate, VLT (veh/h)	78	72		
Proportion of LT in LT lane group, PLT	1.000	1.000		
Proportion of LT in opposing flow, PLTo	0.00	0.00		
Adjusted opposing flow rate, Vo (veh/h)	650	595		
Lost time for LT lane group, tL	6.00	6.00		
Computation				
LT volume per cycle, LTC=VLTC/3600	1.95	1.80		
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	16.25	14.88		
gf=G[exp(- a * (LTC ** b)]-tl, gf<=g	0.0	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.56	0.56		
gq, (see Exhibit C16-4,5,6,7,8)	28.26	24.69		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	14.74	18.31		
n=Max(gq-gf)/2,0)	14.13	12.34		
PTHo=1-PLTo	1.00	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00		
EL1 (refer to Exhibit C16-3)	2.39	2.27		
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.09	0.09		
gdiff=max(gq-gf,0)	0.00	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.14	0.19		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.143	0.187		

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach			S	S
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)			29.0	29.0
Effective permitted green time for LT lane group, g(s)			29.0	29.0
Opposing effective green time, go (s)			29.0	29.0
Number of lanes in LT lane group, N			1	1
Number of lanes in opposing approach, No			1	1
Adjusted LT flow rate, VLT (veh/h)			6	61
Proportion of LT in LT lane group, PLT	0.000	0.000	0.023	0.141
Proportion of LT in opposing flow, PLTo			0.14	0.02
Adjusted opposing flow rate, Vo (veh/h)			433	256
Lost time for LT lane group, tL			6.00	6.00
Computation				
LT volume per cycle, LTC=VLTC/3600			0.15	1.53
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			10.82	6.40
gf=G[exp(- a * (LTC ** b)]-tl, gf<=g			16.3	3.4
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.68	0.68
gq, (see Exhibit C16-4,5,6,7,8)			14.09	7.46
gu=g-gq if gq>=gf, or = g-gf if gq<gf			12.66	21.54
n=Max(gq-gf)/2,0)			0.00	2.01
PTHo=1-PLTo			0.86	0.98
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			0.02	0.14
EL1 (refer to Exhibit C16-3)			2.15	1.80
EL2=Max((1-Ptho**n)/Plto, 1.0)			1.00	1.98
fmin=2(1+PL)/g or fmin=2(1+Pl)/g			0.07	0.08
gdiff=max(gq-gf,0)			0.00	4.01
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.99	0.91
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.989	0.908

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 90.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v	78	72		
v/c ratio from Capacity Worksheet, X	0.31	0.25		
Protected phase effective green interval, g (s)	6.0	6.0		
Opposing queue effective green interval, gq	28.26	24.69		
Unopposed green interval, gu	14.74	18.31		
Red time r=(C-g-gq-gu)	41.0	41.0		
Arrival rate, qa=v/(3600(max[X,1.0]))	0.02	0.02		
Protected ph. departure rate, Sp=s/3600	0.501	0.501		
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.22	0.23		
XPerm	0.29	0.20		
XProt	0.34	0.31		
Case	1	1		
Queue at beginning of green arrow, Qa	0.89	0.82		
Queue at beginning of unsaturated green, Qu	0.61	0.49		
Residual queue, Qr	0.00	0.00		
Uniform Delay, d1	14.7	13.4		

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Dur. Unmet Demand Q veh	Initial Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 26.2 sec/veh Intersection LOS C

BACK OF QUEUE WORKSHEET

LaneGroup	Eastbound L	Eastbound TR		Westbound L	Westbound TR		Northbound LTR		Southbound LTR	
Init Queue	0.0	0.0		0.0	0.0		0.0		0.0	
Flow Rate	78	595		72	650		256		433	
So	1900	1900		1900	1900		1900		1900	
No.Lanes	1	1	0	1	1	0	1	0	1	0
SL	460	1892		533	1888		1807		1681	
LnCapacity	250	841		290	839		582		542	
Flow Ratio	0.17	0.31		0.14	0.34		0.14		0.26	
v/c Ratio	0.31	0.71		0.25	0.77		0.44		0.80	
Grn Ratio	0.54	0.44		0.54	0.44		0.32		0.32	
I Factor		1.000			1.000		1.000		1.000	
AT or PVG	3	3		3	3		3		3	
Pltn Ratio	1.00	1.00		1.00	1.00		1.00		1.00	
PF2	1.00	1.00		1.00	1.00		1.00		1.00	
Q1	0.9	12.1		0.8	13.8		5.1		9.9	
kB	0.3	0.6		0.3	0.6		0.5		0.5	
Q2	0.1	1.4		0.1	2.0		0.4		1.7	
Q Average	1.0	13.5		0.9	15.7		5.4		11.6	
Q Spacing	25.0	25.0		25.0	25.0		25.0		25.0	
Q Storage	0	0		0	0		0		0	
Q S Ratio										
70th Percentile Output:										
fB%	1.2	1.2		1.2	1.2		1.2		1.2	
BOQ	1.2	15.8		1.1	18.4		6.5		13.6	
QSRatio										
85th Percentile Output:										
fB%	1.6	1.5		1.6	1.5		1.6		1.5	
BOQ	1.7	20.1		1.5	23.3		8.4		17.4	
QSRatio										
90th Percentile Output:										
fB%	1.8	1.6		1.8	1.6		1.7		1.6	
BOQ	1.9	21.6		1.7	24.9		9.3		18.8	
QSRatio										
95th Percentile Output:										
fB%	2.1	1.8		2.1	1.8		1.9		1.8	
BOQ	2.2	24.1		1.9	27.5		10.6		21.0	
QSRatio										
98th Percentile Output:										
fB%	2.6	2.1		2.6	2.0		2.4		2.1	
BOQ	2.7	27.7		2.5	31.4		12.8		24.4	
QSRatio										

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: md
Agency:
Date: 1/4/2005
Period: pm
Project ID: 2007 background traffic - no improvements
E/W St: sth 158

Inter.: sth 158/cth h
Area Type: All other areas
Jurisd: wisdot
Year : 2007
N/S St: cth h

SIGNALIZED INTERSECTION SUMMARY

	Eastbound L	T	R	Westbound L	T	R	Northbound L	T	R	Southbound L	T	R
No. Lanes	1	1	0	1	1	0	0	1	0	0	1	0
LGConfig	L	TR		L	TR			LTR			LTR	
Volume	125	655	20	40	385	60	10	310	50	55	280	40
Lane Width	12.0	12.0		12.0	12.0			12.0			12.0	
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A	A			NB Left	A			
Thru		A			Thru	A			
Right		A			Right	A			
Peds					Peds				
WB Left	A	A			SB Left	A			
Thru		A			Thru	A			
Right		A			Right	A			
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	6.0	38.0				31.0			
Yellow	3.0	4.5				4.5			
All Red	0.0	1.5				1.5			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	g/C	Lane Group Delay	LOS	Approach Delay	LOS
Eastbound								
L	337	1805	0.41	0.52	14.5	B		
TR	799	1892	0.94	0.42	43.5	D	39.0	D
Westbound								
L	204	1805	0.22	0.52	18.8	B		
TR	786	1861	0.63	0.42	22.1	C	21.8	C
Northbound								
LTR	633	1837	0.65	0.34	27.3	C	27.3	C
Southbound								
LTR	537	1558	0.77	0.34	33.4	C	33.4	C

Intersection Delay = 31.7 (sec/veh) Intersection LOS = C

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/4/2005
Analysis Time Period: pm
Intersection: sth 158/cth h
Area Type: All other areas
Jurisdiction: wisdot
Analysis Year: 2007
Project ID: 2007 background traffic - no improvements
East/West Street: sth 158 North/South Street: cth h

VOLUME DATA

	Eastbound L	T	R	Westbound L	T	R	Northbound L	T	R	Southbound L	T	R
Volume	125	655	20	40	385	60	10	310	50	55	280	40
% Heavy Veh	0	0	0	0	0	0	0	0	0	0	0	0
PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
PK 15 Vol	35	182	6	11	107	17	3	86	14	15	78	11
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900		1900	1900			1900			1900	
ParkExist												
NumPark												
No. Lanes	1	1	0	1	1	0	0	1	0	0	1	0
LGConfig	L	TR		L	TR			LTR			LTR	
Lane Width	12.0	12.0		12.0	12.0			12.0			12.0	
RTOR Vol			0			0			0			0
Adj Flow	139	750		44	495			411			416	
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000			0.027			0.147	
Prop RTs		0.029			0.135		0.136			0.106		
Peds		0			0			0			0	
Bikes												
Buses	0	0		0	0			0			0	
%InProtPhase	0.0			0.0								
Duration	0.25											

Area Type: All other areas

OPERATING PARAMETERS

	Eastbound L	T	R	Westbound L	T	R	Northbound L	T	R	Southbound L	T	R
Init Unmet	0.0	0.0		0.0	0.0			0.0			0.0	
Arriv. Type	3	3		3	3			3			3	
Unit Ext.	3.0	3.0		3.0	3.0			3.0			3.0	
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0		2.0	2.0			2.0			2.0	
Ext of g	2.0	2.0		2.0	2.0			2.0			2.0	
Ped Min g	3.2			3.2				3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A	A			NB Left	A			
Thru		A			Thru	A			
Right		A			Right	A			
Peds					Peds				
WB Left	A	A			SB Left	A			
Thru		A			Thru	A			
Right		A			Right	A			
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	6.0	38.0				31.0			
Yellow	3.0	4.5				4.5			
All Red	0.0	1.5				1.5			

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound L	T	R	Westbound L	T	R	Northbound L	T	R	Southbound L	T	R
Volume, V	125	655	20	40	385	60	10	310	50	55	280	40
PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj flow	139	728	22	44	428	67	11	344	56	61	311	44
No. Lanes	1	1	0	1	1	0	0	1	0	0	1	0
Lane group	L	TR		L	TR			LTR			LTR	
Adj flow	139	750		44	495			411			416	
Prop LTs	1.000	0.000		1.000	0.000			0.027			0.147	
Prop RTs		0.029			0.135		0.136			0.106		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound L	TR		Westbound L	TR		Northbound LTR			Southbound LTR		
LG												
So	1900	1900		1900	1900		1900			1900		
Lanes	1	1	0	1	1	0	1	0	0	1	0	
fW	1.000	1.000		1.000	1.000		1.000			1.000		
fHV	1.000	1.000		1.000	1.000		1.000			1.000		
fG	1.000	1.000		1.000	1.000		1.000			1.000		
fP	1.000	1.000		1.000	1.000		1.000			1.000		
fBB	1.000	1.000		1.000	1.000		1.000			1.000		
fA	1.000	1.000		1.000	1.000		1.000			1.000		
fLU	1.000	1.000		1.000	1.000		1.000			1.000		
fRT		0.996			0.980		0.982			0.986		
fLT	0.950	1.000		0.950	1.000		0.985			0.832		
Sec.	0.250			0.098								
fLpb	1.000	1.000		1.000	1.000		1.000			1.000		
fRpb		1.000			1.000		1.000			1.000		
S	1805	1892		1805	1861		1837			1558		
Sec.	476			185								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		120	1805	# 0.07	0.067	120	1.00
Perm		19	476	0.04	0.456	217	0.09
Left	L	139			0.52	337	0.41
Prot							
Perm							
Thru	TR	750	1892	# 0.40	0.42	799	0.94
Right							
Westbound							
Prot		44	1805	0.02	0.067	120	0.37
Perm		0	185	0.00	0.456	84	0.00
Left	L	44			0.52	204	0.22
Prot							
Perm							
Thru	TR	495	1861	0.27	0.42	786	0.63
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	411	1837	0.22	0.34	633	0.65
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	416	1558	# 0.27	0.34	537	0.77
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.73
Total lost time per cycle, L = 18.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.91

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group Delay	LOS	Approach Delay	LOS
Eastbound												
L	0.41	0.52	13.7	1.000	337	0.11	0.8	0.0	14.5	B		
TR	0.94	0.42	24.9	1.000	799	0.45	18.6	0.0	43.5	D	39.0	D
Westbound												
L	0.22	0.52	18.3	1.000	204	0.11	0.5	0.0	18.8	B		
TR	0.63	0.42	20.5	1.000	786	0.21	1.6	0.0	22.1	C	21.8	C
Northbound												
LTR	0.65	0.34	24.9	1.000	633	0.23	2.3	0.0	27.3	C	27.3	C
Southbound												

LTR	0.77	0.34	26.4	1.000	537	0.32	7.0	0.0	33.4	C	33.4	C

Intersection delay = 31.7 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

		EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach		M	M		
Cycle length, C	90.0 sec				
Total actual green time for LT lane group, G (s)		47.0	47.0		
Effective permitted green time for LT lane group, g(s)		41.0	41.0		
Opposing effective green time, go (s)		38.0	38.0		
Number of lanes in LT lane group, N		1	1		
Number of lanes in opposing approach, No		1	1		
Adjusted LT flow rate, VLT (veh/h)		139	44		
Proportion of LT in LT lane group, PLT		1.000	1.000		
Proportion of LT in opposing flow, PLTo		0.00	0.00		
Adjusted opposing flow rate, Vo (veh/h)		495	750		
Lost time for LT lane group, tL		6.00	6.00		
Computation					
LT volume per cycle, LTC=VLTC/3600		3.48	1.10		
Opposing lane util. factor, fLUo		1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/{3600(No)fLUo] (veh/ln/cyc)		12.38	18.75		
gf=G[exp(- a * (LTC ** b)]-tl, gf<=g		0.0	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.58	0.58		
gq, (see Exhibit C16-4,5,6,7,8)		19.72	37.00		
gu=g-gq if gq>=gf, or = g-gf if gq<gf		21.28	4.00		
n=Max(gq-gf)/2,0)		9.86	18.50		
PTHo=1-PLTo		1.00	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00	1.00		
EL1 (refer to Exhibit C16-3)		2.07	2.63		
EL2=Max((1-Ptho**n)/Plto, 1.0)					
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.10	0.10		
gdiff=max(gq-gf,0)		0.00	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.25	0.10		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)					
or flt=[fm+0.91(N-1)]/N**					
Left-turn adjustment, fLT		0.250	0.098		

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

		EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				S	S
Cycle length, C	90.0 sec				
Total actual green time for LT lane group, G (s)				31.0	31.0
Effective permitted green time for LT lane group, g(s)				31.0	31.0
Opposing effective green time, go (s)				31.0	31.0
Number of lanes in LT lane group, N				1	1
Number of lanes in opposing approach, No				1	1
Adjusted LT flow rate, VLT (veh/h)				11	61
Proportion of LT in LT lane group, PLT		0.000	0.000	0.027	0.147
Proportion of LT in opposing flow, PLTo				0.15	0.03
Adjusted opposing flow rate, Vo (veh/h)				416	411
Lost time for LT lane group, tL				6.00	6.00
Computation					
LT volume per cycle, LTC=VLTC/3600				0.28	1.53
Opposing lane util. factor, fLUo		1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/{3600(No)fLUo] (veh/ln/cyc)				10.40	10.27
gf=G[exp(- a * (LTC ** b)]-tl, gf<=g				15.2	4.1
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				0.66	0.66
gq, (see Exhibit C16-4,5,6,7,8)				12.81	12.64
gu=g-gq if gq>=gf, or = g-gf if gq<gf				15.84	18.36
n=Max(gq-gf)/2,0)				0.00	4.27
PTHo=1-PLTo				0.85	0.97
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				0.03	0.15
EL1 (refer to Exhibit C16-3)				2.12	2.10
EL2=Max((1-Ptho**n)/Plto, 1.0)				1.00	4.09
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				0.07	0.07
gdiff=max(gq-gf,0)				0.00	8.54
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				0.99	0.83
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)					
or flt=[fm+0.91(N-1)]/N**					
Left-turn adjustment, fLT				0.985	0.832

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

	EB	WB	NB	SB
Permitted Left Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

		EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v		139	44		
v/c ratio from Capacity Worksheet, X		0.41	0.22		
Protected phase effective green interval, g (s)		6.0	6.0		
Opposing queue effective green interval, gq		19.72	37.00		
Unopposed green interval, gu		21.28	4.00		
Red time r=(C-g-gq-gu)		43.0	43.0		
Arrival rate, qa=v/(3600(max[X,1.0]))		0.04	0.01		
Protected ph. departure rate, Sp=s/3600		0.501	0.501		
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)		0.25	0.53		
XPerm		0.29	0.24		
XProt		0.63	0.20		
Case		1	1		
Queue at beginning of green arrow, Qa		1.66	0.53		
Queue at beginning of unsaturated green, Qu		0.76	0.45		
Residual queue, Qr		0.00	0.00		
Uniform Delay, d1		13.7	18.3		

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Dur. Unmet Demand Q veh	Initial Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 31.7 sec/veh Intersection LOS C

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound	Southbound
LaneGroup	L	TR	L	TR	LTR	LTR
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	139	750	44	495	411	416
So	1900	1900	1900	1900	1900	1900
No.Lanes	1	1 0	1	1 0	0 1 0	0 1 0
SL	646	1892	392	1861	1837	1558
LnCapacity	337	799	204	786	633	537
Flow Ratio	0.22	0.40	0.11	0.27	0.22	0.27
v/c Ratio	0.41	0.94	0.22	0.63	0.65	0.77
Grn Ratio	0.52	0.42	0.52	0.42	0.34	0.34
I Factor		1.000		1.000	1.000	1.000
AT or PVG	3	3	3	3	3	3
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00	1.00	1.00	1.00	1.00	1.00
Q1	1.7	17.9	0.5	9.7	8.7	9.3
kB	0.4	0.6	0.3	0.6	0.5	0.5
Q2	0.2	5.1	0.1	1.0	0.9	1.5
Q Average	2.0	23.0	0.6	10.7	9.6	10.8
Q Spacing	25.0	25.0	25.0	25.0	25.0	25.0
Q Storage	0	0	0	0	0	0
Q S Ratio						
70th Percentile Output:						
fB%	1.2	1.2	1.2	1.2	1.2	1.2
BOQ	2.3	26.6	0.7	12.6	11.3	12.7
QSRatio						
85th Percentile Output:						
fB%	1.6	1.4	1.6	1.5	1.5	1.5
BOQ	3.1	33.1	1.0	16.2	14.6	16.3
QSRatio						
90th Percentile Output:						
fB%	1.8	1.5	1.8	1.6	1.6	1.6
BOQ	3.4	35.1	1.1	17.5	15.8	17.6
QSRatio						
95th Percentile Output:						
fB%	2.0	1.7	2.1	1.8	1.9	1.8
BOQ	4.0	38.3	1.3	19.6	17.8	19.7
QSRatio						
98th Percentile Output:						
fB%	2.6	1.9	2.7	2.1	2.2	2.1
BOQ	5.0	43.0	1.6	22.9	20.9	23.0
QSRatio						

ERROR MESSAGES

No errors to report.

HCS2000: Unsignalized Intersections Release 4.1d

TWO-WAY STOP CONTROL SUMMARY

Analyst:
Agency/Co.:
Date Performed: 11/12/2004
Analysis Time Period: am
Intersection: sth 158/104th avenue
Jurisdiction: wisdot
Units: U. S. Customary
Analysis Year: 2004
Project ID: 2007 background traffic - no improvements
East/West Street: sth 158
North/South Street: 104th Avenue
Intersection Orientation: EW
Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	5	535	20	125	460	5
Peak-Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate, HFR	5	535	20	125	460	5
Percent Heavy Vehicles	0	--	--	0	--	--
Median Type/Storage	Undivided		/			
RT Channelized?			No			No
Lanes	1	2	1	1	2	1
Configuration	L	T	R	L	T	R
Upstream Signal?		No			No	

Minor Street: Approach	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	30	5	105	5	10	5
Peak Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate, HFR	30	5	105	5	10	5
Percent Heavy Vehicles	0	0	0	0	0	0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No /			No /
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	L	L		LTR			LTR	
v (vph)	5	125		140			20	
C(m) (vph)	1107	1026		388			187	
v/c	0.00	0.12		0.36			0.11	
95% queue length	0.01	0.41		1.61			0.35	
Control Delay	8.3	9.0		19.4			26.5	
LOS	A	A		C			D	
Approach Delay				19.4			26.5	
Approach LOS				C			D	

HCS2000: Unsignalized Intersections Release 4.1d

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TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst:
Agency/Co.:
Date Performed: 11/12/2004
Analysis Time Period: am
Intersection: sth 158/104th avenue
Jurisdiction: wisdot
Units: U. S. Customary
Analysis Year: 2004
Project ID: 2007 background traffic - no improvements
East/West Street: sth 158
North/South Street: 104th Avenue
Intersection Orientation: EW
Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	5	535	20	125	460	5
Peak-Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Peak-15 Minute Volume	1	134	5	31	115	1
Hourly Flow Rate, HFR	5	535	20	125	460	5
Percent Heavy Vehicles	0	--	--	0	--	--
Median Type/Storage	Undivided		/			
RT Channelized?			No			No
Lanes	1	2	1	1	2	1
Configuration	L	T	R	L	T	R
Upstream Signal?		No			No	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	30	5	105	5	10	5
Peak Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Peak-15 Minute Volume	8	1	26	1	2	1
Hourly Flow Rate, HFR	30	5	105	5	10	5
Percent Heavy Vehicles	0	0	0	0	0	0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No /			No /
RT Channelized?						
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn							
Through							
S5 Left-Turn							
Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation Movement		1	4	7	8	9	10	11	12
		L	L	L	T	R	L	T	R
t(c,base)		4.1	4.1	7.5	6.5	6.9	7.5	6.5	6.9
t(c,hv)		2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
P(hv)		0	0	0	0	0	0	0	0
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Grade/100				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage	4.1	4.1	7.5	6.5	6.9	7.5	6.5	6.9
	2-stage								

Follow-Up Time Calculations Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)	2.20	2.20	3.50	4.00	3.30	3.50	4.00	3.30
t(f,HV)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(HV)	0	0	0	0	0	0	0	0
t(f)	2.2	2.2	3.5	4.0	3.3	3.5	4.0	3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(1,prot)	V(t)	V(1,prot)
V prog				
Total Saturation Flow Rate, s (vph)				
Arrival Type				
Effective Green, g (sec)				
Cycle Length, C (sec)				
Rp (from Exhibit 16-11)				
Proportion vehicles arriving on green P				
g(q1)				
g(q2)				
g(q)				

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2		Movement 5	
	V(t)	V(1,prot)	V(t)	V(1,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p			0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5

Single-Stage Process Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
V c,x	465	555	1030	1260	268	990	1275	230
s								
Ex								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		3000		3000		3000		3000
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	268	230
Potential Capacity	736	779
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	736	779
Probability of Queue free St.	0.86	0.99

Step 2: LT from Major St.	4	1
Conflicting Flows	555	465
Potential Capacity	1026	1107
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	1026	1107
Probability of Queue free St.	0.88	1.00
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows	1260	1275
Potential Capacity	172	168
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.87	0.87
Movement Capacity	150	147
Probability of Queue free St.	0.97	0.93

Step 4: LT from Minor St.	7	10
Conflicting Flows	1030	990
Potential Capacity	190	204
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.81	0.85
Maj. L, Min T Adj. Imp Factor.	0.86	0.88
Cap. Adj. factor due to Impeding mvmnt	0.85	0.76
Movement Capacity	162	154

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	1260	1275
Potential Capacity	172	168
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.87	0.87
Movement Capacity	150	147
Result for 2 stage process:		
a		
y		
C t	150	147
Probability of Queue free St.	0.97	0.93

Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	1030	990
Potential Capacity	190	204
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.81	0.85
Maj. L, Min T Adj. Imp Factor.	0.86	0.88
Cap. Adj. factor due to Impeding mvmnt	0.85	0.76
Movement Capacity	162	154
Results for Two-stage process:		
a		
y		
C t	162	154

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	30	5	105	5	10	5
Movement Capacity (vph)	162	150	736	154	147	779
Shared Lane Capacity (vph)		388			187	

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	162	150	736	154	147	779
Volume	30	5	105	5	10	5
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh		388			187	
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	L	L		LTR			LTR	
v (vph)	5	125		140			20	
C(m) (vph)	1107	1026		388			187	
v/c	0.00	0.12		0.36			0.11	
95% queue length	0.01	0.41		1.61			0.35	
Control Delay	8.3	9.0		19.4			26.5	
LOS	A	A		C			D	
Approach Delay				19.4			26.5	
Approach LOS				C			D	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.88
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4	8.3	9.0
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS2000: Unsignalized Intersections Release 4.1d

TWO-WAY STOP CONTROL SUMMARY

Analyst:
Agency/Co.:
Date Performed: 11/12/2004
Analysis Time Period: pm
Intersection: sth 158/104th avenue
Jurisdiction: wisdot
Units: U. S. Customary
Analysis Year: 2004
Project ID: 2007 background traffic - no improvements
East/West Street: sth 158
North/South Street: 104th Avenue
Intersection Orientation: EW
Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1 L	2 T	3 R	4 L	5 T	6 R
Volume	5	610	20	120	360	5
Peak Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate, HFR	5	610	20	120	360	5
Percent Heavy Vehicles	0	--	--	0	--	--
Median Type/Storage	Undivided			/		
RT Channelized?			No			No
Lanes	1 L	2 T	1 R	1 L	2 T	1 R
Configuration		No			No	
Upstream Signal?						

Minor Street: Approach	Northbound			Southbound		
Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume	20	5	160	10	5	10
Peak Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate, HFR	20	5	160	10	5	10
Percent Heavy Vehicles	0	0	0	0	0	0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No /			No /
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	L	L		LTR			LTR	
v (vph)	5	120		185			25	
C(m) (vph)	1205	962		482			230	
v/c	0.00	0.12		0.38			0.11	
95% queue length	0.01	0.43		1.78			0.36	
Control Delay	8.0	9.3		17.0			22.6	
LOS	A	A		C			C	
Approach Delay				17.0			22.6	
Approach LOS				C			C	

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn							
Through							
S5 Left-Turn							
Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1	4.1	7.5	6.5	6.9	7.5	6.5	6.9
t(c,hv)		2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
P(hv)		0	0	0	0	0	0	0	0
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Grade/100				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage	4.1	4.1	7.5	6.5	6.9	7.5	6.5	6.9
	2-stage								

Follow-Up Time Calculations Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20	2.20	3.50	4.00	3.30	3.50	4.00	3.30
t(f,HV)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(HV)	0	0	0	0	0	0	0	0
t(f)	2.2	2.2	3.5	4.0	3.3	3.5	4.0	3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal	Movement 2 V(t)	Movement 2 V(1,prot)	Movement 5 V(t)	Movement 5 V(1,prot)
V prog				

HCS2000: Unsignalized Intersections Release 4.1d

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TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst:
Agency/Co.:
Date Performed: 11/12/2004
Analysis Time Period: pm
Intersection: sth 158/104th avenue
Jurisdiction: wisdot
Units: U. S. Customary
Analysis Year: 2004
Project ID: 2007 background traffic - no improvements
East/West Street: sth 158
North/South Street: 104th Avenue
Intersection Orientation: EW
Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume	5	610	20	120	360	5
Peak-Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Peak-15 Minute Volume	1	152	5	30	90	1
Hourly Flow Rate, HFR	5	610	20	120	360	5
Percent Heavy Vehicles	0	--	--	0	--	--
Median Type/Storage	Undivided			/		
RT Channelized?			No			No
Lanes	1 L	2 T	1 R	1 L	2 T	1 R
Configuration		No			No	
Upstream Signal?						

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume	20	5	160	10	5	10
Peak Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Peak-15 Minute Volume	5	1	40	2	1	2
Hourly Flow Rate, HFR	20	5	160	10	5	10
Percent Heavy Vehicles	0	0	0	0	0	0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No /			No /
RT Channelized?						
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Total Saturation Flow Rate, s (vph)		
Arrival Type		
Effective Green, g (sec)		
Cycle Length, C (sec)		
Rp (from Exhibit 16-11)		
Proportion vehicles arriving on green P		
g(q1)		
g(q2)		
g(q)		

Computation 2-Proportion of TWSC Intersection Time blocked	Movement 2 V(t)	Movement 2 V(1,prot)	Movement 5 V(t)	Movement 5 V(1,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p		0.000		0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x	365	630	1042	1225	305	918	1240	180
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
a		3000		3000		3000		3000
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	305	180
Potential Capacity	697	838
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	697	838
Probability of Queue free St.	0.77	0.99

Step 2: LT from Major St.	4	1
Conflicting Flows	630	365
Potential Capacity	962	1205
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	962	1205
Probability of Queue free St.	0.88	1.00
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows	1225	1240
Potential Capacity	180	177
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.87	0.87
Movement Capacity	157	154
Probability of Queue free St.	0.97	0.97

Step 4: LT from Minor St.	7	10
Conflicting Flows	1042	918
Potential Capacity	187	230
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.84	0.84
Maj. L, Min T Adj. Imp Factor.	0.88	0.88
Cap. Adj. factor due to Impeding mvmnt	0.87	0.68
Movement Capacity	163	156

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	1225	1240
Potential Capacity	180	177
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.87	0.87
Movement Capacity	157	154
Result for 2 stage process:		
a		
y		
C t	157	154
Probability of Queue free St.	0.97	0.97

Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	1042	918
Potential Capacity	187	230
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.84	0.84
Maj. L, Min T Adj. Imp Factor.	0.88	0.88
Cap. Adj. factor due to Impeding mvmnt	0.87	0.68
Movement Capacity	163	156
Results for Two-stage process:		
a		
y		
C t	163	156

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	20	5	160	10	5	10
Movement Capacity (vph)	163	157	697	156	154	838
Shared Lane Capacity (vph)		482			230	

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	163	157	697	156	154	838
Volume	20	5	160	10	5	10
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh		482			230	
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	L	L		LTR			LTR	
v (vph)	5	120		185			25	
C(m) (vph)	1205	962		482			230	
v/c	0.00	0.12		0.38			0.11	
95% queue length	0.01	0.43		1.78			0.36	
Control Delay	8.0	9.3		17.0			22.6	
LOS	A	A		C			C	
Approach Delay				17.0			22.6	
Approach LOS				C			C	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.88
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4	8.0	9.3
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS2000: Signalized Intersections Release 4.1e

Analyst: md
Agency:
Date: 1/3/2005
Period: am
Project ID: 2007 background traffic - no improvements
E/W St: sth 158

Inter.: sth 158/greyhound access
Area Type: All other areas
Jurisd: wisdot
Year : 2007
N/S St: greyhound access

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	1	1	2	0	2	0	1	0	0	0
LGConfig		TR	R	L	T		L		R			
Volume		555	5	1	495		5		5			
Lane Width		12.0	12.0	12.0	12.0		12.0		12.0			
RTOR Vol			0						0			

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left					NB Left	A			
Thru		A			Thru				
Right		A			Right	A			
Peds					Peds				
WB Left	A	A			SB Left				
Thru	A	A			Thru				
Right					Right				
Peds					Peds				
NB Right	A				EB Right				
SB Right					WB Right				
Green	17.0	47.0				11.0			
Yellow	3.0	4.5				4.5			
All Red	0.0	1.5				1.5			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
TR	1889	3618	0.31	0.52	12.3	B	12.3	B
R	843	1615	0.01	0.52	10.3	B		
Westbound								
L	720	1805	0.00	0.74	3.4	A		
T	2693	3618	0.19	0.74	3.5	A	3.5	A
Northbound								
L	428	3505	0.01	0.12	34.7	C		
							26.1	C
R	610	1615	0.01	0.38	17.5	B		
Southbound								

Intersection Delay = 8.3 (sec/veh) Intersection LOS = A

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/3/2005
Analysis Time Period: am
Intersection: sth 158/greyhound access
Area Type: All other areas
Jurisdiction: wisdot
Analysis Year: 2007
Project ID: 2007 background traffic - no improvements
East/West Street: sth 158 North/South Street: greyhound access

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume		555	5	1	495		5		5			
% Heavy Veh		0	0	0	0		0		0			
PHF		0.96	0.96	0.96	0.96		0.96		0.96			
PK 15 Vol		145	2	1	129		2		2			
Hi Ln Vol												
% Grade		0			0			0				
Ideal Sat		1900	1900	1900	1900		1900		1900			
ParkExist												
NumPark												
No. Lanes	0	2	1	1	2	0	2	0	1	0	0	0
LGConfig		TR	R	L	T		L		R			
Lane Width		12.0	12.0	12.0	12.0		12.0		12.0			
RTOR Vol			0						0			
Adj Flow		578	5	1	516		5		5			
%InSharedLn			0									
Prop LTs		0.000		1.000	0.000							
Prop RTs		0.000	1.000		0.000				1.000			
Peds Bikes	0							0			0	
Buses		0	0	0	0		0		0			
%InProtPhase				0.0								

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0	0.0	0.0	0.0		0.0		0.0			
Arriv. Type		3	3	3	3		3		3			
Unit Ext.		3.0	3.0	3.0	3.0		3.0		3.0			
I Factor		1.000			1.000			1.000				
Lost Time		2.0	2.0	2.0	2.0		2.0		2.0			
Ext of g		2.0	2.0	2.0	2.0		2.0		2.0			
Ped Min g		3.2					3.2		3.2			

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left					NB Left	A			
Thru		A			Thru				
Right		A			Right	A			
Peds					Peds				
WB Left	A	A			SB Left				
Thru	A	A			Thru				
Right					Right				
Peds					Peds				
NB Right	A				EB Right				
SB Right					WB Right				
Green	17.0	47.0				11.0			
Yellow	3.0	4.5				4.5			
All Red	0.0	1.5				1.5			

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V		555	5	1	495		5		5			
PHF		0.96	0.96	0.96	0.96		0.96		0.96			
Adj flow		578	5	1	516		5		5			
No. Lanes	0	2	1	1	2	0	2	0	1	0	0	0
Lane group		TR	R	L	T		L		R			
Adj flow		578	5	1	516		5		5			
Prop LTs		0.000		1.000	0.000							
Prop RTs		0.000	1.000		0.000				1.000			

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	TR	R	L	T			L		R			
So	1900	1900	1900	1900			1900		1900			
Lanes	2	1	1	2	0		2	0	1	0	0	0
fW	1.000	1.000	1.000	1.000			1.000		1.000			
fHV	1.000	1.000	1.000	1.000			1.000		1.000			
fG	1.000	1.000	1.000	1.000			1.000		1.000			
fP	1.000	1.000	1.000	1.000			1.000		1.000			
fBB	1.000	1.000	1.000	1.000			1.000		1.000			
fA	1.000	1.000	1.000	1.000			1.000		1.000			
fLU	0.952	1.000	1.000	0.952			0.971		1.000			
fRT	1.000	0.850		1.000					0.850			
fLT	1.000		0.950	1.000			0.950					
Sec.			0.359									
fLpb	1.000		1.000	1.000			1.000					
fRpb	1.000	1.000		1.000					1.000			
s	3618	1615	1805	3618			3505		1615			
Sec.			682									

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	578	3618	# 0.16	0.52	1889	0.31
Right	R	5	1615	0.00	0.52	843	0.01
Westbound							
Prot		1	1805	0.00	0.189	341	0.00
Perm		0	682	0.00	0.556	379	0.00
Left	L	1			0.74	720	0.00
Prot							
Perm							
Thru	T	516	3618	0.14	0.74	2693	0.19
Right							
Northbound							
Prot							
Perm							
Left	L	5	3505	0.00	0.12	428	0.01
Prot							
Perm							
Thru							
Right	R	5	1615	# 0.00	0.38	610	0.01
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.16
Total lost time per cycle, L = 9.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.18

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
TR	0.31	0.52	12.2	1.000	1889	0.11	0.1	0.0	12.3	B	12.3	B
R	0.01	0.52	10.3	1.000	843	0.11	0.0	0.0	10.3	B		
Westbound												
L	0.00	0.74	3.4	1.000	720	0.11	0.0	0.0	3.4	A		
T	0.19	0.74	3.4	1.000	2693	0.11	0.0	0.0	3.5	A	3.5	A
Northbound												
L	0.01	0.12	34.7	1.000	428	0.11	0.0	0.0	34.7	C		
											26.1	C
R	0.01	0.38	17.5	1.000	610	0.11	0.0	0.0	17.5	B		
Southbound												

Intersection delay = 8.3 (sec/veh) Intersection LOS = A

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach		M		
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)		67.0		
Effective permitted green time for LT lane group, g(s)		50.0		
Opposing effective green time, go (s)		47.0		
Number of lanes in LT lane group, N		1		
Number of lanes in opposing approach, No		2		
Adjusted LT flow rate, VLT (veh/h)		1		
Proportion of LT in LT lane group, PLT		1.000		
Proportion of LT in opposing flow, PLTo		0.00		
Adjusted opposing flow rate, Vo (veh/h)		578		
Lost time for LT lane group, tL		6.00		
Computation				
LT volume per cycle, LTC=VLTC/3600		0.03		
Opposing lane util. factor, fLUo	0.952	0.952		
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		7.59		
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g		0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.48		
gq, (see Exhibit C16-4,5,6,7,8)		8.72		
gu=g-gq if gq>=gf, or = g-gf if gq<gf		41.28		
n=Max(gq-gf)/2,0)		4.36		
PTHo=1-PLTo		1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00		
EL1 (refer to Exhibit C16-3)		2.30		
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.08		
gdiff=max(gq-gf,0)		0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.36		
flt=fm={gf/g]-[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.359		

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000		
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	0.952	0.952		
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 90.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v		1		
v/c ratio from Capacity Worksheet, X		0.00		
Protected phase effective green interval, g (s)		17.0		
Opposing queue effective green interval, gq		8.72		
Unopposed green interval, gu		41.28		
Red time r=(C-g-gq-gu)		23.0		
Arrival rate, qa=v/(3600(max[X,1.0]))		0.00		
Protected ph. departure rate, Sp=s/3600		0.501		
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)		0.23		
XPerm		0.00		
XProt		0.00		
Case		1		
Queue at beginning of green arrow, Qa		0.01		
Queue at beginning of unsaturated green, Qu		0.00		
Residual queue, Qr		0.00		
Uniform Delay, d1		3.4		

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Dur. Unmet Demand Q veh	Initial Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Lane Queue Delay d3 sec	Initial Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 8.3 sec/veh Intersection LOS A

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	TR	R	L	T	L	R		
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0		
Flow Rate	303	5	1	271	2	5		
So	1900	1900	1900	1900	1900	1900		
No.Lanes	2	1	1	2 0	2 0	1	0 0	0
SL	1900	1615	967	1900	1805	1615		
LnCapacity	992	843	720	1414	220	610		
Flow Ratio	0.16	0.00	0.00	0.14	0.00	0.00		
v/c Ratio	0.31	0.01	0.00	0.19	0.01	0.01		
Grn Ratio	0.52	0.52	0.74	0.74	0.12	0.38		
I Factor	1.000			1.000	1.000			
AT or PVG	3	3	3	3	3	3		
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00		
PF2	1.00	1.00	1.00	1.00	1.00	1.00		
Q1	4.3	0.1	0.0	2.0	0.0	0.1		
kB	0.7	0.6	0.6	0.8	0.3	0.5		
Q2	0.3	0.0	0.0	0.2	0.0	0.0		
Q Average	4.6	0.1	0.0	2.2	0.0	0.1		
Q Spacing	25.0	25.0	25.0	25.0	25.0	25.0		
Q Storage	0	0	0	0	0	0		
Q S Ratio								
70th Percentile Output:								
fB%	1.2	1.2	1.2	1.2	1.2	1.2		
BOQ	5.5	0.1	0.0	2.7	0.1	0.1		
QSRatio								
85th Percentile Output:								
fB%	1.6	1.6	1.6	1.6	1.6	1.6		
BOQ	7.2	0.1	0.0	3.5	0.1	0.1		
QSRatio								
90th Percentile Output:								
fB%	1.7	1.8	1.8	1.8	1.8	1.8		
BOQ	7.9	0.1	0.0	3.9	0.1	0.1		
QSRatio								
95th Percentile Output:								
fB%	2.0	2.1	2.1	2.0	2.1	2.1		
BOQ	9.1	0.1	0.0	4.5	0.1	0.2		
QSRatio								
98th Percentile Output:								
fB%	2.4	2.7	2.7	2.5	2.7	2.7		
BOQ	11.1	0.2	0.0	5.6	0.1	0.2		
QSRatio								

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: md
Agency:
Date: 1/3/2005
Period: pm
Project ID: 2007 background traffic - no improvements
E/W St: sth 158

Inter.: sth 158/greyhound access
Area Type: All other areas
Jurisd: wisdot
Year : 2007
N/S St: greyhound access

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	1	1	2	0	2	0	1	0	0	0
LGConfig		TR	R	L	T		L		R			
Volume		630	40	25	365		10		5			
Lane Width		12.0	12.0	12.0	12.0		12.0		12.0			
RTOR Vol			0						0			

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left					NB Left	A			
Thru		A			Thru				
Right		A			Right	A			
Peds					Peds				
WB Left	A	A			SB Left				
Thru	A	A			Thru				
Right					Right				
Peds					Peds				
NB Right	A				EB Right				
SB Right					WB Right				
Green	22.0	42.0				11.0			
Yellow	3.0	4.5				4.5			
All Red	0.0	1.5				1.5			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
TR	1688	3618	0.39	0.47	15.8	B	15.6	B
R	754	1615	0.06	0.47	13.2	B		
Westbound								
L	727	1805	0.04	0.74	3.7	A		
T	2693	3618	0.14	0.74	3.3	A	3.3	A
Northbound								
L	428	3505	0.02	0.12	34.8	C	28.0	C
R	700	1615	0.01	0.43	14.5	B		
Southbound								

Intersection Delay = 11.3 (sec/veh) Intersection LOS = B

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/3/2005
Analysis Time Period: pm
Intersection: sth 158/greyhound access
Area Type: All other areas
Jurisdiction: wisdot
Analysis Year: 2007
Project ID: 2007 background traffic - no improvements

East/West Street: sth 158
North/South Street: greyhound access

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume		630	40	25	365		10		5			
% Heavy Veh		0	0	0	0		0		0			
PHF		0.96	0.96	0.96	0.96		0.96		0.96			
PK 15 Vol		164	10	7	95		3		2			
Hi Ln Vol												
% Grade		0			0			0				
Ideal Sat		1900	1900	1900	1900		1900		1900			
ParkExist												
NumPark												
No. Lanes	0	2	1		1	2	0	2	0	1	0	0	0
LGConfig		TR	R	L	T			L		R			
Lane Width		12.0	12.0	12.0	12.0			12.0		12.0			
RTOR Vol			0							0			
Adj Flow		656	42	26	380			10		5			
%InSharedLn			0										
Prop LTs		0.000		1.000	0.000								
Prop RTs		0.000	1.000		0.000					1.000			
Peds	Bikes	0						0			0		
Buses		0	0	0	0			0		0			
%InProtPhase				0.0									

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0	0.0	0.0	0.0		0.0		0.0			
Arriv. Type		3	3	3	3		3		3			
Unit Ext.		3.0	3.0	3.0	3.0		3.0		3.0			
I Factor		1.000			1.000			1.000				
Lost Time		2.0	2.0	2.0	2.0		2.0		2.0			
Ext of g		2.0	2.0	2.0	2.0		2.0		2.0			

Ped Min g	3.2			3.2		3.2		

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left					NB Left	A			
Thru		A			Thru				
Right		A			Right	A			
Peds					Peds				
WB Left	A	A			SB Left				
Thru	A	A			Thru				
Right					Right				
Peds					Peds				
NB Right	A				EB Right				
SB Right					WB Right				
Green	22.0	42.0				11.0			
Yellow	3.0	4.5				4.5			
All Red	0.0	1.5				1.5			

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V		630	40	25	365		10		5			
PHF		0.96	0.96	0.96	0.96		0.96		0.96			
Adj flow		656	42	26	380		10		5			
No. Lanes	0	2	1		1	2	0	2	0	1	0	0	0
Lane group		TR	R	L	T			L		R			
Adj flow		656	42	26	380			10		5			
Prop LTs		0.000		1.000	0.000								
Prop RTs		0.000	1.000		0.000					1.000			

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound		
LG	TR	R	L	T	L	R			
So	1900	1900	1900	1900	1900	1900			
Lanes 0	2	1	1	2 0	2 0	1 0	0	0	
fW	1.000	1.000	1.000	1.000	1.000	1.000			
fHV	1.000	1.000	1.000	1.000	1.000	1.000			
fG	1.000	1.000	1.000	1.000	1.000	1.000			
fP	1.000	1.000	1.000	1.000	1.000	1.000			
fBB	1.000	1.000	1.000	1.000	1.000	1.000			
fA	1.000	1.000	1.000	1.000	1.000	1.000			
fLU	0.952	1.000	1.000	0.952	0.971	1.000			
fRT	1.000	0.850		1.000		0.850			
fLT	1.000		0.950	1.000	0.950				
Sec.			0.301						
fLpb	1.000		1.000	1.000	1.000				
fRpb	1.000	1.000		1.000		1.000			
S	3618	1615	1805	3618	3505	1615			
Sec.			572						

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	656	3618	# 0.18	0.47	1688	0.39
Right	R	42	1615	0.03	0.47	754	0.06
Westbound							
Prot		26	1805	# 0.01	0.244	441	0.06
Perm		0	572	0.00	0.500	286	0.00
Left	L	26			0.74	727	0.04
Prot							
Perm							
Thru	T	380	3618	0.11	0.74	2693	0.14
Right							
Northbound							
Prot							
Perm							
Left	L	10	3505	# 0.00	0.12	428	0.02
Prot							
Perm							
Thru							
Right	R	5	1615	0.00	0.43	700	0.01
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.20
Total lost time per cycle, L = 18.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.25

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
TR	0.39	0.47	15.6	1.000	1688	0.11	0.1	0.0	15.8	B	15.6	B
R	0.06	0.47	13.1	1.000	754	0.11	0.0	0.0	13.2	B		
Westbound												
L	0.04	0.74	3.7	1.000	727	0.11	0.0	0.0	3.7	A		
T	0.14	0.74	3.3	1.000	2693	0.11	0.0	0.0	3.3	A	3.3	A
Northbound												
L	0.02	0.12	34.8	1.000	428	0.11	0.0	0.0	34.8	C	28.0	C
R	0.01	0.43	14.5	1.000	700	0.11	0.0	0.0	14.5	B		
Southbound												

Intersection delay = 11.3 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach		M		
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)		67.0		
Effective permitted green time for LT lane group, g(s)		45.0		
Opposing effective green time, go (s)		42.0		
Number of lanes in LT lane group, N		1		
Number of lanes in opposing approach, No		2		
Adjusted LT flow rate, VLT (veh/h)		26		
Proportion of LT in LT lane group, PLT		1.000		
Proportion of LT in opposing flow, PLTo		0.00		
Adjusted opposing flow rate, Vo (veh/h)		656		
Lost time for LT lane group, tL		6.00		
Computation				
LT volume per cycle, LTC=VLTC/3600		0.65		
Opposing lane util. factor, fLUo	0.952	0.952		
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		8.61		
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g		0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.53		
gq, (see Exhibit C16-4,5,6,7,8)		11.36		
gu=g-gq if gq>=gf, or = g-gf if gq<gf		33.64		
n=Max(gq-gf)/2,0]		5.68		
PTHo=1-PLTo		1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00		
EL1 (refer to Exhibit C16-3)		2.48		
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+Pl)/g or fmin=2(1+Pl)/g		0.09		
gdiff=max(gq-gf,0)		0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.30		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.301		

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000		
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	0.952	0.952		
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 90.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v		26		
v/c ratio from Capacity Worksheet, X		0.04		
Protected phase effective green interval, g (s)		22.0		
Opposing queue effective green interval, gq		11.36		
Unopposed green interval, gu		33.64		
Red time r=(C-g-gq-gu)		23.0		
Arrival rate, qa=v/(3600(max[X,1.0]))		0.01		
Protected ph. departure rate, Sp=s/3600		0.501		
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)		0.21		
XPerm		0.05		
XProt		0.03		
Case		1		
Queue at beginning of green arrow, Qa		0.17		
Queue at beginning of unsaturated green, Qu		0.08		
Residual queue, Qr		0.00		
Uniform Delay, d1		3.7		

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Dur. Unmet Demand Q veh	Unmet Demand t hrs.	Uniform Delay Unadj. ds	Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Lane Queue Delay d3 sec	Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 11.3 sec/veh Intersection LOS B

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound		
LaneGroup	TR	R	L	T	L	R			
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0			
Flow Rate	344	42	26	199	5	5			
So	1900	1900	1900	1900	1900	1900			
No.Lanes	2	1	1	2	2	1	0	0	0
SL	1900	1615	977	1900	1805	1615			
LnCapacity	886	754	727	1414	220	700			
Flow Ratio	0.18	0.03	0.03	0.10	0.00	0.00			
v/c Ratio	0.39	0.06	0.04	0.14	0.02	0.01			
Grn Ratio	0.47	0.47	0.74	0.74	0.12	0.43			
I Factor	1.000		1.000		1.000				
AT or PVG	3	3	3	3	3	3			
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00			
PF2	1.00	1.00	1.00	1.00	1.00	1.00			
Q1	5.6	0.6	0.2	1.4	0.1	0.1			
kB	0.6	0.6	0.6	0.8	0.3	0.6			
Q2	0.4	0.0	0.0	0.1	0.0	0.0			
Q Average	6.0	0.6	0.2	1.6	0.1	0.1			
Q Spacing	25.0	25.0	25.0	25.0	25.0	25.0			
Q Storage	0	0	0	0	0	0			
Q S Ratio									
70th Percentile Output:									
fB%	1.2	1.2	1.2	1.2	1.2	1.2			
BOQ	7.1	0.7	0.2	1.9	0.1	0.1			
QSRatio									
85th Percentile Output:									
fB%	1.5	1.6	1.6	1.6	1.6	1.6			
BOQ	9.3	1.0	0.3	2.5	0.2	0.1			
QSRatio									
90th Percentile Output:									
fB%	1.7	1.8	1.8	1.8	1.8	1.8			
BOQ	10.2	1.1	0.3	2.8	0.2	0.1			
QSRatio									
95th Percentile Output:									
fB%	1.9	2.1	2.1	2.1	2.1	2.1			
BOQ	11.6	1.3	0.4	3.2	0.2	0.2			
QSRatio									
98th Percentile Output:									
fB%	2.3	2.7	2.7	2.6	2.7	2.7			
BOQ	14.0	1.6	0.5	4.0	0.3	0.2			
QSRatio									

ERROR MESSAGES

No errors to report.

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ALL-WAY STOP CONTROL(AWSC) ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 11/15/2004
Analysis Time Period: am
Intersection: STH 158/Eastern Frontage
Jurisdiction: WisDOT
Units: U. S. Customary
Analysis Year: 2004
Project ID: 2007 background traffic - no improvements
East/West Street: sth 158
North/South Street: Eastern Frontage Road

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	20	400	55	125	320	1	5	35	35	5	0	10
% Thrus Left Lane												

	Eastbound L1	Eastbound L2	Westbound L1	Westbound L2	Northbound L1	Northbound L2	Southbound L1	Southbound L2
Configuration	LT		TR		LT		LR	
PHF	1.00		1.00		1.00		1.00	
Flow Rate	420		321		40		15	
% Heavy Veh	0		0		0		0	
No. Lanes	1		1		1		1	
Opposing-Lanes	1		1		1		1	
Conflicting-lanes	1		1		1		1	
Geometry group	1		1		1		1	

Duration, T 0.25 hrs.

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound L1	Eastbound L2	Westbound L1	Westbound L2	Northbound L1	Northbound L2	Southbound L1	Southbound L2
Flow Rates:								
Total in Lane	420		321		40		15	
Left-Turn	20		0		5		5	
Right-Turn	0		1		0		10	
Prop. Left-Turns	0.0		0.0		0.1		0.3	
Prop. Right-Turns	0.0		0.0		0.0		0.7	
Prop. Heavy Vehicle	0.0		0.0		0.0		0.0	
Geometry Group	1		1		1		1	
Adjustments Exhibit 17-33:								
hLT-adj	0.2		0.2		0.2		0.2	
hRT-adj	-0.6		-0.6		-0.6		-0.6	
hHV-adj	1.7		1.7		1.7		1.7	
hadj, computed	0.0		-0.0		0.0		-0.3	

Worksheet 4 - Departure Headway and Service Time

	Eastbound L1	Eastbound L2	Westbound L1	Westbound L2	Northbound L1	Northbound L2	Southbound L1	Southbound L2
Flow rate	420		321		40		15	
hd, initial value	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20
x, initial	0.37		0.29		0.04		0.01	
hd, final value	4.42		4.50		5.60		5.29	
x, final value	0.52		0.40		0.06		0.02	
Move-up time, m	2.0		2.0		2.0		2.0	
Service Time	2.4		2.5		3.6		3.3	

Worksheet 5 - Capacity and Level of Service

	Eastbound L1	Eastbound L2	Westbound L1	Westbound L2	Northbound L1	Northbound L2	Southbound L1	Southbound L2
Flow Rate	420		321		40		15	
Service Time	2.4		2.5		3.6		3.3	
Utilization, x	0.52		0.40		0.06		0.02	
Dep. headway, hd	4.42		4.50		5.60		5.29	
Capacity	670		571		290		265	
Delay	12.02		10.50		8.97		8.41	
LOS	B		B		A		A	
Approach:								
Delay	12.02		10.50		8.97		8.41	
LOS	B		B		A		A	

Intersection Delay 11.18 Intersection LOS B

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ALL-WAY STOP CONTROL(AWSC) ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 11/15/2004
Analysis Time Period: am
Intersection: STH 158/Western Frontage
Jurisdiction: WisDOT
Units: U. S. Customary
Analysis Year: 2007
Project ID: 2007 background traffic - no improvements
East/West Street: sth 158
North/South Street: Western Frontage Road

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	0	350	30	70	265	0	10	0	70	0	0	0

% Thrus Left Lane

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	T	R	LT		LR			
PHF	1.00	1.00	1.00		1.00			
Flow Rate	350	30	335		80			
% Heavy Veh	0	0	0		0			
No. Lanes	2		1		1			
Opposing-Lanes	1		2		0			
Conflicting-lanes	1		1		2			
Geometry group	5		3a		1			

Duration, T 0.25 hrs.

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	350	30	335		80			
Left-Turn	0	0	70		10			
Right-Turn	0	30	0		70			
Prop. Left-Turns	0.0	0.0	0.2		0.1			
Prop. Right-Turns	0.0	1.0	0.0		0.9			
Prop. Heavy Vehicle	0.0	0.0	0.0		0.0			
Geometry Group	5		3a		1			
Adjustments Exhibit 17-33:								
hLT-adj	0.5		0.2		0.2			
hRT-adj	-0.7		-0.6		-0.6			
hHV-adj	1.7		1.7		1.7			
hadj, computed	0.0	-0.7	0.0		-0.5			

Worksheet 4 - Departure Headway and Service Time

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow rate	350	30	335		80			
hd, initial value	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20
x, initial	0.31	0.03	0.30		0.07			
hd, final value	4.99	4.28	4.69		5.03			
x, final value	0.48	0.04	0.44		0.11			
Move-up time, m	2.3		2.0		2.0			
Service Time	2.7	2.0	2.7		3.0			

Worksheet 5 - Capacity and Level of Service

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rate	350	30	335		80			
Service Time	2.7	2.0	2.7		3.0			
Utilization, x	0.48	0.04	0.44		0.11			
Dep. headway, hd	4.99	4.28	4.69		5.03			
Capacity	600	280	585		330			
Delay	12.29	7.14	11.28		8.67			
LOS	B	A	B		A			
Approach:								
Delay	11.89		11.28		8.67			
LOS	B		B		A			

Intersection Delay 11.31 Intersection LOS B

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ALL-WAY STOP CONTROL(AWSC) ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 11/15/2004
Analysis Time Period: pm
Intersection: STH 158/Western Frontage
Jurisdiction: WisDOT
Units: U. S. Customary
Analysis Year: 2007
Project ID: 2007 background traffic - no improvements
East/West Street: sth 158
North/South Street: Western Frontage Road

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	0	310	65	120	105	0	10	0	55	0	0	0
% Thrus Left Lane												

	Eastbound L1	Eastbound L2	Westbound L1	Westbound L2	Northbound L1	Northbound L2	Southbound L1	Southbound L2
Configuration	T	R	LT		LR			
PHF	1.00	1.00	1.00		1.00			
Flow Rate	310	65	225		65			
% Heavy Veh	0	0	0		0			
No. Lanes	2		1		1			
Opposing-Lanes	1		2		0			
Conflicting-lanes	1		1		2			
Geometry group	5		3a		1			

Duration, T 0.25 hrs.

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound L1	Eastbound L2	Westbound L1	Westbound L2	Northbound L1	Northbound L2	Southbound L1	Southbound L2
Flow Rates:								
Total in Lane	310	65	225		65			
Left-Turn	0	0	120		10			
Right-Turn	0	65	0		55			
Prop. Left-Turns	0.0	0.0	0.5		0.2			
Prop. Right-Turns	0.0	1.0	0.0		0.8			
Prop. Heavy Vehicle	0.0	0.0	0.0		0.0			
Geometry Group	5		3a		1			
Adjustments Exhibit 17-33:								
hLT-adj	0.5		0.2		0.2			
hRT-adj	-0.7		-0.6		-0.6			
hHV-adj	1.7		1.7		1.7			
hadj, computed	0.0	-0.7	0.1		-0.5			

Worksheet 4 - Departure Headway and Service Time

	Eastbound L1	Eastbound L2	Westbound L1	Westbound L2	Northbound L1	Northbound L2	Southbound L1	Southbound L2
Flow rate	310	65	225		65			
hd, initial value	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20
x, initial	0.28	0.06	0.20		0.06			
hd, final value	4.84	4.14	4.66		4.75			
x, final value	0.42	0.07	0.29		0.09			
Move-up time, m	2.3		2.0		2.0			
Service Time	2.5	1.8	2.7		2.8			

Worksheet 5 - Capacity and Level of Service

	Eastbound L1	Eastbound L2	Westbound L1	Westbound L2	Northbound L1	Northbound L2	Southbound L1	Southbound L2
Flow Rate	310	65	225		65			
Service Time	2.5	1.8	2.7		2.8			
Utilization, x	0.42	0.07	0.29		0.09			
Dep. headway, hd	4.84	4.14	4.66		4.75			
Capacity	560	315	475		315			
Delay	10.96	7.17	9.57		8.20			
LOS	B	A	A		A			
Approach:								
Delay	10.30		9.57		8.20			
LOS	B		A		A			

Intersection Delay 9.85 Intersection LOS A

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ALL-WAY STOP CONTROL(AWSC) ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 11/15/2004
Analysis Time Period: am
Intersection: CTH K/104th
Jurisdiction: Kenosha County
Units: U. S. Customary
Analysis Year: 2004
Project ID: 2007 background traffic - no improvements
East/West Street: CTH K
North/South Street: 104th

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	10	160	30	85	110	10	5	110	80	5	130	25

% Thrus Left Lane

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	LT	R	LTR		L	TR	LT	R
PHF	1.00	1.00	1.00		1.00	1.00	1.00	1.00
Flow Rate	170	30	205		5	190	135	25
% Heavy Veh	0	0	0		0	0	0	0
No. Lanes	2		1		2		2	
Opposing-Lanes	1		2		2		2	
Conflicting-lanes	2		2		2		2	
Geometry group	5		4b		5		5	

Duration, T 0.25 hrs.

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	170	30	205		5	190	135	25
Left-Turn	10	0	85		5	0	5	0
Right-Turn	0	30	10		0	80	0	25
Prop. Left-Turns	0.1	0.0	0.4		1.0	0.0	0.0	0.0
Prop. Right-Turns	0.0	1.0	0.0		0.0	0.4	0.0	1.0
Prop. Heavy Vehicle	0.0	0.0	0.0		0.0	0.0	0.0	0.0
Geometry Group	5		4b		5		5	
Adjustments Exhibit 17-33:								
hLT-adj	0.5		0.2		0.5		0.5	
hRT-adj	-0.7		-0.6		-0.7		-0.7	
hHV-adj	1.7		1.7		1.7		1.7	
hadj, computed	0.0	-0.7	0.1		0.5	-0.3	0.0	-0.7

Worksheet 4 - Departure Headway and Service Time

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow rate	170	30	205		5	190	135	25
hd, initial value	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20
x, initial	0.15	0.03	0.18		0.00	0.17	0.12	0.02
hd, final value	5.81	5.08	5.83		6.41	5.61	5.97	5.24
x, final value	0.27	0.04	0.33		0.01	0.30	0.22	0.04
Move-up time, m	2.3		2.3		2.3		2.3	
Service Time	3.5	2.8	3.5		4.1	3.3	3.7	2.9

Worksheet 5 - Capacity and Level of Service

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rate	170	30	205		5	190	135	25
Service Time	3.5	2.8	3.5		4.1	3.3	3.7	2.9
Utilization, x	0.27	0.04	0.33		0.01	0.30	0.22	0.04
Dep. headway, hd	5.81	5.08	5.83		6.41	5.61	5.97	5.24
Capacity	420	280	455		255	440	385	275
Delay	10.69	8.00	11.41		9.17	10.65	10.38	8.14
LOS	B	A	B		A	B	B	A
Approach:								
Delay	10.29		11.41		10.61		10.03	
LOS	B		B		B		B	

Intersection Delay 10.62 Intersection LOS B

HCS2000: Unsignalized Intersections Release 4.1d

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ALL-WAY STOP CONTROL(AWSC) ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 11/15/2004
Analysis Time Period: pm
Intersection: CTH K/104th
Jurisdiction: Kenosha County
Units: U. S. Customary
Analysis Year: 2004
Project ID: 2007 background traffic - no improvements
East/West Street: CTH K
North/South Street: 104th

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	10	215	20	75	175	25	15	140	90	10	115	25
% Thrus Left Lane												

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	LT	R	LTR		L	TR	LT	R
PHF	1.00	1.00	1.00		1.00	1.00	1.00	1.00
Flow Rate	225	20	275		15	230	125	25
% Heavy Veh	0	0	0		0	0	0	0
No. Lanes	2		1		2		2	
Opposing-Lanes	1		2		2		2	
Conflicting-lanes	2		2		2		2	
Geometry group	5		4b		5		5	

Duration, T 0.25 hrs.

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	225	20	275		15	230	125	25
Left-Turn	10	0	75		15	0	10	0
Right-Turn	0	20	25		0	90	0	25
Prop. Left-Turns	0.0	0.0	0.3		1.0	0.0	0.1	0.0
Prop. Right-Turns	0.0	1.0	0.1		0.0	0.4	0.0	1.0
Prop. Heavy Vehicle	0.0	0.0	0.0		0.0	0.0	0.0	0.0
Geometry Group	5		4b		5		5	
Adjustments Exhibit 17-33:								
hLT-adj	0.5		0.2		0.5		0.5	
hRT-adj	-0.7		-0.6		-0.7		-0.7	
hHV-adj	1.7		1.7		1.7		1.7	
hadj, computed	0.0	-0.7	-0.0		0.5	-0.3	0.0	-0.7

Worksheet 4 - Departure Headway and Service Time

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow rate	225	20	275		15	230	125	25
hd, initial value	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20
x, initial	0.20	0.02	0.24		0.01	0.20	0.11	0.02
hd, final value	6.16	5.43	6.09		6.85	6.06	6.55	5.80
x, final value	0.38	0.03	0.46		0.03	0.39	0.23	0.04
Move-up time, m	2.3		2.3		2.3		2.3	
Service Time	3.9	3.1	3.8		4.5	3.8	4.3	3.5

Worksheet 5 - Capacity and Level of Service

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rate	225	20	275		15	230	125	25
Service Time	3.9	3.1	3.8		4.5	3.8	4.3	3.5
Utilization, x	0.38	0.03	0.46		0.03	0.39	0.23	0.04
Dep. headway, hd	6.16	5.43	6.09		6.85	6.06	6.55	5.80
Capacity	475	270	525		265	480	375	275
Delay	12.65	8.30	13.96		9.75	12.55	11.17	8.75
LOS	B	A	B		A	B	B	A
Approach:								
Delay	12.30		13.96		12.37		10.77	
LOS	B		B		B		B	

Intersection Delay 12.57 Intersection LOS B

2007 SITE+BACKGROUND TRAFFIC CAPACITY ANALYSIS – WITH IMPROVEMENTS

HCS2000: Signalized Intersections Release 4.1e

Analyst: md
Agency:
Date: 1/4/2005
Period: am
Project ID: 2007 site+background
E/W St: sth 158

Inter.: sth 158/cth h
Area Type: All other areas
Jurisd: wisdot
Year : 2007

N/S St: cth h

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	2	1	1	2	0	0	1	0	0	1	1
LGConfig	L	T	R	L	TR			LTR			LT	R
Volume	90	640	110	65	720	25	5	160	65	55	260	100
Lane Width	12.0	12.0	12.0	12.0	12.0			12.0			12.0	12.0
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A	A			NB Left		A		
Thru		A			Thru		A		
Right		A			Right		A		
Peds					Peds				
WB Left	A	A			SB Left	A	A		
Thru		A			Thru	A	A		
Right		A			Right	A	A		
Peds					Peds				
NB Right					EB Right				
SB Right	A				WB Right				
Green	5.0	35.0				7.0	25.0		
Yellow	3.0	4.5				3.0	4.5		
All Red	0.0	1.5				0.0	1.5		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	227	1752	0.45	0.48	16.6	B		
T	1311	3370	0.55	0.39	21.9	C	20.9	C
R	628	1615	0.20	0.39	18.4	B		
Westbound								
L	276	1752	0.27	0.48	14.7	B		
TR	1309	3367	0.65	0.39	23.6	C	22.9	C
Northbound								
LTR	493	1774	0.53	0.28	28.6	C	28.6	C
Southbound								
LT	517	1783	0.69	0.39	27.0	C	23.3	C
R	794	1553	0.14	0.51	11.7	B		

Intersection Delay = 22.8 (sec/veh) Intersection LOS = C

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/4/2005
Analysis Time Period: am
Intersection: sth 158/cth h
Area Type: All other areas
Jurisdiction: wisdot
Analysis Year: 2007
Project ID: 2007 site+background

East/West Street: sth 158 North/South Street: cth h

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	90	640	110	65	720	25	5	160	65	55	260	100
% Heavy Veh	3	13	0	3	7	4	20	1	3	4	6	4
PHF	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
PK 15 Vol	26	182	31	18	205	7	2	45	18	16	74	28
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	2000	1900	1900	1900			1900			1900	1900
ParkExist												
NumPark												
No. Lanes	1	2	1	1	2	0	0	1	0	0	1	1
LGConfig	L	T	R	L	TR			LTR			LT	R
Lane Width	12.0	12.0	12.0	12.0	12.0			12.0			12.0	12.0
RTOR Vol			0			0			0			0
Adj Flow	102	727	125	74	846			262			358	114
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000			0.023			0.176	
Prop RTs		0.000	1.000		0.033			0.282			0.000	1.000
Peds Bikes	0			0			0			0		
Buses	0	0	0	0	0			0			0	0
%InProtPhase	0.0			0.0						0.0		

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0	0.0	0.0	0.0			0.0			0.0	0.0
Arriv. Type	3	3	3	3	3			3			3	3
Unit Ext.	3.0	3.0	3.0	3.0	3.0			3.0			3.0	3.0
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0	2.0	2.0	2.0			2.0			2.0	2.0
Ext of g	2.0	2.0	2.0	2.0	2.0			2.0			2.0	2.0

Ped Min g	3.2	3.2	3.2	3.2

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A	A			NB Left		A		
Thru		A			Thru		A		
Right		A			Right		A		
Peds					Peds				
WB Left	A	A			SB Left	A	A		
Thru		A			Thru	A	A		
Right		A			Right	A	A		
Peds					Peds				
NB Right					EB Right				
SB Right	A				WB Right				
Green	5.0	35.0				7.0	25.0		
Yellow	3.0	4.5				3.0	4.5		
All Red	0.0	1.5				0.0	1.5		

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	90	640	110	65	720	25	5	160	65	55	260	100
PHF	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Adj flow	102	727	125	74	818	28	6	182	74	63	295	114
No. Lanes	1	2	1	1	2	0	0	1	0	0	1	1
Lane group	L	T	R	L	TR			LTR			LT	R
Adj flow	102	727	125	74	846			262			358	114
Prop LTs	1.000	0.000		1.000	0.000			0.023			0.176	
Prop RTs		0.000	1.000		0.033			0.282			0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound L	T	R	Westbound L	TR			Northbound LTR			Southbound LT	R
So	1900	2000	1900	1900	1900			1900			1900	1900
Lanes	1	2	1	1	2	0	0	1	0	0	1	1
fW	1.000	1.000	1.000	1.000	1.000			1.000			1.000	1.000
fHV	0.971	0.885	1.000	0.971	0.935			0.980			0.947	0.962
fG	1.000	1.000	1.000	1.000	1.000			1.000			1.000	1.000
fP	1.000	1.000	1.000	1.000	1.000			1.000			1.000	1.000
fBB	1.000	1.000	1.000	1.000	1.000			1.000			1.000	1.000
fA	1.000	1.000	1.000	1.000	1.000			1.000			1.000	1.000
fLU	1.000	0.952	1.000	1.000	0.952			0.962			1.000	0.850
fRT		1.000	0.850		0.995			0.990			0.991	
fLT	0.950	1.000		0.950	1.000						0.676	
Sec.	0.167			0.229				1.000			1.000	
fLpb	1.000	1.000		1.000	1.000			1.000			1.000	1.000
fRpb		1.000	1.000		1.000			1774			1783	1553
S	1752	3370	1615	1752	3367						1215	
Sec.	308			423								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		97	1752	# 0.06	0.056	97	1.00
Perm		5	308	0.02	0.422	130	0.04
Left	L	102			0.48	227	0.45
Prot							
Perm							
Thru	T	727	3370	0.22	0.39	1311	0.55
Right	R	125	1615	0.08	0.39	628	0.20
Westbound							
Prot		74	1752	0.04	0.056	97	0.76
Perm		0	423	0.00	0.422	179	0.00
Left	L	74			0.48	276	0.27
Prot							
Perm							
Thru	TR	846	3367	# 0.25	0.39	1309	0.65
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	262	1774	0.15	0.28	493	0.53
Right							
Southbound							
Prot							
Perm							
Left							
Prot		139	1783	# 0.08	0.078	139	1.00
Perm		219	1215	# 0.18	0.311	378	0.58
Thru	LT	358			0.39	517	0.69
Right	R	114	1553	0.07	0.51	794	0.14

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.56
Total lost time per cycle, L = 18.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.71

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	0.45	0.48	15.2	1.000	227	0.11	1.4	0.0	16.6	B		
T	0.55	0.39	21.4	1.000	1311	0.15	0.5	0.0	21.9	C	20.9	C
R	0.20	0.39	18.2	1.000	628	0.11	0.2	0.0	18.4	B		
Westbound												
L	0.27	0.48	14.2	1.000	276	0.11	0.5	0.0	14.7	B		
TR	0.65	0.39	22.4	1.000	1309	0.22	1.1	0.0	23.6	C	22.9	C
Northbound												
LTR	0.53	0.28	27.5	1.000	493	0.13	1.1	0.0	28.6	C	28.6	C
Southbound												

LT	0.69	0.39	23.0	1.000	517	0.26	4.0	0.0	27.0	C	23.3	C
R	0.14	0.51	11.6	1.000	794	0.11	0.1	0.0	11.7	B		

Intersection delay = 22.8 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M		
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	43.0	43.0		
Effective permitted green time for LT lane group, g(s)	38.0	38.0		
Opposing effective green time, go (s)	35.0	35.0		
Number of lanes in LT lane group, N	1	1		
Number of lanes in opposing approach, No	2	2		
Adjusted LT flow rate, VLT (veh/h)	102	74		
Proportion of LT in LT lane group, PLT	1.000	1.000		
Proportion of LT in opposing flow, PLTo	0.00	0.00		
Adjusted opposing flow rate, Vo (veh/h)	846	727		
Lost time for LT lane group, tL	6.00	6.00		
Computation				
LT volume per cycle, LTC=VLTC/3600	2.55	1.85		
Opposing lane util. factor, fLUo	0.952	0.952	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	11.11	9.55		
gf=G[exp(- a * (LTC ** b)]-tl, gf<=g	0.0	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.61	0.61		
gq, (see Exhibit C16-4,5,6,7,8)	18.03	14.81		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	19.97	23.19		
n=Max(gq-gf)/2,0)	9.01	7.40		
PTHo=1-PLTo	1.00	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00		
EL1 (refer to Exhibit C16-3)	3.15	2.66		
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.11	0.11		
gdiff=max(gq-gf,0)	0.00	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.17	0.23		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.167	0.229		

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach			M	S
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)			25.0	35.0
Effective permitted green time for LT lane group, g(s)			25.0	28.0
Opposing effective green time, go (s)			35.0	25.0
Number of lanes in LT lane group, N			1	1
Number of lanes in opposing approach, No			1	1
Adjusted LT flow rate, VLT (veh/h)			6	63
Proportion of LT in LT lane group, PLT	0.000	0.000	0.023	0.176
Proportion of LT in opposing flow, PLTo			0.18	0.02
Adjusted opposing flow rate, Vo (veh/h)			358	262
Lost time for LT lane group, tL			6.00	6.00
Computation				
LT volume per cycle, LTC=VLTC/3600			0.15	1.58
Opposing lane util. factor, fLUo	0.952	0.952	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			8.95	6.55
gf=G[exp(- a * (LTC ** b)]-tl, gf<=g			13.9	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.61	0.72
gq, (see Exhibit C16-4,5,6,7,8)			0.00	14.66
gu=g-gq if gq>=gf, or = g-gf if gq<gf			11.06	13.34
n=Max(gq-gf)/2,0)			0.00	7.33
PTHo=1-PLTo			0.82	0.98
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			0.02	0.18
EL1 (refer to Exhibit C16-3)			2.00	1.81
EL2=Max((1-Ptho**n)/Plto, 1.0)			1.00	6.82
fmin=2(1+PL)/g or fmin=2(1+Pl)/g			0.08	0.08
gdiff=max(gq-gf,0)			0.00	14.66
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.99	0.68
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.990	0.676

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 90.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v	102	74		
v/c ratio from Capacity Worksheet, X	0.45	0.27		
Protected phase effective green interval, g (s)	5.0	5.0		
Opposing queue effective green interval, gq	18.03	14.81		
Unopposed green interval, gu	19.97	23.19		
Red time r=(C-g-gq-gu)	47.0	47.0		
Arrival rate, qa=v/(3600(max[X,1.0]))	0.03	0.02		
Protected ph. departure rate, Sp=s/3600	0.487	0.487		
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.16	0.19		
XPerm	0.33	0.17		
XProt	0.61	0.44		
Case	1	1		
Queue at beginning of green arrow, Qa	1.33	0.97		
Queue at beginning of unsaturated green, Qu	0.51	0.30		
Residual queue, Qr	0.00	0.00		
Uniform Delay, dl	15.2	14.2		

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Dur. Unmet Demand Q veh	Unmet Demand t hrs.	Uniform Delay Unadj. ds	Adj. dl sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 22.8 sec/veh Intersection LOS C

BACK OF QUEUE WORKSHEET

LaneGroup	Eastbound L	T	R	Westbound L	TR	Northbound LTR	Southbound LT	R
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	102	381	125	74	444	262	358	114
So	1900	2000	1900	1900	1900	1900	1900	1900
No.Lanes	1	2	1	1	2 0	0 1 0	0 1	1
SL	476	1769	1615	578	1768	1774	1328	1553
LnCapacity	227	688	628	276	687	493	517	794
Flow Ratio	0.21	0.22	0.08	0.13	0.25	0.15	0.27	0.07
v/c Ratio	0.45	0.55	0.20	0.27	0.65	0.53	0.69	0.14
Grn Ratio	0.48	0.39	0.39	0.48	0.39	0.28	0.39	0.51
I Factor		1.000			1.000	1.000	1.000	
AT or PVG	3	3	3	3	3	3	3	3
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Q1	1.4	7.4	2.1	1.0	9.1	5.5	5.8	1.5
kB	0.3	0.6	0.5	0.3	0.6	0.5	0.5	0.6
Q2	0.2	0.7	0.1	0.1	1.0	0.5	1.0	0.1
Q Average	1.6	8.1	2.2	1.1	10.0	6.1	6.8	1.6
Q Spacing	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0
Q Storage	0	0	0	0	0	0	0	0
Q S Ratio								
70th Percentile Output:								
fB%	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
BOQ	1.9	9.6	2.6	1.3	11.8	7.2	8.0	1.9
QSRatio								
85th Percentile Output:								
fB%	1.6	1.5	1.6	1.6	1.5	1.5	1.5	1.6
BOQ	2.5	12.4	3.5	1.7	15.2	9.4	10.4	2.5
QSRatio								
90th Percentile Output:								
fB%	1.8	1.7	1.8	1.8	1.6	1.7	1.7	1.8
BOQ	2.8	13.5	3.9	2.0	16.5	10.3	11.4	2.8
QSRatio								
95th Percentile Output:								
fB%	2.0	1.9	2.0	2.1	1.8	1.9	1.9	2.0
BOQ	3.3	15.2	4.5	2.3	18.5	11.7	13.0	3.3
QSRatio								
98th Percentile Output:								
fB%	2.6	2.2	2.5	2.6	2.2	2.3	2.3	2.6
BOQ	4.1	18.1	5.6	2.9	21.7	14.1	15.5	4.1
QSRatio								

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: md
Agency:
Date: 1/4/2005
Period: pm
Project ID: 2007 site+background
E/W St: sth 158

Inter.: sth 158/cth h
Area Type: All other areas
Jurisd: wisdot
Year : 2007

N/S St: cth h

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	2	1	1	2	0	0	1	0	0	1	1
LGConfig	L	T	R	L	TR		LTR			LT		R
Volume	150	880	165	40	625	60	10	310	50	55	280	70
Lane Width	12.0	12.0	12.0	12.0	12.0		12.0			12.0		12.0
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A	A			NB Left		A		
Thru		A			Thru		A		
Right		A			Right		A		
Peds					Peds				
WB Left	A	A			SB Left	A	A		
Thru		A			Thru	A	A		
Right		A			Right	A	A		
Peds					Peds				
NB Right					EB Right				
SB Right	A				WB Right				
Green	6.0	30.0				7.0	29.0		
Yellow	3.0	4.5				3.0	4.5		
All Red	0.0	1.5				0.0	1.5		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	230	1805	0.74	0.43	30.2	C		
T	1209	3627	0.83	0.33	32.5	C	30.9	C
R	538	1615	0.35	0.33	23.0	C		
Westbound								
L	204	1805	0.22	0.43	18.9	B		
TR	1148	3444	0.68	0.33	27.5	C	27.0	C
Northbound								
LTR	579	1796	0.73	0.32	31.5	C	31.5	C
Southbound								
LT	533	1832	0.71	0.43	25.5	C	22.6	C
R	824	1455	0.10	0.57	9.0	A		

Intersection Delay = 28.7 (sec/veh) Intersection LOS = C

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/4/2005
Analysis Time Period: pm
Intersection: sth 158/cth h
Area Type: All other areas
Jurisdiction: wisdot
Analysis Year: 2007
Project ID: 2007 site+background

East/West Street: sth 158
North/South Street: cth h

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	150	880	165	40	625	60	10	310	50	55	280	70
% Heavy Veh	0	5	0	0	4	0	10	2	4	2	3	11
PHF	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
PK 15 Vol	43	250	47	11	178	17	3	88	14	16	80	20
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	2000	1900	1900	1900			1900			1900	1900
ParkExist												
NumPark												
No. Lanes	1	2	1	1	2	0	0	1	0	0	1	1
LGConfig	L	T	R	L	TR		LTR			LT		R
Lane Width	12.0	12.0	12.0	12.0	12.0		12.0			12.0		12.0
RTOR Vol			0			0			0			0
Adj Flow	170	1000	188	45	778			420			381	80
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000			0.026			0.165	
Prop RTs		0.000	1.000		0.087		0.136			0.000		1.000
Peds Bikes	0			0			0			0		
Buses	0	0	0	0	0			0			0	0
%InProtPhase	0.0			0.0						0.0		
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0	0.0	0.0	0.0			0.0			0.0	0.0
Arriv. Type	3	3	3	3	3			3			3	3
Unit Ext.	3.0	3.0	3.0	3.0	3.0			3.0			3.0	3.0
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0	2.0	2.0	2.0			2.0			2.0	2.0
Ext of g	2.0	2.0	2.0	2.0	2.0			2.0			2.0	2.0

Ped Min g	3.2	3.2	3.2	3.2

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A	A			NB Left		A		
Thru		A			Thru		A		
Right		A			Right		A		
Peds					Peds				
WB Left	A	A			SB Left	A	A		
Thru		A			Thru	A	A		
Right		A			Right	A	A		
Peds					Peds				
NB Right					EB Right				
SB Right	A				WB Right				
Green	6.0	30.0				7.0	29.0		
Yellow	3.0	4.5				3.0	4.5		
All Red	0.0	1.5				0.0	1.5		

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	150	880	165	40	625	60	10	310	50	55	280	70
PHF	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Adj flow	170	1000	188	45	710	68	11	352	57	63	318	80
No. Lanes	1	2	1	1	2	0	0	1	0	0	1	1
Lane group	L	T	R	L	TR		LTR			LT		R
Adj flow	170	1000	188	45	778		420			381	80	
Prop LTs	1.000	0.000		1.000	0.000		0.026			0.165		
Prop RTs		0.000	1.000		0.087		0.136			0.000		1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L	T	R	L	TR		LTR			LT	R	
So	1900	2000	1900	1900	1900		1900			1900	1900	
Lanes	1	2	1	1	2	0	0	1	0	0	1	1
fW	1.000	1.000	1.000	1.000	1.000			1.000			1.000	1.000
fHV	1.000	0.952	1.000	1.000	0.965			0.976			0.972	0.901
fG	1.000	1.000	1.000	1.000	1.000			1.000			1.000	1.000
fP	1.000	1.000	1.000	1.000	1.000			1.000			1.000	1.000
fBB	1.000	1.000	1.000	1.000	1.000			1.000			1.000	1.000
fA	1.000	1.000	1.000	1.000	1.000			1.000			1.000	1.000
fLU	1.000	0.952	1.000	1.000	0.952			1.000			1.000	1.000
fRT		1.000	0.850		0.987			0.982			1.000	0.850
fLT	0.950	1.000		0.950	1.000			0.987			0.992	
Sec.	0.158			0.121							0.595	
fLpb	1.000	1.000		1.000	1.000			1.000			1.000	
fRpb		1.000	1.000		1.000			1.000			1.000	1.000
S	1805	3627	1615	1805	3444			1796			1832	1455
Sec.	301			230							1099	

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		120	1805	# 0.07	0.067	120	1.00
Perm		50	301	0.17	0.367	110	0.45
Left	L	170			0.43	230	0.74
Prot							
Perm							
Thru	T	1000	3627	# 0.28	0.33	1209	0.83
Right	R	188	1615	0.12	0.33	538	0.35
Westbound							
Prot		45	1805	0.02	0.067	120	0.38
Perm		0	230	0.00	0.367	84	0.00
Left	L	45			0.43	204	0.22
Prot							
Perm							
Thru	TR	778	3444	0.23	0.33	1148	0.68
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	420	1796	# 0.23	0.32	579	0.73
Right							
Southbound							
Prot							
Perm							
Left							
Prot		142	1832	# 0.08	0.078	142	1.00
Perm		239	1099	0.22	0.356	391	0.61
Thru	LT	381			0.43	533	0.71
Right	R	80	1455	0.05	0.57	824	0.10

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.65
Total lost time per cycle, L = 24.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.89

Control Delay and LOS Determination

Appr/ Lane Grp	v/c	g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	0.74	0.43	18.3	1.000	230	0.30	11.9	0.0	30.2	C		
T	0.83	0.33	27.6	1.000	1209	0.37	4.9	0.0	32.5	C	30.9	C
R	0.35	0.33	22.6	1.000	538	0.11	0.4	0.0	23.0	C		
Westbound												
L	0.22	0.43	18.4	1.000	204	0.11	0.5	0.0	18.9	B		
TR	0.68	0.33	25.8	1.000	1148	0.25	1.6	0.0	27.5	C	27.0	C
Northbound												
LTR	0.73	0.32	27.0	1.000	579	0.29	4.5	0.0	31.5	C	31.5	C
Southbound												

LT	0.71	0.43	20.9	1.000	533	0.28	4.5	0.0	25.5	C	22.6	C
R	0.10	0.57	8.9	1.000	824	0.11	0.1	0.0	9.0	A		

Intersection delay = 28.7 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M		
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	39.0	39.0		
Effective permitted green time for LT lane group, g(s)	33.0	33.0		
Opposing effective green time, go (s)	30.0	30.0		
Number of lanes in LT lane group, N	1	1		
Number of lanes in opposing approach, No	2	2		
Adjusted LT flow rate, VLT (veh/h)	170	45		
Proportion of LT in LT lane group, PLT	1.000	1.000		
Proportion of LT in opposing flow, PLTo	0.00	0.00		
Adjusted opposing flow rate, Vo (veh/h)	778	1000		
Lost time for LT lane group, tL	6.00	6.00		
Computation				
LT volume per cycle, LTC=VLTC/3600	4.25	1.13		
Opposing lane util. factor, fLUo	0.952	0.952	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	10.22	13.13		
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g	0.0	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.67	0.67		
gq, (see Exhibit C16-4,5,6,7,8)	17.62	24.72		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	15.38	8.28		
n=Max(gq-gf)/2,0)	8.81	12.36		
PTHo=1-PLTo	1.00	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00		
EL1 (refer to Exhibit C16-3)	2.94	3.48		
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.12	0.12		
gdiff=max(gq-gf,0)	0.00	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.16	0.12		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.158	0.121		

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach			M	S
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)			29.0	39.0
Effective permitted green time for LT lane group, g(s)			29.0	32.0
Opposing effective green time, go (s)			39.0	29.0
Number of lanes in LT lane group, N			1	1
Number of lanes in opposing approach, No			1	1
Adjusted LT flow rate, VLT (veh/h)			11	63
Proportion of LT in LT lane group, PLT	0.000	0.000	0.026	0.165
Proportion of LT in opposing flow, PLTo			0.17	0.03
Adjusted opposing flow rate, Vo (veh/h)			381	420
Lost time for LT lane group, tL			6.00	6.00
Computation				
LT volume per cycle, LTC=VLTC/3600			0.28	1.58
Opposing lane util. factor, fLUo	0.952	0.952	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			9.52	10.50
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g			14.4	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.57	0.68
gq, (see Exhibit C16-4,5,6,7,8)			0.00	19.63
gu=g-gq if gq>=gf, or = g-gf if gq<gf			14.55	12.37
n=Max(gq-gf)/2,0)			0.00	9.82
PTHo=1-PLTo			0.83	0.97
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			0.03	0.17
EL1 (refer to Exhibit C16-3)			2.04	2.12
EL2=Max((1-Ptho**n)/Plto, 1.0)			1.00	8.76
fmin=2(1+PL)/g or fmin=2(1+Pl)/g			0.07	0.07
gdiff=max(gq-gf,0)			0.00	19.63
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.99	0.59
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.987	0.595

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 90.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v	170	45		
v/c ratio from Capacity Worksheet, X	0.74	0.22		
Protected phase effective green interval, g (s)	6.0	6.0		
Opposing queue effective green interval, gq	17.62	24.72		
Unopposed green interval, gu	15.38	8.28		
Red time r=(C-g-gq-gu)	51.0	51.0		
Arrival rate, qa=v/(3600(max[X,1.0]))	0.05	0.01		
Protected ph. departure rate, Sp=s/3600	0.501	0.501		
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.18	0.25		
XPerm	0.56	0.20		
XProt	0.89	0.24		
Case	1	1		
Queue at beginning of green arrow, Qa	2.41	0.64		
Queue at beginning of unsaturated green, Qu	0.83	0.31		
Residual queue, Qr	0.00	0.00		
Uniform Delay, dl	18.3	18.4		

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. dl sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 28.7 sec/veh Intersection LOS C

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	T	R	L	TR		LTR			LT	R	
Init Queue	0.0	0.0	0.0	0.0	0.0		0.0			0.0	0.0	
Flow Rate	170	525	188	45	408		420			381	80	
So	1900	2000	1900	1900	1900		1900			1900	1900	
No.Lanes	1	2	1	1	2	0	0	1	0	0 1	1	
SL	532	1904	1615	472	1808		1796			1230	1455	
LnCapacity	230	634	538	204	602		579			533	824	
Flow Ratio	0.32	0.28	0.12	0.10	0.23		0.23			0.31	0.05	
v/c Ratio	0.74	0.83	0.35	0.22	0.68		0.73			0.71	0.10	
Grn Ratio	0.43	0.33	0.33	0.43	0.33		0.32			0.43	0.57	
I Factor		1.000			1.000		1.000			1.000		
AT or PVG	3	3	3	3	3		3			3	3	
Pltn Ratio	1.00	1.00	1.00	1.00	1.00		1.00			1.00	1.00	
PF2	1.00	1.00	1.00	1.00	1.00		1.00			1.00	1.00	
Q1	2.5	12.1	3.5	0.6	8.8		9.3			5.7	0.9	
kB	0.3	0.5	0.5	0.3	0.5		0.5			0.5	0.6	
Q2	0.7	2.2	0.3	0.1	1.0		1.2			1.1	0.1	
Q Average	3.3	14.3	3.8	0.7	9.8		10.5			6.8	1.0	
Q Spacing	25.0	25.0	25.0	25.0	25.0		25.0			25.0	25.0	
Q Storage	0	0	0	0	0		0			0	0	
Q S Ratio												
70th Percentile Output:												
fB%	1.2	1.2	1.2	1.2	1.2		1.2			1.2	1.2	
BOQ	3.9	16.7	4.5	0.9	11.6		12.4			8.1	1.2	
QSRatio												
85th Percentile Output:												
fB%	1.6	1.5	1.6	1.6	1.5		1.5			1.5	1.6	
BOQ	5.1	21.2	5.9	1.2	14.9		15.9			10.5	1.6	
QSRatio												
90th Percentile Output:												
fB%	1.7	1.6	1.7	1.8	1.6		1.6			1.7	1.8	
BOQ	5.7	22.8	6.6	1.3	16.1		17.2			11.5	1.8	
QSRatio												
95th Percentile Output:												
fB%	2.0	1.8	2.0	2.1	1.8		1.8			1.9	2.1	
BOQ	6.5	25.3	7.5	1.5	18.1		19.3			13.1	2.0	
QSRatio												
98th Percentile Output:												
fB%	2.5	2.0	2.4	2.6	2.2		2.1			2.3	2.6	
BOQ	8.1	29.0	9.3	1.9	21.3		22.6			15.7	2.6	
QSRatio												

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: md
Agency:
Date: 1/10/2005
Period: am
Project ID: 2007 Site+Background
E/W St: STH 158

Inter.: STH 158/104th
Area Type: All other areas
Jurisd: WisDOT
Year : 2007

N/S St: 104th Ave

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	2	1	1	2	1	1	1	1	1	1	0
LGConfig	L	T	R	L	T	R	L	LT	R	L	TR	
Volume	5	540	65	170	600	5	460	5	335	5	10	5
Lane Width	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A		A		NB Left	A			
Thru			A		Thru	A			
Right			A		Right	A			
Peds									
WB Left	A	A	A		SB Left		A		
Thru		A	A		Thru		A		
Right		A	A		Right		A		
Peds									
NB Right	A	A			EB Right	A			
SB Right					WB Right		A		
Green	5.0	5.0	23.0			22.0	11.0		
Yellow	3.0	3.0	4.5			4.5	4.5		
All Red	0.0	0.0	1.5			1.5	1.5		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	269	1770	0.02	0.31	21.5	C		
T	846	3311	0.77	0.26	35.4	D	32.5	C
R	897	1583	0.09	0.57	8.9	A		
Westbound								
L	339	1770	0.60	0.43	21.3	C		
T	1215	3526	0.60	0.34	25.1	C	24.2	C
R	739	1583	0.01	0.47	12.9	B		
Northbound								
L	441	1805	0.63	0.24	33.2	C		
LT	443	1811	0.64	0.24	33.5	C	29.8	C
R	622	1599	0.65	0.39	24.9	C		
Southbound								
L	216	1770	0.03	0.12	34.8	C		
TR	216	1770	0.08	0.12	35.2	D	35.1	D

Intersection Delay = 28.6 (sec/veh) Intersection LOS = C

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/10/2005
Analysis Time Period: am
Intersection: STH 158/104th
Area Type: All other areas
Jurisdiction: WisDOT
Analysis Year: 2007
Project ID: 2007 Site+Background

East/West Street: STH 158
North/South Street: 104th Ave

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	5	540	65	170	600	5	460	5	335	5	10	5
% Heavy Veh	2	15	2	2	8	2	0	0	1	2	2	2
PHF	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83
PK 15 Vol	2	163	20	51	181	2	139	2	101	2	3	2
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	2000	1900	1900	2000	1900	1900	1900	1900	1900	1900	
ParkExist												
NumPark												
No. Lanes	1	2	1	1	2	1	1	1	1	1	1	0
LGConfig	L	T	R	L	T	R	L	LT	R	L	TR	
Lane Width	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	
RTOR Vol			0			0			0			0
Adj Flow	6	651	78	205	723	6	277	283	404	6	18	
%InSharedLn							50					
Prop LTs	1.000	0.000		1.000	0.000			0.979			0.000	
Prop RTs		0.000	1.000		0.000	1.000		0.000	1.000		0.333	
Peds Bikes	0			0			0			0		
Buses	0	0	0	0	0	0	0	0	0	0	0	
%InProtPhase	0.0			0.0								

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Arriv. Type	3	3	3	3	3	3	3	3	3	3	3	
Unit Ext.	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	
Ext of g	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	

Ped Min g	3.2	3.2	3.2	3.2

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A		A		NB Left	A			
Thru			A		Thru	A			
Right			A		Right	A			
Peds					Peds				
WB Left	A	A	A		SB Left		A		
Thru		A	A		Thru		A		
Right		A	A		Right		A		
Peds					Peds				
NB Right	A	A			EB Right	A			
SB Right					WB Right		A		
Green	5.0	5.0	23.0			22.0	11.0		
Yellow	3.0	3.0	4.5			4.5	4.5		
All Red	0.0	0.0	1.5			1.5	1.5		

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	5	540	65	170	600	5	460	5	335	5	10	5
PHF	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83
Adj flow	6	651	78	205	723	6	554	6	404	6	12	6
No. Lanes	1	2	1	1	2	1	1	1	1	1	1	0
Lane group	L	T	R	L	T	R	L	LT	R	L	TR	
Adj flow	6	651	78	205	723	6	277	283	404	6	18	
Prop LTs	1.000	0.000		1.000	0.000			0.979			0.000	
Prop RTs		0.000	1.000		0.000	1.000		0.000	1.000		0.333	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L	T	R	L	T	R	L	LT	R	L	TR	
So	1900	2000	1900	1900	2000	1900	1900	1900	1900	1900	1900	0
Lanes	1	2	1	1	2	1	1	1	1	1	1	
fW	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
fHV	0.980	0.870	0.980	0.980	0.926	0.980	1.000	1.000	0.990	0.980	0.980	
fG	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
fP	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
fBB	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
fA	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
fLU	1.000	0.952	1.000	1.000	0.952	1.000	1.000	1.000	1.000	1.000	1.000	
fRT		1.000	0.850		1.000	0.850		1.000	0.850		0.950	
fLT	0.950	1.000		0.950	1.000		0.950	0.953		0.950	1.000	
Sec.	0.359			0.154								
fLpb	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fRpb		1.000	1.000		1.000	1.000		1.000	1.000		1.000	
S	1770	3311	1583	1770	3526	1583	1805	1811	1599	1770	1770	
Sec.	668			287								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		6	1770	0.00	0.056	98	0.06
Perm		0	668	0.00	0.256	171	0.00
Left	L	6			0.31	269	0.02
Prot							
Perm							
Thru	T	651	3311	# 0.20	0.26	846	0.77
Right	R	78	1583	0.05	0.57	897	0.09
Westbound							
Prot		205	1770	# 0.12	0.144	256	0.80
Perm		0	287	0.00	0.289	83	0.00
Left	L	205			0.43	339	0.60
Prot							
Perm							
Thru	T	723	3526	0.21	0.34	1215	0.60
Right	R	6	1583	0.00	0.47	739	0.01
Northbound							
Prot							
Perm							
Left	L	277	1805	0.15	0.24	441	0.63
Prot							
Perm							
Thru	LT	283	1811	# 0.16	0.24	443	0.64
Right	R	404	1599	0.25	0.39	622	0.65
Southbound							
Prot							
Perm							
Left	L	6	1770	0.00	0.12	216	0.03
Prot							
Perm							
Thru	TR	18	1770	# 0.01	0.12	216	0.08
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.48
Total lost time per cycle, L = 24.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.65

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	0.02	0.31	21.4	1.000	269	0.11	0.0	0.0	21.5	C		
T	0.77	0.26	31.0	1.000	846	0.32	4.4	0.0	35.4	D	32.5	C
R	0.09	0.57	8.9	1.000	897	0.11	0.0	0.0	8.9	A		
Westbound												
L	0.60	0.43	18.3	1.000	339	0.19	3.1	0.0	21.3	C		
T	0.60	0.34	24.3	1.000	1215	0.18	0.8	0.0	25.1	C	24.2	C
R	0.01	0.47	12.8	1.000	739	0.11	0.0	0.0	12.9	B		
Northbound												
L	0.63	0.24	30.3	1.000	441	0.21	2.8	0.0	33.2	C		
LT	0.64	0.24	30.4	1.000	443	0.22	3.1	0.0	33.5	C	29.8	C
R	0.65	0.39	22.5	1.000	622	0.23	2.4	0.0	24.9	C		
Southbound												
L	0.03	0.12	34.8	1.000	216	0.11	0.1	0.0	34.8	C		

TR	0.08	0.12	35.0	1.000	216	0.11	0.2	0.0	35.2	D	35.1	D

Intersection delay = 28.6 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M		
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	28.0	39.0		
Effective permitted green time for LT lane group, g(s)	23.0	26.0		
Opposing effective green time, go (s)	31.0	23.0		
Number of lanes in LT lane group, N	1	1		
Number of lanes in opposing approach, No	2	2		
Adjusted LT flow rate, VLT (veh/h)	6	205		
Proportion of LT in LT lane group, PLT	1.000	1.000		
Proportion of LT in opposing flow, PLTo	0.00	0.00		
Adjusted opposing flow rate, Vo (veh/h)	723	651		
Lost time for LT lane group, tL	9.00	6.00		
Computation				
LT volume per cycle, LTC=VLTC/3600	0.15	5.13		
Opposing lane util. factor, fLUo	0.952	0.952	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	9.49	8.55		
gf=G[exp(- a * (LTC ** b)]-tl, gf<=g	0.0	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.66	0.74		
gq, (see Exhibit C16-4,5,6,7,8)	0.00	15.71		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	23.00	10.29		
n=Max(gq-gf)/2,0)	0.00	7.86		
PTHo=1-PLTo	1.00	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00		
EL1 (refer to Exhibit C16-3)	2.79	2.60		
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.17	0.15		
gdiff=max(gq-gf,0)	0.00	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.36	0.15		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.359	0.154		

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000	0.979	0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	0.952	0.952	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b)]-tl, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 90.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v	6	205		
v/c ratio from Capacity Worksheet, X	0.02	0.60		
Protected phase effective green interval, g (s)	5.0	13.0		
Opposing queue effective green interval, gq	0.00	15.71		
Unopposed green interval, gu	23.00	10.29		
Red time r=(C-g-gq-gu)	62.0	51.0		
Arrival rate, qa=v/(3600(max[X,1.0]))	0.00	0.06		
Protected ph. departure rate, Sp=s/3600	0.492	0.492		
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.19	0.20		
XPerm	0.01	0.71		
XProt	0.05	0.57		
Case	1	1		
Queue at beginning of green arrow, Qa	0.10	2.90		
Queue at beginning of unsaturated green, Qu	0.00	0.89		
Residual queue, Qr	0.00	0.00		
Uniform Delay, d1	21.4	18.3		

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Dur. Unmet Demand Q veh	Unmet Demand t hrs.	Uniform Delay Unadj. ds	Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 28.6 sec/veh Intersection LOS C

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	T	R	L	T	R	L	LT	R	L	TR	
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Flow Rate	6	341	78	205	379	6	277	283	404	6	18	
So	1900	2000	1900	1900	2000	1900	1900	1900	1900	1900	1900	
No.Lanes	1	2	1	1	2	1	1	1	1	1	1	0
SL	865	1738	1583	781	1851	1583	1805	1811	1599	1770	1770	
LnCapacity	269	444	897	339	638	739	441	443	622	216	216	
Flow Ratio	0.01	0.20	0.05	0.26	0.20	0.00	0.15	0.16	0.25	0.00	0.01	
v/c Ratio	0.02	0.77	0.09	0.60	0.59	0.01	0.63	0.64	0.65	0.03	0.08	
Grn Ratio	0.31	0.26	0.57	0.43	0.34	0.47	0.24	0.24	0.39	0.12	0.12	
I Factor		1.000			1.000			1.000			1.000	
AT or PVG	3	3	3	3	3	3	3	3	3	3	3	
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
PF2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Q1	0.1	7.9	0.9	3.2	7.8	0.1	6.2	6.3	8.3	0.1	0.4	
kB	0.3	0.4	0.6	0.4	0.5	0.6	0.4	0.4	0.5	0.3	0.3	
Q2	0.0	1.3	0.1	0.5	0.8	0.0	0.7	0.7	0.9	0.0	0.0	
Q Average	0.1	9.2	1.0	3.7	8.6	0.1	6.9	7.1	9.2	0.1	0.4	
Q Spacing	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	
Q Storage	0	0	0	0	0	0	0	0	0	0	0	
Q S Ratio												
70th Percentile Output:												
fB%	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	
BOQ	0.1	10.8	1.1	4.4	10.1	0.1	8.1	8.4	10.8	0.2	0.5	
QSRatio												
85th Percentile Output:												
fB%	1.6	1.5	1.6	1.6	1.5	1.6	1.5	1.5	1.5	1.6	1.6	
BOQ	0.2	14.0	1.5	5.8	13.1	0.1	10.6	10.8	14.0	0.2	0.7	
QSRatio												
90th Percentile Output:												
fB%	1.8	1.7	1.8	1.7	1.7	1.8	1.7	1.7	1.7	1.8	1.8	
BOQ	0.2	15.2	1.7	6.4	14.2	0.2	11.6	11.9	15.2	0.3	0.8	
QSRatio												
95th Percentile Output:												
fB%	2.1	1.9	2.1	2.0	1.9	2.1	1.9	1.9	1.9	2.1	2.1	
BOQ	0.2	17.1	2.0	7.4	16.0	0.2	13.1	13.4	17.1	0.3	0.9	
QSRatio												
98th Percentile Output:												
fB%	2.7	2.2	2.6	2.5	2.2	2.7	2.3	2.3	2.2	2.7	2.7	
BOQ	0.3	20.1	2.5	9.1	19.0	0.2	15.7	16.1	20.2	0.4	1.1	
QSRatio												

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: md
Agency:
Date: 12/10/2004
Period: pm
Project ID: 2007 Site+Background
E/W St: STH 158

Inter.: STH 158/104th
Area Type: All other areas
Jurisd: WisDOT
Year : 2007

N/S St: 104th Ave

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	2	1	1	2	1	1	1	1	1	1	0
LGConfig	L	T	R	L	T	R	L	LT	R	L	TR	
Volume	5	615	45	140	610	5	755	5	550	10	5	10
Lane Width	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A		A		NB Left	A			
Thru			A		Thru	A			
Right			A		Right	A			
Peds					Peds				
WB Left	A	A	A		SB Left		A		
Thru		A	A		Thru		A		
Right		A	A		Right		A		
Peds					Peds				
NB Right	A	A			EB Right				
SB Right					WB Right				
Green	5.0	4.0	22.0			29.0	6.0		
Yellow	3.0	3.0	4.5			4.5	4.5		
All Red	0.0	0.0	1.5			1.5	1.5		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	234	1770	0.03	0.30	22.2	C		
T	887	3627	0.90	0.24	45.2	D	43.8	D
R	395	1615	0.15	0.24	26.8	C		
Westbound								
L	322	1787	0.57	0.41	22.3	C		
T	1157	3592	0.68	0.32	28.2	C	27.1	C
R	510	1583	0.01	0.32	20.8	C		
Northbound								
L	582	1805	0.84	0.32	39.3	D		
LT	614	1906	0.81	0.32	35.9	D	43.9	D
R	728	1599	0.98	0.46	52.6	D		
Southbound								
L	118	1770	0.11	0.07	39.9	D		
TR	111	1672	0.17	0.07	40.4	D	40.2	D

Intersection Delay = 39.2 (sec/veh) Intersection LOS = D

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 12/10/2004
Analysis Time Period: pm
Intersection: STH 158/104th
Area Type: All other areas
Jurisdiction: WisDOT
Analysis Year: 2007
Project ID: 2007 Site+Background
East/West Street: STH 158
North/South Street: 104th Ave

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	5	615	45	140	610	5	755	5	550	10	5	10
% Heavy Veh	2	5	0	1	6	2	0	0	1	2	2	2
PHF	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77
PK 15 Vol	2	200	15	45	198	2	245	2	179	3	2	3
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	2000	1900	1900	2000	1900	1900	2000	1900	1900	1900	
ParkExist												
NumPark												
No. Lanes	1	2	1	1	2	1	1	1	1	1	1	0
LGConfig	L	T	R	L	T	R	L	LT	R	L	TR	
Lane Width	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	
RTOR Vol			0			0			0			0
Adj Flow	6	799	58	182	792	6	491	496	714	13	19	
%InSharedLn							50					
Prop LTs	1.000	0.000		1.000	0.000			0.989			0.000	
Prop RTs		0.000	1.000		0.000	1.000		0.000	1.000		0.684	
Peds Bikes	0			0			0			0		
Buses	0	0	0	0	0	0	0	0	0	0	0	
%InProtPhase	0.0			0.0								

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Arriv. Type	3	3	3	3	3	3	3	3	3	3	3	
Unit Ext.	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	
Ext of g	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	
Ped Min g	3.2			3.2			3.2			3.2		

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A		A		NB Left	A			
Thru			A		Thru	A			
Right			A		Right	A			
Peds					Peds				
WB Left	A	A	A		SB Left		A		
Thru		A	A		Thru		A		
Right		A	A		Right		A		
Peds					Peds				
NB Right	A	A			EB Right				
SB Right					WB Right				
Green	5.0	4.0	22.0			29.0	6.0		
Yellow	3.0	3.0	4.5			4.5	4.5		
All Red	0.0	0.0	1.5			1.5	1.5		

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	5	615	45	140	610	5	755	5	550	10	5	10
PHF	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77
Adj flow	6	799	58	182	792	6	981	6	714	13	6	13
No. Lanes	1	2	1	1	2	1	1	1	1	1	1	0
Lane group	L	T	R	L	T	R	L	LT	R	L	TR	
Adj flow	6	799	58	182	792	6	491	496	714	13	19	
Prop LTs	1.000	0.000		1.000	0.000			0.989			0.000	
Prop RTs		0.000	1.000		0.000	1.000		0.000	1.000		0.684	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L	T	R	L	T	R	L	LT	R	L	TR	
So	1900	2000	1900	1900	2000	1900	1900	2000	1900	1900	1900	0
Lanes	1	2	1	1	2	1	1	1	1	1	1	
fW	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
fHV	0.980	0.952	1.000	0.990	0.943	0.980	1.000	1.000	0.990	0.980	0.980	
fG	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
fP	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
fBB	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
fA	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
fLU	1.000	0.952	1.000	1.000	0.952	1.000	1.000	1.000	1.000	1.000	1.000	
fRT		1.000	0.850		1.000	0.850		1.000	0.850		0.897	
fLT	0.950	1.000		0.950	1.000		0.950	0.953		0.950	1.000	
Sec.	0.300			0.160								
fLpb	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fRpb		1.000	1.000		1.000	1.000		1.000	1.000		1.000	
S	1770	3627	1615	1787	3592	1583	1805	1906	1599	1770	1672	
Sec.	558			301								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		6	1770	0.00	0.056	98	0.06
Perm		0	558	0.00	0.244	136	0.00
Left	L	6			0.30	234	0.03
Prot							
Perm							
Thru	T	799	3627	# 0.22	0.24	887	0.90
Right	R	58	1615	0.04	0.24	395	0.15
Westbound							
Prot		182	1787	0.10	0.133	238	0.76
Perm		0	301	0.00	0.278	84	0.00
Left	L	182			0.41	322	0.57
Prot							
Perm							
Thru	T	792	3592	0.22	0.32	1157	0.68
Right	R	6	1583	0.00	0.32	510	0.01
Northbound							
Prot							
Perm							
Left	L	491	1805	0.27	0.32	582	0.84
Prot							
Perm							
Thru	LT	496	1906	0.26	0.32	614	0.81
Right	R	714	1599	# 0.45	0.46	728	0.98
Southbound							
Prot							
Perm							
Left	L	13	1770	0.01	0.07	118	0.11
Prot							
Perm							
Thru	TR	19	1672	# 0.01	0.07	111	0.17
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.68
Total lost time per cycle, L = 21.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.88

Control Delay and LOS Determination

Appr/ Lane Grp	v/c	g/C	Ratios	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound													
L	0.03	0.30	22.2	1.000	234	0.11	0.0	0.0	22.2	C			
T	0.90	0.24	32.9	1.000	887	0.42	12.2	0.0	45.2	D	43.8	D	
R	0.15	0.24	26.6	1.000	395	0.11	0.2	0.0	26.8	C			
Westbound													
L	0.57	0.41	20.0	1.000	322	0.16	2.3	0.0	22.3	C			
T	0.68	0.32	26.5	1.000	1157	0.25	1.7	0.0	28.2	C	27.1	C	
R	0.01	0.32	20.8	1.000	510	0.11	0.0	0.0	20.8	C			
Northbound													
L	0.84	0.32	28.4	1.000	582	0.38	10.9	0.0	39.3	D			
LT	0.81	0.32	27.9	1.000	614	0.35	7.9	0.0	35.9	D	43.9	D	
R	0.98	0.46	24.1	1.000	728	0.48	28.5	0.0	52.6	D			
Southbound													
L	0.11	0.07	39.5	1.000	118	0.11	0.4	0.0	39.9	D			

TR	0.17	0.07	39.7	1.000	111	0.11	0.7	0.0	40.4	D	40.2	D

Intersection delay = 39.2 (sec/veh) Intersection LOS = D

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M		
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	27.0	37.0		
Effective permitted green time for LT lane group, g(s)	22.0	25.0		
Opposing effective green time, go (s)	29.0	22.0		
Number of lanes in LT lane group, N	1	1		
Number of lanes in opposing approach, No	2	2		
Adjusted LT flow rate, VLT (veh/h)	6	182		
Proportion of LT in LT lane group, PLT	1.000	1.000		
Proportion of LT in opposing flow, PLTo	0.00	0.00		
Adjusted opposing flow rate, Vo (veh/h)	792	799		
Lost time for LT lane group, tL	9.00	6.00		
Computation				
LT volume per cycle, LTC=VLTC/3600	0.15	4.55		
Opposing lane util. factor, fLUo	0.952	0.952	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	10.40	10.49		
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g	0.0	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.68	0.76		
gq, (see Exhibit C16-4,5,6,7,8)	2.33	20.67		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	19.67	4.33		
n=Max(gq-gf)/2,0)	1.17	10.34		
PTHo=1-PLTo	1.00	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00		
EL1 (refer to Exhibit C16-3)	2.98	3.01		
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.18	0.16		
gdiff=max(gq-gf,0)	0.00	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.30	0.16		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.300	0.160		

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000	0.989	0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	0.952	0.952	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 90.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v	6	182		
v/c ratio from Capacity Worksheet, X	0.03	0.57		
Protected phase effective green interval, g (s)	5.0	12.0		
Opposing queue effective green interval, gq	2.33	20.67		
Unopposed green interval, gu	19.67	4.33		
Red time r=(C-g-gq-gu)	63.0	53.0		
Arrival rate, qa=v/(3600(max[X,1.0]))	0.00	0.05		
Protected ph. departure rate, Sp=s/3600	0.492	0.496		
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.17	0.48		
XPerm	0.01	0.60		
XProt	0.05	0.55		
Case	1	1		
Queue at beginning of green arrow, Qa	0.10	2.68		
Queue at beginning of unsaturated green, Qu	0.00	1.05		
Residual queue, Qr	0.00	0.00		
Uniform Delay, d1	22.2	20.0		

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 39.2 sec/veh Intersection LOS D

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	T	R	L	T	R	L	LT	R	L	TR	
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Flow Rate	6	419	58	182	415	6	491	496	714	13	19	
So	1900	2000	1900	1900	2000	1900	1900	2000	1900	1900	1900	
No.Lanes	1	2	1	1	2	1	1	1	1	1	1	0
SL	782	1904	1615	783	1866	1583	1805	1906	1599	1770	1672	
LnCapacity	234	465	395	322	607	510	582	614	728	118	111	
Flow Ratio	0.01	0.22	0.04	0.23	0.22	0.00	0.27	0.26	0.45	0.01	0.01	
v/c Ratio	0.03	0.90	0.15	0.57	0.68	0.01	0.84	0.81	0.98	0.11	0.17	
Grn Ratio	0.30	0.24	0.24	0.41	0.32	0.32	0.32	0.32	0.46	0.07	0.07	
I Factor		1.000			1.000			1.000			1.000	
AT or PVG	3	3	3	3	3	3	3	3	3	3	3	
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
PF2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Q1	0.1	10.2	1.1	2.9	9.0	0.1	11.4	11.4	17.6	0.3	0.4	
kB	0.3	0.4	0.4	0.3	0.5	0.5	0.5	0.5	0.6	0.2	0.2	
Q2	0.0	2.7	0.1	0.4	1.1	0.0	2.2	1.9	6.3	0.0	0.0	
Q Average	0.1	12.9	1.2	3.3	10.1	0.1	13.7	13.3	23.9	0.3	0.5	
Q Spacing	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	
Q Storage	0	0	0	0	0	0	0	0	0	0	0	
Q S Ratio												
70th Percentile Output:												
fB%	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	
BOQ	0.1	15.1	1.4	4.0	11.9	0.1	16.0	15.6	27.6	0.4	0.6	
QSRatio												
85th Percentile Output:												
fB%	1.6	1.5	1.6	1.6	1.5	1.6	1.5	1.5	1.4	1.6	1.6	
BOQ	0.2	19.2	1.9	5.2	15.3	0.2	20.4	19.8	34.3	0.5	0.8	
QSRatio												
90th Percentile Output:												
fB%	1.8	1.6	1.8	1.7	1.6	1.8	1.6	1.6	1.5	1.8	1.8	
BOQ	0.2	20.7	2.1	5.8	16.5	0.2	21.9	21.3	36.3	0.6	0.9	
QSRatio												
95th Percentile Output:												
fB%	2.1	1.8	2.1	2.0	1.8	2.1	1.8	1.8	1.7	2.1	2.1	
BOQ	0.2	23.1	2.5	6.7	18.6	0.2	24.3	23.7	39.6	0.7	1.0	
QSRatio												
98th Percentile Output:												
fB%	2.7	2.1	2.6	2.5	2.2	2.7	2.0	2.1	1.9	2.7	2.7	
BOQ	0.3	26.6	3.1	8.3	21.8	0.3	28.0	27.4	44.4	0.9	1.3	
QSRatio												

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: md
Agency:
Date: 1/3/2005
Period: am
Project ID: 2007 Site+Background
E/W St: sth 158

Inter.: sth 158/greyhound access
Area Type: All other areas
Jurisd: wisdot
Year : 2007

N/S St: greyhound access

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	1	2	0	2	0	1	0	0	0
LGConfig		T		L	T		L		R			
Volume		600		260	805		10		10			
Lane Width		12.0		12.0	12.0		12.0		12.0			
RTOR Vol									0			

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left	A		
Thru		A			Thru			
Right					Right	A		
Peds					Peds			
WB Left	A	A			SB Left			
Thru	A	A			Thru			
Right					Right			
Peds					Peds			
NB Right	A				EB Right			
SB Right					WB Right			
Green	15.0	50.0			10.0			
Yellow	3.0	4.5			4.5			
All Red	0.0	1.5			1.5			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
T	1839	3311	0.34	0.56	11.0	B	11.0	B
Westbound								
L	727	1900	0.37	0.76	4.1	A		
T	2531	3350	0.33	0.76	3.7	A	3.8	A
Northbound								
L	389	3505	0.03	0.11	35.7	D	27.6	C
R	556	1615	0.02	0.34	19.5	B		
Southbound								

Intersection Delay = 6.6 (sec/veh) Intersection LOS = A

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/3/2005
Analysis Time Period: am
Intersection: sth 158/greyhound access
Area Type: All other areas
Jurisdiction: wisdot
Analysis Year: 2007
Project ID: 2007 Site+Background

East/West Street: sth 158
North/South Street: greyhound access

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume		600		260	805		10		10			
% Heavy Veh		15		0	8		0		0			
PHF		0.97		0.97	0.97		0.97		0.97			
PK 15 Vol		155		67	207		3		3			
Hi Ln Vol												
% Grade		0			0			0				
Ideal Sat		2000		2000	1900		1900		1900			
ParkExist												
NumPark												
No. Lanes	0	2	0	1	2	0	2	0	1	0	0	0
LGConfig		T		L	T		L		R			
Lane Width		12.0		12.0	12.0		12.0		12.0			
RTOR Vol									0			
Adj Flow		619		268	830		10		10			
%InSharedLn												
Prop LTs		0.000		1.000	0.000							
Prop RTs		0.000			0.000				1.000			
Peds		0						0			0	
Bikes												
Buses		0		0	0		0		0			
%InProtPhase				0.0								

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0		0.0	0.0		0.0		0.0			
Arriv. Type		3		3	3		3		3			
Unit Ext.		3.0		3.0	3.0		3.0		3.0			
I Factor		1.000			1.000			1.000				
Lost Time		2.0		2.0	2.0		2.0		2.0			
Ext of g		2.0		2.0	2.0		2.0		2.0			

Ped Min g	3.2			3.2		3.2		

PHASE DATA

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left	A		
Thru		A			Thru			
Right					Right	A		
Peds					Peds			
WB Left	A	A			SB Left			
Thru	A	A			Thru			
Right					Right			
Peds					Peds			
NB Right	A				EB Right			
SB Right					WB Right			
Green	15.0	50.0			10.0			
Yellow	3.0	4.5			4.5			
All Red	0.0	1.5			1.5			

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V		600		260	805		10		10			
PHF		0.97		0.97	0.97		0.97		0.97			
Adj flow		619		268	830		10		10			
No. Lanes	0	2	0	1	2	0	2	0	1	0	0	0
Lane group		T		L	T		L		R			
Adj flow		619		268	830		10		10			
Prop LTs		0.000		1.000	0.000							
Prop RTs	0.000				0.000				1.000			

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG		T		L	T		L		R			
So		2000		2000	1900		1900		1900			
Lanes	0	2	0	1	2	0	2	0	1	0	0	0
fW		1.000		1.000	1.000		1.000		1.000			
fHV		0.870		1.000	0.926		1.000		1.000			
fG		1.000		1.000	1.000		1.000		1.000			
fP		1.000		1.000	1.000		1.000		1.000			
fBB		1.000		1.000	1.000		1.000		1.000			
fA		1.000		1.000	1.000		1.000		1.000			
fLU		0.952		1.000	0.952		0.971		1.000			
fRT		1.000			1.000				0.850			
fLT		1.000		0.950	1.000		0.950					
Sec.				0.348								
fLpb		1.000		1.000	1.000		1.000					
fRpb		1.000			1.000				1.000			
S		3311		1900	3350		3505		1615			
Sec.				697								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	619	3311	# 0.19	0.56	1839	0.34
Right							
Westbound							
Prot		268	1900	# 0.14	0.167	317	0.85
Perm		0	697	0.00	0.589	410	0.00
Left	L	268			0.76	727	0.37
Prot							
Perm							
Thru	T	830	3350	0.25	0.76	2531	0.33
Right							
Northbound							
Prot							
Perm							
Left	L	10	3505	# 0.00	0.11	389	0.03
Prot							
Perm							
Thru							
Right	R	10	1615	0.01	0.34	556	0.02
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.33
Total lost time per cycle, L = 18.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.41

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
T	0.34	0.56	10.9	1.000	1839	0.11	0.1	0.0	11.0	B	11.0	B
Westbound												
L	0.37	0.76	3.8	1.000	727	0.11	0.3	0.0	4.1	A		
T	0.33	0.76	3.6	1.000	2531	0.11	0.1	0.0	3.7	A	3.8	A
Northbound												
L	0.03	0.11	35.7	1.000	389	0.11	0.0	0.0	35.7	D	27.6	C
R	0.02	0.34	19.5	1.000	556	0.11	0.0	0.0	19.5	B		
Southbound												

Intersection delay = 6.6 (sec/veh) Intersection LOS = A

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach		M		
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)		68.0		
Effective permitted green time for LT lane group, g(s)		53.0		
Opposing effective green time, go (s)		50.0		
Number of lanes in LT lane group, N		1		
Number of lanes in opposing approach, No		2		
Adjusted LT flow rate, VLT (veh/h)		268		
Proportion of LT in LT lane group, PLT		1.000		
Proportion of LT in opposing flow, PLTo		0.00		
Adjusted opposing flow rate, Vo (veh/h)		619		
Lost time for LT lane group, tL		6.00		
Computation				
LT volume per cycle, LTC=VLTC/3600		6.70		
Opposing lane util. factor, fLUo	0.952	0.952		
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		8.13		
gf=G[exp(- a * (LTC ** b)]-tl, gf<=g		0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.44		
gq, (see Exhibit C16-4,5,6,7,8)		8.82		
gu=g-gq if gq>=gf, or = g-gf if gq<gf		44.18		
n=Max(gq-gf)/2,0)		4.41		
PTHo=1-PLTo		1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00		
EL1 (refer to Exhibit C16-3)		2.39		
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.08		
gdiff=max(gq-gf,0)		0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.35		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.348		

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT		0.000	0.000	
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo		0.952	0.952	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b)]-tl, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 90.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v		268		
v/c ratio from Capacity Worksheet, X		0.37		
Protected phase effective green interval, g (s)		15.0		
Opposing queue effective green interval, gq		8.82		
Unopposed green interval, gu		44.18		
Red time r=(C-g-gq-gu)		22.0		
Arrival rate, qa=v/(3600(max[X,1.0]))		0.07		
Protected ph. departure rate, Sp=s/3600		0.528		
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)		0.23		
XPerm		0.38		
XProt		0.35		
Case		1		
Queue at beginning of green arrow, Qa		1.64		
Queue at beginning of unsaturated green, Qu		0.66		
Residual queue, Qr		0.00		
Uniform Delay, d1		3.8		

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. dx	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 6.6 sec/veh Intersection LOS A

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup		T		L	T		L		R			
Init Queue		0.0		0.0	0.0		0.0		0.0			
Flow Rate		325		268	435		5		10			
So		2000		2000	1900		1900		1900			
No.Lanes	0	2	0	1	2	0	2	0	1	0	0	0
SL		1738		962	1759		1805		1615			
LnCapacity		965		727	1329		200		556			
Flow Ratio		0.19		0.28	0.25		0.00		0.01			
v/c Ratio		0.34		0.37	0.33		0.03		0.02			
Grn Ratio		0.56		0.76	0.76		0.11		0.34			
I Factor		1.000			1.000			1.000				
AT or PVG		3		3	3		3		3			
Pltn Ratio		1.00		1.00	1.00		1.00		1.00			
PF2		1.00		1.00	1.00		1.00		1.00			
Q1		4.4		1.7	3.5		0.1		0.2			
kB		0.7		0.6	0.8		0.3		0.5			
Q2		0.3		0.3	0.4		0.0		0.0			
Q Average		4.8		2.1	3.9		0.1		0.2			
Q Spacing		25.0		25.0	25.0		25.0		25.0			
Q Storage		0		0	0		0		0			
Q S Ratio												
70th Percentile Output:												
fB%		1.2		1.2	1.2		1.2		1.2			
BOQ		5.7		2.5	4.7		0.1		0.2			
QSRatio												
85th Percentile Output:												
fB%		1.6		1.6	1.6		1.6		1.6			
BOQ		7.4		3.3	6.1		0.2		0.3			
QSRatio												
90th Percentile Output:												
fB%		1.7		1.8	1.7		1.8		1.8			
BOQ		8.2		3.7	6.8		0.2		0.3			
QSRatio												
95th Percentile Output:												
fB%		2.0		2.0	2.0		2.1		2.1			
BOQ		9.4		4.2	7.8		0.2		0.4			
QSRatio												
98th Percentile Output:												
fB%		2.4		2.6	2.4		2.7		2.7			
BOQ		11.4		5.3	9.6		0.3		0.5			
QSRatio												

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: md
Agency:
Date: 1/3/2005
Period: pm
Project ID: 2007 Site+Background
E/W St: sth 158

Inter.: sth 158/greyhound access
Area Type: All other areas
Jurisd: wisdot
Year : 2007

N/S St: greyhound access

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	1	2	0	2	0	1	0	0	0
LGConfig		T		L	T		L		R			
Volume		655		465	910		20		10			
Lane Width		12.0		12.0	12.0		12.0		12.0			
RTOR Vol									0			

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left								
Thru		A						
Right								
Peds								
WB Left	A	A						
Thru	A	A						
Right								
Peds								
NB Right	A							
SB Right								
Green	20.0	45.0						
Yellow	3.0	4.5						
All Red	0.0	1.5						

NB Left	A							
Thru								
Right	A							
Peds								
SB Left								
Thru								
Right								
Peds								
EB Right								
WB Right								
	10.0							
	4.5							
	1.5							

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
T	1814	3627	0.39	0.50	14.1	B	14.1	B
Westbound								
L	682	1805	0.73	0.76	10.5	B		
T	2714	3592	0.36	0.76	3.8	A	6.1	A
Northbound								
L	389	3505	0.06	0.11	35.8	D	29.3	C
R	646	1615	0.02	0.40	16.3	B		
Southbound								

Intersection Delay = 9.0 (sec/veh) Intersection LOS = A

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/3/2005
Analysis Time Period: pm
Intersection: sth 158/greyhound access
Area Type: All other areas
Jurisdiction: wisdot
Analysis Year: 2007
Project ID: 2007 Site+Background
East/West Street: sth 158
North/South Street: greyhound access

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume		655		465	910		20		10			
% Heavy Veh		5		0	6		0		0			
PHF		0.93		0.93	0.93		0.93		0.93			
PK 15 Vol		176		125	245		5		3			
Hi Ln Vol								0				
% Grade		0			0		1900		1900			
Ideal Sat		2000		1900	2000							
ParkExist												
NumPark												
No. Lanes	0	2	0	1	2	0	2	0	1	0	0	0
LGConfig		T		L	T		L		R			
Lane Width		12.0		12.0	12.0		12.0		12.0			
RTOR Vol									0			
Adj Flow		704		500	978		22		11			
%InSharedLn												
Prop LTs		0.000		1.000	0.000							
Prop RTs		0.000			0.000				1.000			
Peds Bikes	0						0			0		
Buses		0		0	0		0		0			
%InProtPhase				0.0								

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0		0.0	0.0		0.0		0.0			
Arriv. Type		3		3	3		3		3			
Unit Ext.		3.0		3.0	3.0		3.0		3.0			
I Factor		1.000			1.000			1.000				
Lost Time		2.0		2.0	2.0		2.0		2.0			
Ext of g		2.0		2.0	2.0		2.0		2.0			
Ped Min g		3.2						3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4	5	6	7	8
EB Left								
Thru		A						
Right								
Peds								
WB Left	A	A						
Thru	A	A						
Right								
Peds								
NB Right	A							
SB Right								
Green	20.0	45.0						
Yellow	3.0	4.5						
All Red	0.0	1.5						

NB Left	A							
Thru								
Right	A							
Peds								
SB Left								
Thru								
Right								
Peds								
EB Right								
WB Right								
	10.0							
	4.5							
	1.5							

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V		655		465	910		20		10			
PHF		0.93		0.93	0.93		0.93		0.93			
Adj flow		704		500	978		22		11			
No. Lanes	0	2	0	1	2	0	2	0	1	0	0	0
Lane group		T		L	T		L		R			
Adj flow		704		500	978		22		11			
Prop LTs		0.000		1.000	0.000							
Prop RTs	0.000				0.000				1.000			

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	T			L	T		L		R			
So	2000			1900	2000		1900		1900			
Lanes 0	2	0		1	2	0	2	0	1	0	0	0
fW	1.000			1.000	1.000		1.000		1.000			
fHV	0.952			1.000	0.943		1.000		1.000			
fG	1.000			1.000	1.000		1.000		1.000			
fP	1.000			1.000	1.000		1.000		1.000			
fBB	1.000			1.000	1.000		1.000		1.000			
fA	1.000			1.000	1.000		1.000		1.000			
fLU	0.952			1.000	0.952		0.971		1.000			
fRT	1.000				1.000				0.850			
fLT	1.000			0.950	1.000		0.950					
Sec.				0.277								
fLpb	1.000			1.000	1.000		1.000					
fRpb	1.000				1.000				1.000			
S	3627			1805	3592		3505		1615			
Sec.				526								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	704	3627	# 0.19	0.50	1814	0.39
Right							
Westbound							
Prot		401	1805	# 0.22	0.222	401	1.00
Perm		99	526	0.19	0.533	281	0.35
Left	L	500			0.76	682	0.73
Prot							
Perm							
Thru	T	978	3592	0.27	0.76	2714	0.36
Right							
Northbound							
Prot							
Perm							
Left	L	22	3505	# 0.01	0.11	389	0.06
Prot							
Perm							
Thru							
Right	R	11	1615	0.01	0.40	646	0.02
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.42
Total lost time per cycle, L = 18.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.53

Control Delay and LOS Determination

Appr/ Lane Grp	v/c	g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
T	0.39	0.50	14.0	1.000	1814	0.11	0.1	0.0	14.1	B	14.1	B
Westbound												
L	0.73	0.76	6.4	1.000	682	0.29	4.1	0.0	10.5	B		
T	0.36	0.76	3.7	1.000	2714	0.11	0.1	0.0	3.8	A	6.1	A
Northbound												
L	0.06	0.11	35.8	1.000	389	0.11	0.1	0.0	35.8	D	29.3	C
R	0.02	0.40	16.3	1.000	646	0.11	0.0	0.0	16.3	B		
Southbound												

Intersection delay = 9.0 (sec/veh) Intersection LOS = A

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach		M		
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)		68.0		
Effective permitted green time for LT lane group, g(s)		48.0		
Opposing effective green time, go (s)		45.0		
Number of lanes in LT lane group, N		1		
Number of lanes in opposing approach, No		2		
Adjusted LT flow rate, VLT (veh/h)		500		
Proportion of LT in LT lane group, PLT		1.000		
Proportion of LT in opposing flow, PLTo		0.00		
Adjusted opposing flow rate, Vo (veh/h)		704		
Lost time for LT lane group, tL		6.00		
Computation				
LT volume per cycle, LTC=VLTC/3600		12.50		
Opposing lane util. factor, fLUo	0.952	0.952		
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		9.24		
gf=G[exp(- a * (LTC ** b)]-tl, gf<=g		0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.50		
gq, (see Exhibit C16-4,5,6,7,8)		11.63		
gu=g-gq if gq>=gf, or = g-gf if gq<gf		36.37		
n=Max(gq-gf)/2,0)		5.82		
PTHo=1-PLTo		1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00		
EL1 (refer to Exhibit C16-3)		2.74		
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.08		
gdiff=max(gq-gf,0)		0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.28		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.277		

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000		
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	0.952	0.952		
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b)]-tl, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 90.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v		500		
v/c ratio from Capacity Worksheet, X		0.73		
Protected phase effective green interval, g (s)		20.0		
Opposing queue effective green interval, gq		11.63		
Unopposed green interval, gu		36.37		
Red time r=(C-g-gq-gu)		22.0		
Arrival rate, qa=v/(3600(max[X,1.0]))		0.14		
Protected ph. departure rate, Sp=s/3600		0.501		
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)		0.19		
XPerm		0.95		
XProt		0.58		
Case		1		
Queue at beginning of green arrow, Qa		3.06		
Queue at beginning of unsaturated green, Qu		1.62		
Residual queue, Qr		0.00		
Uniform Delay, d1		6.4		

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 9.0 sec/veh Intersection LOS A

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	T		L	T	L	R		
Init Queue	0.0		0.0	0.0	0.0	0.0		
Flow Rate	369		500	513	11	11		
So	2000		1900	2000	1900	1900		
No.Lanes	2	0	1	2 0	2 0	1	0 0	0
SL	1904		902	1886	1805	1615		
LnCapacity	952		682	1425	200	646		
Flow Ratio	0.19		0.55	0.27	0.01	0.01		
v/c Ratio	0.39		0.73	0.36	0.05	0.02		
Grn Ratio	0.50		0.76	0.76	0.11	0.40		
I Factor	1.000			1.000	1.000			
AT or PVG	3		3	3	3	3		
Pltn Ratio	1.00		1.00	1.00	1.00	1.00		
PF2	1.00		1.00	1.00	1.00	1.00		
Q1	5.7		3.7	4.3	0.2	0.2		
kB	0.7		0.5	0.9	0.3	0.5		
Q2	0.4		1.4	0.5	0.0	0.0		
Q Average	6.1		5.1	4.8	0.3	0.2		
Q Spacing	25.0		25.0	25.0	25.0	25.0		
Q Storage	0		0	0	0	0		
Q S Ratio								
70th Percentile Output:								
fB%	1.2		1.2	1.2	1.2	1.2		
BOQ	7.3		6.0	5.7	0.3	0.2		
QSRatio								
85th Percentile Output:								
fB%	1.5		1.6	1.6	1.6	1.6		
BOQ	9.5		7.9	7.4	0.4	0.3		
QSRatio								
90th Percentile Output:								
fB%	1.7		1.7	1.7	1.8	1.8		
BOQ	10.4		8.7	8.2	0.5	0.3		
QSRatio								
95th Percentile Output:								
fB%	1.9		2.0	2.0	2.1	2.1		
BOQ	11.8		9.9	9.4	0.5	0.4		
QSRatio								
98th Percentile Output:								
fB%	2.3		2.4	2.4	2.7	2.7		
BOQ	14.3		12.0	11.4	0.7	0.5		
QSRatio								

ERROR MESSAGES

No errors to report.

HCS2000: Unsignalized Intersections Release 4.1d

TWO-WAY STOP CONTROL SUMMARY

Analyst: md
Agency/Co.:
Date Performed: 1/4/2005
Analysis Time Period: am
Intersection: sth 158/eastern frontage road
Jurisdiction: wisdot
Units: U. S. Customary
Analysis Year: 2007
Project ID: 2007 site+background
East/West Street: sth 158
North/South Street: eastern frontage road
Intersection Orientation: EW
Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1 L	2 T	3 R	4 L	5 T	6 R
Volume	20	620			460	1
Peak-Hour Factor, PHF	1.00	1.00			1.00	1.00
Hourly Flow Rate, HFR	20	620			460	1
Percent Heavy Vehicles	0	--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes	0	1			1	0
Configuration	LT				TR	
Upstream Signal?		No			No	

Minor Street: Approach	Northbound			Southbound		
Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume	5	35		5		10
Peak Hour Factor, PHF	1.00	1.00		1.00		1.00
Hourly Flow Rate, HFR	5	35		5		10
Percent Heavy Vehicles	0	0		0		0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/		No	/
Lanes	0	1		0	0	
Configuration	LT				LR	

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	LT		LT				LR	
v (vph)	20		40				15	
C(m) (vph)	1111		198				305	
v/c	0.02		0.20				0.05	
95% queue length	0.05		0.73				0.15	
Control Delay	8.3		27.7				17.4	
LOS	A		D				C	
Approach Delay				27.7			17.4	
Approach LOS				D			C	

HCS2000: Unsignalized Intersections Release 4.1d

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TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/4/2005
Analysis Time Period: am
Intersection: sth 158/eastern frontage road
Jurisdiction: wisdot
Units: U. S. Customary
Analysis Year: 2007
Project ID: 2007 site+background
East/West Street: sth 158
North/South Street: eastern frontage road
Intersection Orientation: EW
Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume	20	620			460	1
Peak-Hour Factor, PHF	1.00	1.00			1.00	1.00
Peak-15 Minute Volume	5	155			115	0
Hourly Flow Rate, HFR	20	620			460	1
Percent Heavy Vehicles	0	--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes	0	1			1	0
Configuration	LT				TR	
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume	5	35		5		10
Peak Hour Factor, PHF	1.00	1.00		1.00		1.00
Peak-15 Minute Volume	1	9		1		2
Hourly Flow Rate, HFR	5	35		5		10
Percent Heavy Vehicles	0	0		0		0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/		No	/
RT Channelized?						
Lanes	0	1		0	0	
Configuration	LT				LR	

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn							
Through							
S5 Left-Turn							
Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:	620	
Shared ln volume, major rt vehicles:	0	
Sat flow rate, major th vehicles:	1700	
Sat flow rate, major rt vehicles:	1700	
Number of major street through lanes:	1	

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)	4.1		7.1	6.5		7.1		6.2
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)	0		0	0		0		0
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Grade/100			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)			0.00	0.00		0.00		0.00
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage	4.1		7.1	6.5		7.1		6.2
2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20		3.50	4.00		3.50		3.30
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)	0		0	0		0		0
t(f)	2.2		3.5	4.0		3.5		3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2 V(t)	Movement 2 V(l,prot)	Movement 5 V(t)	Movement 5 V(l,prot)
V prog				
Total Saturation Flow Rate, s (vph)				
Arrival Type				
Effective Green, g (sec)				
Cycle Length, C (sec)				
Rp (from Exhibit 16-11)				
Proportion vehicles arriving on green P				
g(q1)				
g(q2)				
g(q)				

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2 V(t)	Movement 2 V(l,prot)	Movement 5 V(t)	Movement 5 V(l,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p		0.000		0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5
Single-Stage Process

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x	461		1126	1121		1138		460
s								
Px								
V c,u,x								

C r,x	
C plat,x	

Two-Stage Process	7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		1500		1500		1500		
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		460
Potential Capacity		605
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		605
Probability of Queue free St.	1.00	0.98
Step 2: LT from Major St.	4	1
Conflicting Flows		461
Potential Capacity		1111
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		1111
Probability of Queue free St.	1.00	0.98
Maj L-Shared Prob Q free St.		0.97
Step 3: TH from Minor St.	8	11
Conflicting Flows	1121	
Potential Capacity	208	
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.97	0.97
Movement Capacity	202	
Probability of Queue free St.	0.83	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows	1126	1138
Potential Capacity	184	180
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.97	0.80
Maj. L, Min T Adj. Imp Factor.	0.98	0.85
Cap. Adj. factor due to Impeding mvmnt	0.96	0.85
Movement Capacity	177	153

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	1121	
Potential Capacity	208	
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.97	0.97
Movement Capacity	202	
Result for 2 stage process:		
a		
y		
C t	202	
Probability of Queue free St.	0.83	1.00
Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	1126	1138
Potential Capacity	184	180
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.97	0.80
Maj. L, Min T Adj. Imp Factor.	0.98	0.85
Cap. Adj. factor due to Impeding mvmnt	0.96	0.85
Movement Capacity	177	153
Results for Two-stage process:		
a		
y		
C t	177	153

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	5	35		5		10
Movement Capacity (vph)	177	202		153		605
Shared Lane Capacity (vph)	198				305	

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	177	202		153		605
Volume	5	35		5		10
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh	198				305	
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	LT		LT				LR	
v (vph)	20		40				15	
C(m) (vph)	1111		198				305	
v/c	0.02		0.20				0.05	
95% queue length	0.05		0.73				0.15	
Control Delay	8.3		27.7				17.4	
LOS	A		D				C	
Approach Delay				27.7			17.4	
Approach LOS				D			C	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.98	1.00
v(i1), Volume for stream 2 or 5	620	
v(i2), Volume for stream 3 or 6	0	
s(i1), Saturation flow rate for stream 2 or 5	1700	
s(i2), Saturation flow rate for stream 3 or 6	1700	
$P^*(oj)$	0.97	
d(M,LT), Delay for stream 1 or 4	8.3	
N, Number of major street through lanes	1	
d(rank,1) Delay for stream 2 or 5	0.2	

HCS2000: Unsignalized Intersections Release 4.1d

TWO-WAY STOP CONTROL SUMMARY

Analyst: md
Agency/Co.:
Date Performed: 1/4/2005
Analysis Time Period: pm
Intersection: sth 158/eastern frontage road
Jurisdiction: wisdot
Units: U. S. Customary
Analysis Year: 2007
Project ID: 2007 site+background
East/West Street: sth 158
North/South Street: eastern frontage road
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	15	670			435	1
Peak-Hour Factor, PHF	1.00	1.00			1.00	1.00
Hourly Flow Rate, HFR	15	670			435	1
Percent Heavy Vehicles	0	--	--		--	--
Median Type/Storage	Undivided		/			
RT Channelized?						
Lanes	0	1			1	0
Configuration	LT					TR
Upstream Signal?		No			No	

Minor Street: Approach	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	30	65		5		5
Peak Hour Factor, PHF	1.00	1.00		1.00		1.00
Hourly Flow Rate, HFR	30	65		5		5
Percent Heavy Vehicles	0	0		0		0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/		No	/
Lanes	0	1		0	0	
Configuration	LT				LR	

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	LT		LT				LR	
v (vph)	15		95				10	
C(m) (vph)	1134		192				211	
v/c	0.01		0.49				0.05	
95% queue length	0.04		2.45				0.15	
Control Delay	8.2		40.8				22.9	
LOS	A		E				C	
Approach Delay				40.8			22.9	
Approach LOS				E			C	

HCS2000: Unsignalized Intersections Release 4.1d

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TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/4/2005
Analysis Time Period: pm
Intersection: sth 158/eastern frontage road
Jurisdiction: wisdot
Units: U. S. Customary
Analysis Year: 2007
Project ID: 2007 site+background
East/West Street: sth 158
North/South Street: eastern frontage road
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	15	670			435	1
Peak-Hour Factor, PHF	1.00	1.00			1.00	1.00
Peak-15 Minute Volume	4	168			109	0
Hourly Flow Rate, HFR	15	670			435	1
Percent Heavy Vehicles	0	--	--		--	--
Median Type/Storage	Undivided		/			
RT Channelized?						
Lanes	0	1			1	0
Configuration	LT					TR
Upstream Signal?		No			No	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	30	65		5		5
Peak Hour Factor, PHF	1.00	1.00		1.00		1.00
Peak-15 Minute Volume	8	16		1		1
Hourly Flow Rate, HFR	30	65		5		5
Percent Heavy Vehicles	0	0		0		0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/		No	/
RT Channelized?						
Lanes	0	1		0	0	
Configuration	LT				LR	

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn							
Through							
S5 Left-Turn							
Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:	670	
Shared ln volume, major rt vehicles:	0	
Sat flow rate, major th vehicles:	1700	
Sat flow rate, major rt vehicles:	1700	
Number of major street through lanes:	1	

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1	4	7	8	9	10	11	12
		L	L	L	T	R	L	T	R
t(c,base)		4.1		7.1	6.5		7.1		6.2
t(c,hv)		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		0		0	0		0		0
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Grade/100				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00		0.00	0.00		0.00		0.00
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage	4.1		7.1	6.5		7.1		6.2
	2-stage								

Follow-Up Time Calculations

Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)	2.20		3.50	4.00		3.50		3.30
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)	0		0	0		0		0
t(f)	2.2		3.5	4.0		3.5		3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2 V(t)	Movement 2 V(1,prot)	Movement 5 V(t)	Movement 5 V(1,prot)
V prog				
Total Saturation Flow Rate, s (vph)				
Arrival Type				
Effective Green, g (sec)				
Cycle Length, C (sec)				
Rp (from Exhibit 16-11)				
Proportion vehicles arriving on green P				
g(q1)				
g(q2)				
g(q)				

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2 V(t)	Movement 2 V(1,prot)	Movement 5 V(t)	Movement 5 V(1,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p		0.000		0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5
Single-Stage Process

Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
V c,x	436		1138	1136		1168		436
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		1500		1500		1500		
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		436
Potential Capacity		625
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		625
Probability of Queue free St.	1.00	0.99

Step 2: LT from Major St.	4	1
Conflicting Flows		436
Potential Capacity		1134
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		1134
Probability of Queue free St.	1.00	0.99
Maj L-Shared Prob Q free St.		0.98

Step 3: TH from Minor St.	8	11
Conflicting Flows	1136	
Potential Capacity	204	
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.98	0.98
Movement Capacity	200	
Probability of Queue free St.	0.68	1.00

Step 4: LT from Minor St.	7	10
Conflicting Flows	1138	1168
Potential Capacity	180	172
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.98	0.66
Maj. L, Min T Adj. Imp Factor.	0.98	0.74
Cap. Adj. factor due to Impeding mvmnt	0.98	0.74
Movement Capacity	176	127

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	1136	
Potential Capacity	204	
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.98	0.98
Movement Capacity	200	
Result for 2 stage process:		
a		
y		
C t	200	
Probability of Queue free St.	0.68	1.00

Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	1138	1168
Potential Capacity	180	172
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.98	0.66
Maj. L, Min T Adj. Imp Factor.	0.98	0.74
Cap. Adj. factor due to Impeding mvmnt	0.98	0.74
Movement Capacity	176	127
Results for Two-stage process:		
a		
y		
C t	176	127

Worksheet 8-Shared Lane Calculations

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (vph)	30	65		5		5
Movement Capacity (vph)	176	200		127		625
Shared Lane Capacity (vph)	192				211	

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
C sep	176	200		127		625
Volume	30	65		5		5
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh	192				211	
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	LT		LT				LR	
v (vph)	15		95				10	
C(m) (vph)	1134		192				211	
v/c	0.01		0.49				0.05	
95% queue length	0.04		2.45				0.15	
Control Delay	8.2		40.8				22.9	
LOS	A		E				C	
Approach Delay				40.8			22.9	
Approach LOS				E			C	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.99	1.00
v(i1), Volume for stream 2 or 5	670	
v(i2), Volume for stream 3 or 6	0	
s(i1), Saturation flow rate for stream 2 or 5	1700	
s(i2), Saturation flow rate for stream 3 or 6	1700	
P*(oj)	0.98	
d(M,LT), Delay for stream 1 or 4	8.2	
N, Number of major street through lanes	1	
d(rank,1) Delay for stream 2 or 5	0.2	

HCS2000: Unsignalized Intersections Release 4.1d

TWO-WAY STOP CONTROL SUMMARY

Analyst: md
Agency/Co.:
Date Performed: 1/4/2005
Analysis Time Period: am
Intersection: sth 158_Western Frontage Road
Jurisdiction: wisdot
Units: U. S. Customary
Analysis Year: 2007
Project ID: 2007 site+background
East/West Street: sth 158
North/South Street: western frontage road
Intersection Orientation: EW
Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1 L	2 T	3 R	4 L	5 T	6 R
Volume		570	30	70	405	
Peak-Hour Factor, PHF		1.00	1.00	1.00	1.00	
Hourly Flow Rate, HFR		570	30	70	405	
Percent Heavy Vehicles		--	--	0	--	--
Median Type/Storage	Undivided			/		
RT Channelized?			No			
Lanes		1	1		0	1
Configuration		T	R		LT	
Upstream Signal?		No			No	

Minor Street: Approach	Northbound			Southbound		
Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume	10		70			
Peak Hour Factor, PHF	1.00		1.00			
Hourly Flow Rate, HFR	10		70			
Percent Heavy Vehicles	0		0			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No	/		/
Lanes	0		0			
Configuration		LR				

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config		LT		LR				
v (vph)		70		80				
C(m) (vph)		987		445				
v/c		0.07		0.18				
95% queue length		0.23		0.65				
Control Delay		8.9		14.9				
LOS		A		B				
Approach Delay				14.9				
Approach LOS				B				

HCS2000: Unsignalized Intersections Release 4.1d

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TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/4/2005
Analysis Time Period: am
Intersection: sth 158_Western Frontage Road
Jurisdiction: wisdot
Units: U. S. Customary
Analysis Year: 2007
Project ID: 2007 site+background
East/West Street: sth 158
North/South Street: western frontage road
Intersection Orientation: EW
Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume		570	30	70	405	
Peak-Hour Factor, PHF		1.00	1.00	1.00	1.00	
Peak-15 Minute Volume		142	8	18	101	
Hourly Flow Rate, HFR		570	30	70	405	
Percent Heavy Vehicles		--	--	0	--	--
Median Type/Storage	Undivided			/		
RT Channelized?			No			
Lanes		1	1		0	1
Configuration		T	R		LT	
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume	10		70			
Peak Hour Factor, PHF	1.00		1.00			
Peak-15 Minute Volume	2		18			
Hourly Flow Rate, HFR	10		70			
Percent Heavy Vehicles	0		0			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No	/		/
RT Channelized?						
Lanes	0		0			
Configuration		LR				

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn							
Through							
S5 Left-Turn							
Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		405
Shared ln volume, major rt vehicles:		0
Sat flow rate, major th vehicles:		1700
Sat flow rate, major rt vehicles:		1700
Number of major street through lanes:		1

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)			4.1	7.1		6.2			
t(c,hv)		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)			0	0		0			
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Grade/100				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)			0.00	0.70		0.00			
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage		4.1	6.4		6.2			
	2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)		2.20	3.50		3.30			
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)		0	0		0			
t(f)		2.2	3.5		3.3			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2 V(t)	Movement 2 V(1,prot)	Movement 5 V(t)	Movement 5 V(1,prot)
V prog				
Total Saturation Flow Rate, s (vph)				
Arrival Type				
Effective Green, g (sec)				
Cycle Length, C (sec)				
Rp (from Exhibit 16-11)				
Proportion vehicles arriving on green P				
g(q1)				
g(q2)				
g(q)				

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2 V(t)	Movement 2 V(1,prot)	Movement 5 V(t)	Movement 5 V(1,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p		0.000		0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5

Single-Stage Process Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x		600	1115		570			
s								
Px								
V c,u,x								

C r,x	
C plat,x	

Two-Stage Process	7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		1500						
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	570	
Potential Capacity	525	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	525	
Probability of Queue free St.	0.87	1.00

Step 2: LT from Major St.	4	1
Conflicting Flows	600	
Potential Capacity	987	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	987	
Probability of Queue free St.	0.93	1.00
Maj L-Shared Prob Q free St.	0.91	

Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.91	0.91
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Conflicting Flows	1115	
Potential Capacity	232	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.91
Maj. L, Min T Adj. Imp Factor.		0.93
Cap. Adj. factor due to Impeding mvmnt	0.93	0.80
Movement Capacity	216	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.91	0.91
Movement Capacity		
Result for 2 stage process:		
a		
y		
C t		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	1115	
Potential Capacity	232	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.91
Maj. L, Min T Adj. Imp Factor.		0.93
Cap. Adj. factor due to Impeding mvmnt	0.93	0.80
Movement Capacity	216	
Results for Two-stage process:		
a		
y		
C t	216	

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	10		70			
Movement Capacity (vph)	216		525			
Shared Lane Capacity (vph)		445				

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	216		525			
Volume	10		70			
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh		445				
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		LT		LR				
v (vph)		70		80				
C(m) (vph)		987		445				
v/c		0.07		0.18				
95% queue length		0.23		0.65				
Control Delay		8.9		14.9				
LOS		A		B				
Approach Delay				14.9				
Approach LOS				B				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.93
v(i1), Volume for stream 2 or 5		405
v(i2), Volume for stream 3 or 6		0
s(i1), Saturation flow rate for stream 2 or 5		1700
s(i2), Saturation flow rate for stream 3 or 6		1700
P*(oj)		0.91
d(M,LT), Delay for stream 1 or 4		8.9
N, Number of major street through lanes		1
d(rank,1) Delay for stream 2 or 5		0.8

HCS2000: Unsignalized Intersections Release 4.1d

TWO-WAY STOP CONTROL SUMMARY

Analyst: md
Agency/Co.:
Date Performed: 1/4/2005
Analysis Time Period: pm
Intersection: sth 158_Western Frontage Road
Jurisdiction: wisdot
Units: U. S. Customary
Analysis Year: 2007
Project ID: 2007 site+background
East/West Street: sth 158
North/South Street: western frontage road
Intersection Orientation: EW
Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1 L	2 T	3 R	4 L	5 T	6 R
Volume		630	65	120	350	
Peak-Hour Factor, PHF		1.00	1.00	1.00	1.00	
Hourly Flow Rate, HFR		630	65	120	350	
Percent Heavy Vehicles		--	--	0	--	--
Median Type/Storage	Undivided			/		
RT Channelized?			No			
Lanes		1	1	0	1	
Configuration		T	R		LT	
Upstream Signal?		No			No	

Minor Street: Approach	Northbound			Southbound		
Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume	10		55			
Peak Hour Factor, PHF	1.00		1.00			
Hourly Flow Rate, HFR	10		55			
Percent Heavy Vehicles	0		0			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No	/		/
Lanes	0		0			
Configuration		LR				

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config		LT		LR				
v (vph)		120		65				
C(m) (vph)		910		380				
v/c		0.13		0.17				
95% queue length		0.45		0.61				
Control Delay		9.6		16.4				
LOS		A		C				
Approach Delay				16.4				
Approach LOS				C				

HCS2000: Unsignalized Intersections Release 4.1d

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TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/4/2005
Analysis Time Period: pm
Intersection: sth 158_Western Frontage Road
Jurisdiction: wisdot
Units: U. S. Customary
Analysis Year: 2007
Project ID: 2007 site+background
East/West Street: sth 158
North/South Street: western frontage road
Intersection Orientation: EW
Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume		630	65	120	350	
Peak-Hour Factor, PHF		1.00	1.00	1.00	1.00	
Peak-15 Minute Volume		158	16	30	88	
Hourly Flow Rate, HFR		630	65	120	350	
Percent Heavy Vehicles		--	--	0	--	--
Median Type/Storage	Undivided			/		
RT Channelized?			No			
Lanes		1	1	0	1	
Configuration		T	R		LT	
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume	10		55			
Peak Hour Factor, PHF	1.00		1.00			
Peak-15 Minute Volume	2		14			
Hourly Flow Rate, HFR	10		55			
Percent Heavy Vehicles	0		0			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No	/		/
RT Channelized?						
Lanes	0		0			
Configuration		LR				

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn							
Through							
S5 Left-Turn							
Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		350
Shared ln volume, major rt vehicles:		0
Sat flow rate, major th vehicles:		1700
Sat flow rate, major rt vehicles:		1700
Number of major street through lanes:		1

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)			4.1	7.1		6.2			
t(c,hv)		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)			0	0		0			
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Grade/100				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)			0.00	0.70		0.00			
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage		4.1	6.4		6.2			
	2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)		2.20	3.50		3.30			
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)		0	0		0			
t(f)		2.2	3.5		3.3			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2 V(t)	Movement 2 V(1,prot)	Movement 5 V(t)	Movement 5 V(1,prot)
V prog				
Total Saturation Flow Rate, s (vph)				
Arrival Type				
Effective Green, g (sec)				
Cycle Length, C (sec)				
Rp (from Exhibit 16-11)				
Proportion vehicles arriving on green P				
g(q1)				
g(q2)				
g(q)				

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2 V(t)	Movement 2 V(1,prot)	Movement 5 V(t)	Movement 5 V(1,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p		0.000		0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5
Single-Stage Process

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x		695	1220		630			
s								
Px								
V c,u,x								

C r,x	
C plat,x	

Two-Stage Process	7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		1500						
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	630	
Potential Capacity	485	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	485	
Probability of Queue free St.	0.89	1.00

Step 2: LT from Major St.	4	1
Conflicting Flows	695	
Potential Capacity	910	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	910	
Probability of Queue free St.	0.87	1.00
Maj L-Shared Prob Q free St.	0.83	

Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.83	0.83
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Conflicting Flows	1220	
Potential Capacity	201	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.83
Maj. L, Min T Adj. Imp Factor.		0.87
Cap. Adj. factor due to Impeding mvmnt	0.87	0.77
Movement Capacity	174	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.83	0.83
Movement Capacity		
Result for 2 stage process:		
a		
y		
C t		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	1220	
Potential Capacity	201	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.83
Maj. L, Min T Adj. Imp Factor.		0.87
Cap. Adj. factor due to Impeding mvmnt	0.87	0.77
Movement Capacity	174	
Results for Two-stage process:		
a		
y		
C t	174	

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	10		55			
Movement Capacity (vph)	174		485			
Shared Lane Capacity (vph)		380				

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	174		485			
Volume	10		55			
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh		380				
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		LT		LR				
v (vph)		120		65				
C(m) (vph)		910		380				
v/c		0.13		0.17				
95% queue length		0.45		0.61				
Control Delay		9.6		16.4				
LOS		A		C				
Approach Delay				16.4				
Approach LOS				C				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.87
v(i1), Volume for stream 2 or 5		350
v(i2), Volume for stream 3 or 6		0
s(i1), Saturation flow rate for stream 2 or 5		1700
s(i2), Saturation flow rate for stream 3 or 6		1700
P*(oj)		0.83
d(M,LT), Delay for stream 1 or 4		9.6
N, Number of major street through lanes		1
d(rank,1) Delay for stream 2 or 5		1.6

HCS2000: Signalized Intersections Release 4.1c

Analyst: md
Agency:
Date: 1/4/2005
Period: am
Project ID: 2007 site+background traffic
E/W St: cth k

Inter.: cth k/104th ave
Area Type: All other areas
Jurisd: kenosha county
Year : 2007
N/S St: 104th ave

SIGNALIZED INTERSECTION SUMMARY

	Eastbound L	Eastbound T	Eastbound R	Westbound L	Westbound T	Westbound R	Northbound L	Northbound T	Northbound R	Southbound L	Southbound T	Southbound R
No. Lanes		1	1	0	1	1	0	1	1	0	1	1	0
LGConfig	L		TR	L		TR	L		TR	L		TR
Volume	10	160	30	130	110	85	5	185	80	10	135	25
Lane Width	12.0	12.0		12.0	12.0		12.0	12.0		12.0	12.0	
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A	A			NB Left	A	A		
Thru		A			Thru		A		
Right		A			Right		A		
Peds					Peds				
WB Left	A	A			SB Left	A	A		
Thru		A			Thru		A		
Right		A			Right		A		
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	7.0	25.0				7.0	33.0		
Yellow	3.0	4.5				3.0	4.5		
All Red	0.0	1.5				0.0	1.5		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	360	1770	0.04	0.39	17.6	B		
TR	505	1819	0.48	0.28	27.8	C	27.3	C
Westbound								
L	364	1770	0.45	0.39	20.1	C		
TR	484	1741	0.51	0.28	28.3	C	25.0	C
Northbound								
L	513	1770	0.01	0.48	12.6	B		
TR	652	1779	0.51	0.37	22.9	C	22.8	C
Southbound								
L	404	1770	0.03	0.48	13.4	B		
TR	667	1819	0.30	0.37	20.6	C	20.1	C

Intersection Delay = 24.0 (sec/veh) Intersection LOS = C

HCS2000: Signalized Intersections Release 4.1c

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OPERATIONAL ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/4/2005
Analysis Time Period: am
Intersection: cth k/104th ave
Area Type: All other areas
Jurisdiction: kenosha county
Analysis Year: 2007
Project ID: 2007 site+background traffic
East/West Street: cth k
North/South Street: 104th ave

VOLUME DATA

	Eastbound L	Eastbound T	Eastbound R	Westbound L	Westbound T	Westbound R	Northbound L	Northbound T	Northbound R	Southbound L	Southbound T	Southbound R
Volume	10	160	30	130	110	85	5	185	80	10	135	25
% Heavy Veh	2	2	2	2	2	2	2	2	2	2	2	2
PHF	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79
PK 15 Vol	3	51	9	41	35	27	2	59	25	3	43	8
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900		1900	1900		1900	1900		1900	1900	
ParkExist												
NumPark												
No. Lanes		1	1	0	1	1	0	1	1	0	1	1	0
LGConfig	L		TR	L		TR	L		TR	L		TR
Lane Width	12.0	12.0		12.0	12.0		12.0	12.0		12.0	12.0	
RTOR Vol			0			0			0			0
Adj Flow	13	241		165	247		6	335		13	203	
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.158			0.437			0.301			0.158	
Peds		0			0			0			0	
Bikes												
Buses	0	0		0	0		0	0		0	0	
%InProtPhase	0.0			0.0			0.0			0.0		

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound L	Eastbound T	Eastbound R	Westbound L	Westbound T	Westbound R	Northbound L	Northbound T	Northbound R	Southbound L	Southbound T	Southbound R
Init Unmet	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Arriv. Type	3	3		3	3		3	3		3	3	
Unit Ext.	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Ext of g	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Ped Min g	3.2			3.2			3.2			3.2		

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A	A			NB Left	A	A		
Thru		A			Thru		A		
Right		A			Right		A		
Peds					Peds				
WB Left	A	A			SB Left	A	A		
Thru		A			Thru		A		
Right		A			Right		A		
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	7.0	25.0				7.0	33.0		
Yellow	3.0	4.5				3.0	4.5		
All Red	0.0	1.5				0.0	1.5		

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound L	Eastbound T	Eastbound R	Westbound L	Westbound T	Westbound R	Northbound L	Northbound T	Northbound R	Southbound L	Southbound T	Southbound R
Volume, V	10	160	30	130	110	85	5	185	80	10	135	25
PHF	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79
Adj flow	13	203	38	165	139	108	6	234	101	13	171	32
No. Lanes		1	1	0	1	1	0	1	1	0	1	1	0
Lane group	L		TR	L		TR	L		TR	L		TR
Adj flow	13	241		165	247		6	335		13	203	
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.158			0.437			0.301			0.158	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L	TR		L	TR		L	TR		L	TR	
So	1900	1900		1900	1900		1900	1900		1900	1900	
Lanes	1	1	0	1	1	0	1	1	0	1	1	0
fW	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fHV	0.980	0.980		0.980	0.980		0.980	0.980		0.980	0.980	
fG	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fP	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fBB	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fA	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fLU	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fRT		0.976			0.934			0.955			0.976	
fLT	0.950	1.000		0.950	1.000		0.950	1.000		0.950	1.000	
Sec.	0.382			0.390			0.504			0.357		
fLpb	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fRpb		1.000			1.000			1.000			1.000	
S	1770	1819		1770	1741		1770	1779		1770	1819	
Sec.	712			727			938			664		

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		13	1770	0.01	0.078	138	0.09
Perm		0	712	0.00	0.311	222	0.00
Left	L	13			0.39	360	0.04
Prot							
Perm							
Thru	TR	241	1819	0.13	0.28	505	0.48
Right							
Westbound							
Prot		138	1770	# 0.08	0.078	138	1.00
Perm		27	727	0.04	0.311	226	0.12
Left	L	165			0.39	364	0.45
Prot							
Perm							
Thru	TR	247	1741	# 0.14	0.28	484	0.51
Right							
Northbound							
Prot		6	1770	0.00	0.078	138	0.04
Perm		0	938	0.00	0.400	375	0.00
Left	L	6			0.48	513	0.01
Prot							
Perm							
Thru	TR	335	1779	# 0.19	0.37	652	0.51
Right							
Southbound							
Prot		13	1770	# 0.01	0.078	138	0.09
Perm		0	664	0.00	0.400	266	0.00
Left	L	13			0.48	404	0.03
Prot							
Perm							
Thru	TR	203	1819	0.11	0.37	667	0.30
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.42
Total lost time per cycle, L = 24.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.57

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	0.04	0.39	17.5	1.000	360	0.11	0.0	0.0	17.6	B		
TR	0.48	0.28	27.1	1.000	505	0.11	0.7	0.0	27.8	C	27.3	C
Westbound												
L	0.45	0.39	19.2	1.000	364	0.11	0.9	0.0	20.1	C		
TR	0.51	0.28	27.3	1.000	484	0.12	0.9	0.0	28.3	C	25.0	C
Northbound												
L	0.01	0.48	12.6	1.000	513	0.11	0.0	0.0	12.6	B		
TR	0.51	0.37	22.2	1.000	652	0.12	0.7	0.0	22.9	C	22.8	C
Southbound												
L	0.03	0.48	13.3	1.000	404	0.11	0.0	0.0	13.4	B		

TR	0.30	0.37	20.3	1.000	667	0.11	0.3	0.0	20.6	C	20.1	C

Intersection delay = 24.0 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M	M	M
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	35.0	35.0	43.0	43.0
Effective permitted green time for LT lane group, g(s)	28.0	28.0	36.0	36.0
Opposing effective green time, go (s)	25.0	25.0	33.0	33.0
Number of lanes in LT lane group, N	1	1	1	1
Number of lanes in opposing approach, No	1	1	1	1
Adjusted LT flow rate, VLT (veh/h)	13	165	6	13
Proportion of LT in LT lane group, PLT	1.000	1.000	1.000	1.000
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	247	241	203	335
Lost time for LT lane group, tL	6.00	6.00	6.00	6.00
Computation				
LT volume per cycle, LTC=VLTC/3600	0.33	4.13	0.15	0.33
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	6.18	6.03	5.07	8.38
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g	0.0	0.0	0.0	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.72	0.72	0.63	0.63
gq, (see Exhibit C16-4,5,6,7,8)	10.34	10.05	7.25	13.03
gu=g-gq if gq>=gf, or = g-gf if gq<gf	17.66	17.95	28.75	22.97
n=Max(gq-gf)/2,0)	5.17	5.02	3.62	6.52
PTHo=1-PLTo	1.00	1.00	1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00	1.00	1.00
EL1 (refer to Exhibit C16-3)	1.65	1.64	1.59	1.79
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.14	0.14	0.11	0.11
gdiff=max(gq-gf,0)	0.00	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.38	0.39	0.50	0.36
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.382	0.390	0.504	0.357

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000	0.000	0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 90.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v	13	165	6	13
v/c ratio from Capacity Worksheet, X	0.04	0.45	0.01	0.03
Protected phase effective green interval, g (s)	7.0	7.0	7.0	7.0
Opposing queue effective green interval, gq	10.34	10.05	7.25	13.03
Unopposed green interval, gu	17.66	17.95	28.75	22.97
Red time r=(C-g-gq-gu)	55.0	55.0	47.0	47.0
Arrival rate, qa=v/(3600(max[X,1.0]))	0.00	0.05	0.00	0.00
Protected ph. departure rate, Sp=s/3600	0.492	0.492	0.492	0.492
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.31	0.31	0.33	0.29
XPerm	0.02	0.23	0.01	0.02
XProt	0.07	0.83	0.03	0.06
Case	1	1	1	1
Queue at beginning of green arrow, Qa	0.20	2.52	0.08	0.17
Queue at beginning of unsaturated green, Qu	0.04	0.46	0.01	0.05
Residual queue, Qr	0.00	0.00	0.00	0.00
Uniform Delay, d1	17.5	19.2	12.6	13.3

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 24.0 sec/veh Intersection LOS C

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	L	TR	L	TR	L	TR	L	TR
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	13	241	165	247	6	335	13	203
So	1900	1900	1900	1900	1900	1900	1900	1900
No.Lanes	1	1 0	1	1 0	1	1 0	1	1 0
SL	924	1819	936	1741	1073	1779	844	1819
LnCapacity	360	505	364	484	513	652	404	667
Flow Ratio	0.01	0.13	0.18	0.14	0.01	0.19	0.02	0.11
v/c Ratio	0.04	0.48	0.45	0.51	0.01	0.51	0.03	0.30
Grn Ratio	0.39	0.28	0.39	0.28	0.48	0.37	0.48	0.37
I Factor		1.000		1.000		1.000		1.000
AT or PVG	3	3	3	3	3	3	3	3
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Q1	0.2	5.0	2.6	5.2	0.1	6.5	0.2	3.6
kB	0.4	0.5	0.4	0.4	0.5	0.5	0.4	0.5
Q2	0.0	0.4	0.3	0.5	0.0	0.6	0.0	0.2
Q Average	0.2	5.4	2.9	5.7	0.1	7.1	0.2	3.9
Q Spacing	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0
Q Storage	0	0	0	0	0	0	0	0
Q S Ratio								
70th Percentile Output:								
fB%	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
BOQ	0.3	6.4	3.5	6.7	0.1	8.4	0.2	4.6
QSRatio								
85th Percentile Output:								
fB%	1.6	1.6	1.6	1.5	1.6	1.5	1.6	1.6
BOQ	0.3	8.4	4.6	8.8	0.1	10.9	0.3	6.0
QSRatio								
90th Percentile Output:								
fB%	1.8	1.7	1.7	1.7	1.8	1.7	1.8	1.7
BOQ	0.4	9.3	5.1	9.6	0.2	11.9	0.3	6.7
QSRatio								
95th Percentile Output:								
fB%	2.1	1.9	2.0	1.9	2.1	1.9	2.1	2.0
BOQ	0.4	10.6	5.9	11.0	0.2	13.5	0.4	7.6
QSRatio								
98th Percentile Output:								
fB%	2.7	2.4	2.5	2.3	2.7	2.3	2.7	2.4
BOQ	0.6	12.8	7.3	13.3	0.2	16.2	0.5	9.4
QSRatio								

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: md
Agency:
Date: 1/4/2005
Period: pm
Project ID: 2007 site+background traffic
E/W St: cth k

Inter.: cth k/104th ave
Area Type: All other areas
Jurisd: kenosha county
Year : 2007
N/S St: 104th ave

SIGNALIZED INTERSECTION SUMMARY

	Eastbound L	Eastbound T	Eastbound R	Westbound L	Westbound T	Westbound R	Northbound L	Northbound T	Northbound R	Southbound L	Southbound T	Southbound R
No. Lanes	1	1	0	1	1	0	1	1	0	1	1	0
LGConfig	L	TR		L	TR		L	TR		L	TR	
Volume	10	215	20	140	175	130	15	245	90	30	135	25
Lane Width	12.0	12.0		12.0	12.0		12.0	12.0		12.0	12.0	
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A	A			NB Left	A	A		
Thru		A			Thru		A		
Right		A			Right		A		
Peds					Peds				
WB Left	A	A			SB Left	A	A		
Thru		A			Thru		A		
Right		A			Right		A		
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	7.0	25.0				7.0	33.0		
Yellow	3.0	4.5				3.0	4.5		
All Red	0.0	1.5				0.0	1.5		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	271	1770	0.04	0.39	18.5	B		
TR	511	1839	0.54	0.28	28.8	C	28.4	C
Westbound								
L	335	1770	0.49	0.39	20.6	C		
TR	484	1744	0.74	0.28	35.6	D	30.9	C
Northbound								
L	526	1770	0.03	0.48	12.7	B		
TR	656	1788	0.60	0.37	24.7	C	24.2	C
Southbound								
L	358	1770	0.10	0.48	14.1	B		
TR	667	1820	0.28	0.37	20.4	C	19.4	B

Intersection Delay = 26.7 (sec/veh) Intersection LOS = C

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/4/2005
Analysis Time Period: pm
Intersection: cth k/104th ave
Area Type: All other areas
Jurisdiction: kenosha county
Analysis Year: 2007
Project ID: 2007 site+background traffic

East/West Street: cth k
North/South Street: 104th ave

VOLUME DATA

	Eastbound L	Eastbound T	Eastbound R	Westbound L	Westbound T	Westbound R	Northbound L	Northbound T	Northbound R	Southbound L	Southbound T	Southbound R
Volume	10	215	20	140	175	130	15	245	90	30	135	25
% Heavy Veh	2	2	2	2	2	2	2	2	2	2	2	2
PHF	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
PK 15 Vol	3	63	6	41	51	38	4	72	26	9	40	7
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900		1900	1900		1900	1900		1900	1900	
ParkExist												
NumPark												
No. Lanes	1	1	0	1	1	0	1	1	0	1	1	0
LGConfig	L	TR		L	TR		L	TR		L	TR	
Lane Width	12.0	12.0		12.0	12.0		12.0	12.0		12.0	12.0	
RTOR Vol			0			0			0			0
Adj Flow	12	277		165	359		18	394		35	188	
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.087			0.426			0.269			0.154	
Peds Bikes	0			0			0			0		
Buses	0	0		0	0		0	0		0	0	
%InProtPhase	0.0			0.0			0.0			0.0		

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound L	Eastbound T	Eastbound R	Westbound L	Westbound T	Westbound R	Northbound L	Northbound T	Northbound R	Southbound L	Southbound T	Southbound R
Init Unmet	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Arriv. Type	3	3		3	3		3	3		3	3	
Unit Ext.	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Ext of g	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Ped Min g	3.2			3.2			3.2			3.2		

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A	A			NB Left	A	A		
Thru		A			Thru		A		
Right		A			Right		A		
Peds					Peds				
WB Left	A	A			SB Left	A	A		
Thru		A			Thru		A		
Right		A			Right		A		
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	7.0	25.0				7.0	33.0		
Yellow	3.0	4.5				3.0	4.5		
All Red	0.0	1.5				0.0	1.5		

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound L	Eastbound T	Eastbound R	Westbound L	Westbound T	Westbound R	Northbound L	Northbound T	Northbound R	Southbound L	Southbound T	Southbound R
Volume, V	10	215	20	140	175	130	15	245	90	30	135	25
PHF	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Adj flow	12	253	24	165	206	153	18	288	106	35	159	29
No. Lanes	1	1	0	1	1	0	1	1	0	1	1	0
Lane group	L	TR		L	TR		L	TR		L	TR	
Adj flow	12	277		165	359		18	394		35	188	
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.087			0.426			0.269			0.154	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound L	Eastbound TR		Westbound L	Westbound TR		Northbound L	Northbound TR		Southbound L	Southbound TR	
So	1900	1900		1900	1900		1900	1900		1900	1900	
Lanes	1	1	0	1	1	0	1	1	0	1	1	0
fW	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fHV	0.980	0.980		0.980	0.980		0.980	0.980		0.980	0.980	
fG	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fP	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fBB	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fA	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fLU	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fRT		0.987			0.936			0.960			0.977	
fLT	0.950	1.000		0.950	1.000		0.950	1.000		0.950	1.000	
Sec.	0.231			0.340			0.521			0.295		
fLpb	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fRpb		1.000			1.000			1.000			1.000	
S	1770	1839		1770	1744		1770	1788		1770	1820	
Sec.	429			634			971			549		

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	Lane Group Capacity (c)	v/c Ratio
Eastbound							
Prot		12	1770	0.01	0.078	138	0.09
Perm		0	429	0.00	0.311	133	0.00
Left	L	12			0.39	271	0.04
Prot							
Perm							
Thru	TR	277	1839	0.15	0.28	511	0.54
Right							
Westbound							
Prot		138	1770	# 0.08	0.078	138	1.00
Perm		27	634	0.04	0.311	197	0.14
Left	L	165			0.39	335	0.49
Prot							
Perm							
Thru	TR	359	1744	# 0.21	0.28	484	0.74
Right							
Northbound							
Prot		18	1770	0.01	0.078	138	0.13
Perm		0	971	0.00	0.400	388	0.00
Left	L	18			0.48	526	0.03
Prot							
Perm							
Thru	TR	394	1788	# 0.22	0.37	656	0.60
Right							
Southbound							
Prot		35	1770	# 0.02	0.078	138	0.25
Perm		0	549	0.00	0.400	220	0.00
Left	L	35			0.48	358	0.10
Prot							
Perm							
Thru	TR	188	1820	0.10	0.37	667	0.28
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.52
Total lost time per cycle, L = 24.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.71

Control Delay and LOS Determination

Appr/ Lane Grp	v/c	g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	0.04	0.39	18.4	1.000	271	0.11	0.1	0.0	18.5	B		
TR	0.54	0.28	27.6	1.000	511	0.14	1.2	0.0	28.8	C	28.4	C
Westbound												
L	0.49	0.39	19.4	1.000	335	0.11	1.1	0.0	20.6	C		
TR	0.74	0.28	29.6	1.000	484	0.30	6.1	0.0	35.6	D	30.9	C
Northbound												
L	0.03	0.48	12.6	1.000	526	0.11	0.0	0.0	12.7	B		
TR	0.60	0.37	23.1	1.000	656	0.19	1.5	0.0	24.7	C	24.2	C
Southbound												
L	0.10	0.48	14.0	1.000	358	0.11	0.1	0.0	14.1	B		

TR	0.28	0.37	20.1	1.000	667	0.11	0.2	0.0	20.4	C	19.4	B

Intersection delay = 26.7 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M	M	M
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	35.0	35.0	43.0	43.0
Effective permitted green time for LT lane group, g(s)	28.0	28.0	36.0	36.0
Opposing effective green time, go (s)	25.0	25.0	33.0	33.0
Number of lanes in LT lane group, N	1	1	1	1
Number of lanes in opposing approach, No	1	1	1	1
Adjusted LT flow rate, VLT (veh/h)	12	165	18	35
Proportion of LT in LT lane group, PLT	1.000	1.000	1.000	1.000
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	359	277	188	394
Lost time for LT lane group, tL	6.00	6.00	6.00	6.00
Computation				
LT volume per cycle, LTC=VLTC/3600	0.30	4.13	0.45	0.88
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	8.98	6.93	4.70	9.85
gf=G[exp(- a * (LTC ** b)]-tl, gf<=g	0.0	0.0	0.0	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, qro=Max(1-Rpo(go/C),0)	0.72	0.72	0.63	0.63
gq, (see Exhibit C16-4,5,6,7,8)	16.19	11.82	6.65	15.97
gu=g-gq if gq>=gf, or = g-gf if gq<gf	11.81	16.18	29.35	20.03
n=Max(gq-gf)/2,0)	8.10	5.91	3.32	7.99
PTHo=1-PLTo	1.00	1.00	1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00	1.00	1.00
EL1 (refer to Exhibit C16-3)	1.83	1.70	1.56	1.89
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.14	0.14	0.11	0.11
gdiff=max(gq-gf,0)	0.00	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.23	0.34	0.52	0.29
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.231	0.340	0.521	0.295

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000	0.000	0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b)]-tl, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max(1-Rpo(go/C),0)				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 90.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v	12	165	18	35
v/c ratio from Capacity Worksheet, X	0.04	0.49	0.03	0.10
Protected phase effective green interval, g (s)	7.0	7.0	7.0	7.0
Opposing queue effective green interval, gq	16.19	11.82	6.65	15.97
Unopposed green interval, gu	11.81	16.18	29.35	20.03
Red time r=(C-g-gq-gu)	55.0	55.0	47.0	47.0
Arrival rate, qa=v/(3600(max[X,1.0]))	0.00	0.05	0.00	0.01
Protected ph. departure rate, Sp=s/3600	0.492	0.492	0.492	0.492
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.28	0.30	0.33	0.27
XPerm	0.03	0.26	0.02	0.06
XProt	0.06	0.83	0.08	0.15
Case	1	1	1	1
Queue at beginning of green arrow, Qa	0.18	2.52	0.23	0.46
Queue at beginning of unsaturated green, Qu	0.05	0.54	0.03	0.16
Residual queue, Qr	0.00	0.00	0.00	0.00
Uniform Delay, d1	18.4	19.4	12.6	14.0

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Dur. Unmet Demand Q veh	Unmet Demand t hrs.	Uniform Delay Unadj. ds	Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 26.7 sec/veh Intersection LOS C

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	L	TR	L	TR	L	TR	L	TR
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	12	277	165	359	18	394	35	188
So	1900	1900	1900	1900	1900	1900	1900	1900
No.Lanes	1	1 0	1	1 0	1	1 0	1	1 0
SL	697	1839	861	1744	1101	1788	748	1820
LnCapacity	271	511	335	484	526	656	358	667
Flow Ratio	0.02	0.15	0.19	0.21	0.02	0.22	0.05	0.10
v/c Ratio	0.04	0.54	0.49	0.74	0.03	0.60	0.10	0.28
Grn Ratio	0.39	0.28	0.39	0.28	0.48	0.37	0.48	0.37
I Factor		1.000		1.000		1.000		1.000
AT or PVG	3	3	3	3	3	3	3	3
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Q1	0.2	5.9	2.6	8.2	0.2	8.0	0.5	3.3
kB	0.3	0.5	0.4	0.4	0.5	0.5	0.4	0.5
Q2	0.0	0.5	0.3	1.2	0.0	0.8	0.0	0.2
Q Average	0.2	6.4	3.0	9.4	0.3	8.8	0.5	3.5
Q Spacing	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0
Q Storage	0	0	0	0	0	0	0	0
Q S Ratio								
70th Percentile Output:								
fB%	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
BOQ	0.2	7.6	3.5	11.0	0.3	10.4	0.6	4.2
QSRatio								
85th Percentile Output:								
fB%	1.6	1.5	1.6	1.5	1.6	1.5	1.6	1.6
BOQ	0.3	9.9	4.7	14.2	0.4	13.4	0.8	5.5
QSRatio								
90th Percentile Output:								
fB%	1.8	1.7	1.7	1.7	1.8	1.7	1.8	1.7
BOQ	0.4	10.9	5.2	15.4	0.5	14.6	0.9	6.1
QSRatio								
95th Percentile Output:								
fB%	2.1	1.9	2.0	1.9	2.1	1.9	2.1	2.0
BOQ	0.4	12.3	6.0	17.4	0.5	16.4	1.0	7.0
QSRatio								
98th Percentile Output:								
fB%	2.7	2.3	2.5	2.2	2.7	2.2	2.7	2.5
BOQ	0.5	14.8	7.4	20.5	0.7	19.4	1.3	8.7
QSRatio								

ERROR MESSAGES

No errors to report.

HCS2000: Unsignalized Intersections Release 4.1d

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ALL-WAY STOP CONTROL(AWSC) ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/4/2005
Analysis Time Period: am
Intersection: cth k/eastern frontage road
Jurisdiction: kenosha county
Units: U. S. Customary
Analysis Year: 2007
Project ID: 2007 site+background
East/West Street: cth k
North/South Street: eastern frontage road

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	10	120	25	45	60	5	5	75	80	1	1	1

% Thrus Left Lane

	Eastbound L1	Eastbound L2	Westbound L1	Westbound L2	Northbound L1	Northbound L2	Southbound L1	Southbound L2
Configuration	LTR		LTR		LTR		LTR	
PHF	1.00		1.00		1.00		1.00	
Flow Rate	155		110		160		3	
% Heavy Veh	0		0		0		0	
No. Lanes	1		1		1		1	
Opposing-Lanes	1		1		1		1	
Conflicting-lanes	1		1		1		1	
Geometry group	1		1		1		1	

Duration, T 0.25 hrs.

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound L1	Eastbound L2	Westbound L1	Westbound L2	Northbound L1	Northbound L2	Southbound L1	Southbound L2
Flow Rates:								
Total in Lane	155		110		160		3	
Left-Turn	10		45		5		1	
Right-Turn	25		5		80		1	
Prop. Left-Turns	0.1		0.4		0.0		0.3	
Prop. Right-Turns	0.2		0.0		0.5		0.3	
Prop. Heavy Vehicle	0.0		0.0		0.0		0.0	
Geometry Group	1		1		1		1	
Adjustments Exhibit 17-33:								
hLT-adj	0.2		0.2		0.2		0.2	
hRT-adj	-0.6		-0.6		-0.6		-0.6	
hHV-adj	1.7		1.7		1.7		1.7	
hadj, computed	-0.1		0.1		-0.3		-0.1	

Worksheet 4 - Departure Headway and Service Time

	Eastbound L1	Eastbound L2	Westbound L1	Westbound L2	Northbound L1	Northbound L2	Southbound L1	Southbound L2
Flow rate	155		110		160		3	
hd, initial value	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20
x, initial	0.14		0.10		0.14		0.00	
hd, final value	4.31		4.49		4.22		4.56	
x, final value	0.19		0.14		0.19		0.00	
Move-up time, m	2.0		2.0		2.0		2.0	
Service Time	2.3		2.5		2.2		2.6	

Worksheet 5 - Capacity and Level of Service

	Eastbound L1	Eastbound L2	Westbound L1	Westbound L2	Northbound L1	Northbound L2	Southbound L1	Southbound L2
Flow Rate	155		110		160		3	
Service Time	2.3		2.5		2.2		2.6	
Utilization, x	0.19		0.14		0.19		0.00	
Dep. headway, hd	4.31		4.49		4.22		4.56	
Capacity	405		360		410		253	
Delay	8.29		8.21		8.19		7.58	
LOS	A		A		A		A	
Approach:								
Delay	8.29		8.21		8.19		7.58	
LOS	A		A		A		A	

Intersection Delay 8.23 Intersection LOS A

HCS2000: Unsignalized Intersections Release 4.1d

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Jurisdiction: kenosha county
Units: U. S. Customary
Analysis Year: 2007
Project ID: 2007 site+background
East/West Street: cth k
North/South Street: eastern frontage road

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	25	145	60	60	135	20	15	115	95	10	5	10
% Thrus Left Lane												

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	LTR		LTR		LTR		LTR	
PHF	1.00		1.00		1.00		1.00	
Flow Rate	230		215		225		25	
% Heavy Veh	0		0		0		0	
No. Lanes		1		1		1		1
Opposing-Lanes		1		1		1		1
Conflicting-lanes		1		1		1		1
Geometry group		1		1		1		1

Duration, T 0.25 hrs.

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	230		215		225		25	
Left-Turn	25		60		15		10	
Right-Turn	60		20		95		10	
Prop. Left-Turns	0.1		0.3		0.1		0.4	
Prop. Right-Turns	0.3		0.1		0.4		0.4	
Prop. Heavy Vehicle	0.0		0.0		0.0		0.0	
Geometry Group		1		1		1		1
Adjustments Exhibit 17-33:								
hLT-adj		0.2		0.2		0.2		0.2
hRT-adj		-0.6		-0.6		-0.6		-0.6
hHV-adj		1.7		1.7		1.7		1.7
hadj, computed	-0.1		0.0		-0.2		-0.2	

Worksheet 4 - Departure Headway and Service Time

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow rate	230		215		225		25	
hd, initial value	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20
x, initial	0.20		0.19		0.20		0.02	
hd, final value	4.69		4.84		4.78		5.17	
x, final value	0.30		0.29		0.30		0.04	
Move-up time, m		2.0		2.0		2.0		2.0
Service Time	2.7		2.8		2.8		3.2	

Worksheet 5 - Capacity and Level of Service

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rate	230		215		225		25	
Service Time	2.7		2.8		2.8		3.2	
Utilization, x	0.30		0.29		0.30		0.04	
Dep. headway, hd	4.69		4.84		4.78		5.17	
Capacity	480		465		475		275	
Delay	9.68		9.79		9.81		8.36	
LOS	A		A		A		A	
Approach:								
Delay		9.68		9.79		9.81		8.36
LOS		A		A		A		A

Intersection Delay 9.71 Intersection LOS A

HCS2000: Signalized Intersections Release 4.1e

Analyst: md
Agency:
Date: 1/3/2005
Period: am
Project ID: 2007 Site+Background
E/W St: Southern Access Drive

Inter.: 104th Ave/Southern Access Driv
Area Type: All other areas
Jurisd: Kenosha
Year : 2007

N/S St: 104th Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound L	T	R	Westbound L	T	R	Northbound L	T	R	Southbound L	T	R
No. Lanes	2	0	0	0	0	0	1	1	0	0	1	1
LGConfig	L						L	T			T	R
Volume	500						1	280			170	1
Lane Width	12.0						12.0	12.0			12.0	12.0
RTOR Vol												0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4			5	6	7	8
EB Left	A				NB	Left	A	A		
Thru						Thru	A	A		
Right						Right				
Peds						Peds				
WB Left					SB	Left				
Thru						Thru		A		
Right						Right		A		
Peds						Peds				
NB Right					EB	Right				
SB Right	A				WB	Right				
Green	30.0						5.0	40.0		
Yellow	4.5						3.0	4.5		
All Red	1.5						0.0	1.5		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group	Adj Sat Flow Rate (s)	Ratios v/c	g/C	Lane Group Delay	LOS	Approach Delay	LOS
Eastbound								
L	1168	3505	0.50	0.33	24.4	C	24.4	C
Westbound								
Northbound								
L	566	1805	0.00	0.53	10.0+	B		
T	1046	1961	0.31	0.53	11.9	B	11.9	B
Southbound								
T	872	1961	0.23	0.44	15.6	B	15.5	B
R	1364	1615	0.00	0.84	1.1	A		

Intersection Delay = 19.1 (sec/veh) Intersection LOS = B

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/3/2005
Analysis Time Period: am
Intersection: 104th Ave/Southern Access Driv
Area Type: All other areas
Jurisdiction: Kenosha
Analysis Year: 2007
Project ID: 2007 Site+Background
East/West Street: Southern Access Drive
North/South Street: 104th Avenue

VOLUME DATA

	Eastbound L	T	R	Westbound L	T	R	Northbound L	T	R	Southbound L	T	R
Volume	500						1	280			170	1
% Heavy Veh	0						0	2			2	0
PHF	0.85						0.85	0.85			0.85	0.85
PK 15 Vol	147						1	82			50	1
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat	1900						1900	2000			2000	1900
ParkExist												
NumPark												
No. Lanes	2	0	0	0	0	0	1	1	0	0	1	1
LGConfig	L						L	T			T	R
Lane Width	12.0						12.0	12.0			12.0	12.0
RTOR Vol												0
Adj Flow	588						1	329			200	1
%InSharedLn												
Prop LTs							1.000	0.000			0.000	
Prop RTs								0.000			0.000	1.000
Peds Bikes				0							0	
Buses	0						0	0			0	0
%InProtPhase							0.0					

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound L	T	R	Westbound L	T	R	Northbound L	T	R	Southbound L	T	R
Init Unmet	0.0						0.0	0.0			0.0	0.0
Arriv. Type	3						3	3			3	3
Unit Ext.	3.0						3.0	3.0			3.0	3.0
I Factor		1.000						1.000			1.000	
Lost Time	2.0						2.0	2.0			2.0	2.0
Ext of g	2.0						2.0	2.0			2.0	2.0
Ped Min g					3.2						3.2	

PHASE DATA

Phase Combination	1	2	3	4			5	6	7	8
EB Left	A				NB	Left	A	A		
Thru						Thru	A	A		
Right						Right				
Peds						Peds				
WB Left					SB	Left				
Thru						Thru		A		
Right						Right		A		
Peds						Peds				
NB Right					EB	Right				
SB Right	A				WB	Right				
Green	30.0						5.0	40.0		
Yellow	4.5						3.0	4.5		
All Red	1.5						0.0	1.5		

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound L	T	R	Westbound L	T	R	Northbound L	T	R	Southbound L	T	R
Volume, V	500						1	280			170	1
PHF	0.85						0.85	0.85			0.85	0.85
Adj flow	588						1	329			200	1
No. Lanes	2	0	0	0	0	0	1	1	0	0	1	1
Lane group	L						L	T			T	R
Adj flow	588						1	329			200	1
Prop LTs							1.000	0.000			0.000	
Prop RTs								0.000			0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L						L	T			T	R
So	1900						1900	2000			2000	1900
Lanes	2	0	0	0	0	0	1	1	0	0	1	1
fW	1.000						1.000	1.000			1.000	1.000
fHV	1.000						1.000	0.980			0.980	1.000
fG	1.000						1.000	1.000			1.000	1.000
fP	1.000						1.000	1.000			1.000	1.000
fBB	1.000						1.000	1.000			1.000	1.000
fA	1.000						1.000	1.000			1.000	1.000
fLU	0.971						1.000	1.000			1.000	0.850
fRT								1.000			1.000	
fLT	0.950						0.950	1.000				
Sec.							0.513					
fLpb	1.000						1.000	1.000			1.000	
fRpb								1.000			1.000	1.000
S	3505						1805	1961			1961	1615
Sec.							975					

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	588	3505	# 0.17	0.33	1168	0.50
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot		1	1805	0.00	0.056	100	0.01
Perm		0	975	0.00	0.478	466	0.00
Left	L	1			0.53	566	0.00
Prot							
Perm							
Thru	T	329	1961	# 0.17	0.53	1046	0.31
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	200	1961	0.10	0.44	872	0.23
Right	R	1	1615	0.00	0.84	1364	0.00

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.34
Total lost time per cycle, L = 12.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.39

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group Delay	LOS	Approach Delay	LOS
Eastbound												
L	0.50	0.33	24.0	1.000	1168	0.11	0.4	0.0	24.4	C	24.4	C
Westbound												
Northbound												
L	0.00	0.53	10.0	1.000	566	0.11	0.0	0.0	10.0+	B		
T	0.31	0.53	11.8	1.000	1046	0.11	0.2	0.0	11.9	B	11.9	B
Southbound												

T	C.23	0.44	15.5	1.000	872	0.11	0.1	0.0	15.6	B	15.5	B
R	C.00	0.84	1.1	1.000	1364	0.11	0.0	0.0	1.1	A		

Intersection delay = 19.1 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach			M	
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)			48.0	
Effective permitted green time for LT lane group, g(s)			43.0	
Opposing effective green time, go (s)			40.0	
Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			1	
Adjusted LT flow rate, VLT (veh/h)			1	
Proportion of LT in LT lane group, PLT			1.000	
Proportion of LT in opposing flow, PLTo			0.00	
Adjusted opposing flow rate, Vo (veh/h)			200	
Lost time for LT lane group, tL			6.00	
Computation				
LT volume per cycle, LTC=VLTC/3600			0.03	
Opposing lane util. factor, fLUo			1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			5.00	
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.56	
gq, (see Exhibit C16-4,5,6,7,8)			6.25	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			36.75	
n=Max(gq-gf)/2,0)			3.13	
PTHo=1-PLTo			1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	
EL1 (refer to Exhibit C16-3)			1.67	
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g			0.09	
gdiff=max(gq-gf,0)			0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.51	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.513	

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT			0.000	0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo			1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 90.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v			1	
v/c ratio from Capacity Worksheet, X			0.00	
Protected phase effective green interval, g (s)			5.0	
Opposing queue effective green interval, gq			6.25	
Unopposed green interval, gu			36.75	
Red time r=(C-g-gq-gu)			42.0	
Arrival rate, qa=v/(3600(max[X,1.0]))			0.00	
Protected ph. departure rate, Sp=s/3600			0.501	
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)			0.32	
XPerm			0.00	
XProt			0.01	
Case			1	
Queue at beginning of green arrow, Qa			0.01	
Queue at beginning of unsaturated green, Qu			0.00	
Residual queue, Qr			0.00	
Uniform Delay, d1			10.0	

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Dur. Unmet Demand Q veh	Unmet Demand t hrs.	Uniform Delay Unadj. ds	Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 19.1 sec/veh Intersection LOS B

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L						L	T		T	R	
Init Queue	0.0						0.0	0.0		0.0	0.0	
Flow Rate	302						1	329		200	1	
So	1900						1900	2000		2000	1900	
No.Lanes	2	0	0	0	0	0	1	1	0	1	1	
SL	1805						1061	1961		1961	1615	
LnCapacity	601						566	1046		872	1364	
Flow Ratio	0.17						0.00	0.17		0.10	0.00	
v/c Ratio	0.50						0.00	0.31		0.23	0.00	
Grn Ratio	0.33						0.53	0.53		0.44	0.84	
I Factor		1.000						1.000		1.000		
AT or PVG	3						3	3		3	3	
Pltn Ratio	1.00						1.00	1.00		1.00	1.00	
PF2	1.00						1.00	1.00		1.00	1.00	
Q1	6.0						0.0	4.6		3.1	0.0	
kB	0.5						0.5	0.7		0.6	0.8	
Q2	0.5						0.0	0.3		0.2	0.0	
Q Average	6.6						0.0	4.9		3.3	0.0	
Q Spacing	25.0						25.0	25.0		25.0	25.0	
Q Storage	0						0	0		0	0	
Q S Ratio												
70th Percentile Output:												
fB%	1.2						1.2	1.2		1.2	1.2	
BOQ	7.8						0.0	5.9		3.9	0.0	
QSRatio												
85th Percentile Output:												
fB%	1.5						1.6	1.6		1.6	1.6	
BOQ	10.1						0.0	7.7		5.1	0.0	
QSRatio												
90th Percentile Output:												
fB%	1.7						1.8	1.7		1.7	1.8	
BOQ	11.1						0.0	8.5		5.7	0.0	
QSRatio												
95th Percentile Output:												
fB%	1.9						2.1	2.0		2.0	2.1	
BOQ	12.6						0.0	9.7		6.6	0.0	
QSRatio												
98th Percentile Output:												
fB%	2.3						2.7	2.4		2.5	2.7	
BOQ	15.1						0.0	11.8		8.1	0.0	
QSRatio												

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: md
Agency:
Date: 1/3/2005
Period: pm
Project ID: 2007 Site+Background
E/W St: Southern Access Drive

Inter.: 104th Ave/Southern Access Driv
Area Type: All other areas
Jurisd: Kenosha
Year : 2007

N/S St: 104th Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	2	0	0	0	0	0	1	2	0	0	2	1
LGConfig	L						L	T			T	R
Volume	785						1	385			190	1
Lane Width	12.0						12.0	12.0			12.0	12.0
RTOR Vol												0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4			5	6	7	8
EB Left		A			NB	Left	A	A		
Thru						Thru	A	A		
Right						Right				
Peds						Peds				
WB Left					SB	Left				
Thru						Thru		A		
Right						Right		A		
Peds						Peds				
NB Right					EB	Right				
SB Right		A			WB	Right				
Green		30.0					5.0	40.0		
Yellow		4.5					3.0	4.5		
All Red		1.5					0.0	1.5		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	1168	3505	0.79	0.33	30.9	C	30.9	C
Westbound								
Northbound								
L	554	1805	0.00	0.53	10.0+	B		
T	1991	3733	0.23	0.53	11.2	B	11.2	B
Southbound								
T	1659	3733	0.14	0.44	14.8	B	14.8	B
R	1364	1615	0.00	0.84	1.1	A		

Intersection Delay = 23.1 (sec/veh) Intersection LOS = C

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/3/2005
Analysis Time Period: pm
Intersection: 104th Ave/Southern Access Driv
Area Type: All other areas
Jurisdiction: Kenosha
Analysis Year: 2007
Project ID: 2007 Site+Background

East/West Street: Southern Access Drive
North/South Street: 104th Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	785						1	385			190	1
% Heavy Veh	0						0	2			2	0
PHF	0.85						0.85	0.85			0.85	0.85
PK 15 Vol	231						1	113			56	1
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat	1900						1900	2000			2000	1900
ParkExist												
NumPark												
No. Lanes	2	0	0	0	0	0	1	2	0	0	2	1
LGConfig	L						L	T			T	R
Lane Width	12.0						12.0	12.0			12.0	12.0
RTOR Vol												0
Adj Flow	924						1	453			224	1
%InSharedLn							1.000	0.000			0.000	
Prop LTs							0.000				0.000	1.000
Prop RTs											0	
Peds Bikes				0								
Buses	0						0	0			0	0
%InProtPhase							0.0					
Duration	0.25											

Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0						0.0	0.0			0.0	0.0
Arriv. Type	3						3	3			3	3
Unit Ext.	3.0						3.0	3.0			3.0	3.0
I Factor		1.000						1.000			1.000	
Lost Time	2.0						2.0	2.0			2.0	2.0
Ext of g	2.0						2.0	2.0			2.0	2.0
Ped Min g					3.2						3.2	

PHASE DATA

Phase Combination	1	2	3	4			5	6	7	8
EB Left		A			NB	Left	A	A		
Thru						Thru	A	A		
Right						Right				
Peds						Peds				
WB Left					SB	Left				
Thru						Thru		A		
Right						Right		A		
Peds						Peds				
NB Right					EB	Right				
SB Right		A			WB	Right				
Green		30.0					5.0	40.0		
Yellow		4.5					3.0	4.5		
All Red		1.5					0.0	1.5		

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	785						1	385			190	1
PHF	0.85						0.85	0.85			0.85	0.85
Adj flow	924						1	453			224	1
No. Lanes	2	0	0	0	0	0	1	2	0	0	2	1
Lane group	L						L	T			T	R
Adj flow	924						1	453			224	1
Prop LTs							1.000	0.000			0.000	
Prop RTs								0.000			0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L						L	T			T	R
So	1900						1900	2000			2000	1900
Lanes	2	0	0	0	0	0	1	2	0	0	2	1
fW	1.000						1.000	1.000			1.000	1.000
fHV	1.000						1.000	0.980			0.980	1.000
fG	1.000						1.000	1.000			1.000	1.000
fP	1.000						1.000	1.000			1.000	1.000
fBB	1.000						1.000	1.000			1.000	1.000
fA	1.000						1.000	1.000			1.000	1.000
fLU	0.971						1.000	0.952			0.952	1.000
fRT								1.000			1.000	0.850
fLT	0.950						0.950	1.000			1.000	
Sec.							0.500					
fLpb	1.000						1.000	1.000			1.000	
fRpb								1.000			1.000	1.000
S	3505						1805	3733			3733	1615
Sec.							951					

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	924	3505	# 0.26	0.33	1168	0.79
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot		1	1805	0.00	0.056	100	0.01
Perm		0	951	0.00	0.478	454	0.00
Left	L	1			0.53	554	0.00
Prot							
Perm							
Thru	T	453	3733	# 0.12	0.53	1991	0.23
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	224	3733	0.06	0.44	1659	0.14
Right	R	1	1615	0.00	0.84	1364	0.00

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.38
Total lost time per cycle, L = 12.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.44

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	0.79	0.33	27.2	1.000	1168	0.34	3.8	0.0	30.9	C	30.9	C
Westbound												
Northbound												
L	0.00	0.53	10.0	1.000	554	0.11	0.0	0.0	10.0+	B		
T	0.23	0.53	11.2	1.000	1991	0.11	0.1	0.0	11.2	B	11.2	B
Southbound												

T	0.14	0.44	14.8	1.000	1659	0.11	0.0	0.0	14.8	B	14.8	B
R	0.00	0.84	1.1	1.000	1364	0.11	0.0	0.0	1.1	A		

Intersection delay = 23.1 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach			M	
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)			48.0	
Effective permitted green time for LT lane group, g(s)			43.0	
Opposing effective green time, go (s)			40.0	
Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			2	
Adjusted LT flow rate, VLT (veh/h)			1	
Proportion of LT in LT lane group, PLT			1.000	
Proportion of LT in opposing flow, PLTo			0.00	
Adjusted opposing flow rate, Vo (veh/h)			224	
Lost time for LT lane group, tL			6.00	
Computation				
LT volume per cycle, LTC=VLTC/3600			0.03	
Opposing lane util. factor, fLUo			0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			2.94	
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.56	
gq, (see Exhibit C16-4,5,6,7,8)			6.00	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			37.00	
n=Max(gq-gf)/2,0)			3.00	
PTHo=1-PLTo			1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	
EL1 (refer to Exhibit C16-3)			1.72	
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g			0.09	
gdiff=max(gq-gf,0)			0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.50	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.500	

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT			0.000	0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo			0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 90.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v			1	
v/c ratio from Capacity Worksheet, X			0.00	
Protected phase effective green interval, g (s)			5.0	
Opposing queue effective green interval, gq			6.00	
Unopposed green interval, gu			37.00	
Red time r=(C-g-gq-gu)			42.0	
Arrival rate, qa=v/(3600(max[X,1.0]))			0.00	
Protected ph. departure rate, Sp=s/3600			0.501	
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)			0.31	
XPerm			0.00	
XProt			0.01	
Case			1	
Queue at beginning of green arrow, Qa			0.01	
Queue at beginning of unsaturated green, Qu			0.00	
Residual queue, Qr			0.00	
Uniform Delay, d1			10.0	

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Dur. Unmet Demand Q veh	Unmet Demand t hrs.	Uniform Delay Unadj. ds	Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 23.1 sec/veh Intersection LOS C

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L						L	T		T	R	
Init Queue	0.0						0.0	0.0		0.0	0.0	
Flow Rate	475						1	237		117	1	
So	1900						1900	2000		2000	1900	
No.Lanes	2	0	0	0	0	0	1	2	0	2	1	
SL	1805						1040	1960		1960	1615	
LnCapacity	601						554	1045		871	1364	
Flow Ratio	0.26						0.00	0.12		0.06	0.00	
v/c Ratio	0.79						0.00	0.23		0.13	0.00	
Grn Ratio	0.33						0.53	0.53		0.44	0.84	
I Factor		1.000						1.000		1.000		
AT or PVG	3						3	3		3	3	
Pltn Ratio	1.00						1.00	1.00		1.00	1.00	
PF2	1.00						1.00	1.00		1.00	1.00	
Q1	10.7						0.0	3.1		1.7	0.0	
kB	0.5						0.5	0.7		0.6	0.8	
Q2	1.7						0.0	0.2		0.1	0.0	
Q Average	12.5						0.0	3.4		1.8	0.0	
Q Spacing	25.0						25.0	25.0		25.0	25.0	
Q Storage	0						0	0		0	0	
Q S Ratio												
70th Percentile Output:												
fB%	1.2						1.2	1.2		1.2	1.2	
BOQ	14.6						0.0	4.0		2.2	0.0	
QSRatio												
85th Percentile Output:												
fB%	1.5						1.6	1.6		1.6	1.6	
BOQ	18.7						0.0	5.3		2.9	0.0	
QSRatio												
90th Percentile Output:												
fB%	1.6						1.8	1.7		1.8	1.8	
BOQ	20.1						0.0	5.8		3.2	0.0	
QSRatio												
95th Percentile Output:												
fB%	1.8						2.1	2.0		2.0	2.1	
BOQ	22.5						0.0	6.7		3.7	0.0	
QSRatio												
98th Percentile Output:												
fB%	2.1						2.7	2.5		2.6	2.7	
BOQ	26.0						0.0	8.3		4.7	0.0	
QSRatio												

ERROR MESSAGES

No errors to report.

2007 SITE+BACKGROUND TRAFFIC CAPACITY ANALYSIS – WITHOUT IMPROVEMENTS

HCS2000: Signalized Intersections Release 4.1e

Analyst: md
Agency:
Date: 1/4/2005
Period: am
Project ID: 2007 site+background - no improvements
E/W St: sth 158

Inter.: sth 158/cth h
Area Type: All other areas
Juried: wisdot
Year : 2007
N/S St: cth h

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	1	1	0	0	1	0	0	1	0
LGConfig	L	TR		L	TR			LTR			LTR	
Volume	90	640	15	65	720	25	5	160	65	55	260	100
Lane Width	12.0	12.0		12.0	12.0			12.0			12.0	
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A	A			NB Left	A			
Thru		A			Thru	A			
Right		A			Right	A			
Peds					Peds				
WB Left	A	A			SB Left	A			
Thru		A			Thru	A			
Right		A			Right	A			
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	6.0	40.0				29.0			
Yellow	3.0	4.5				4.5			
All Red	0.0	1.5				1.5			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	205	1805	0.49	0.54	20.6	C		
TR	841	1893	0.87	0.44	32.0	C	30.6	C
Westbound								
L	205	1805	0.35	0.54	17.8	B		
TR	840	1890	0.99	0.44	52.2	D	49.4	D
Northbound								
LTR	582	1806	0.44	0.32	24.6	C	24.6	C
Southbound								
LTR	541	1678	0.85	0.32	40.9	D	40.9	D

Intersection Delay = 38.9 (sec/veh) Intersection LOS = D

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/4/2005
Analysis Time Period: am
Intersection: sth 158/cth h
Area Type: All other areas
Jurisdiction: wisdot
Analysis Year: 2007
Project ID: 2007 site+background - no improvements

East/West Street: sth 158 North/South Street: cth h

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	90	640	15	65	720	25	5	160	65	55	260	100
% Heavy Veh	0	0	0	0	0	0	0	0	0	0	0	0
PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
PK 15 Vol	25	178	4	18	200	7	2	44	18	15	72	28
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900		1900	1900			1900			1900	
ParkExist												
NumPark												
No. Lanes	1	1	0	1	1	0	0	1	0	0	1	0
LGConfig	L	TR		L	TR			LTR			LTR	
Lane Width	12.0	12.0		12.0	12.0			12.0			12.0	
RTOR Vol			0			0			0			0
Adj Flow	100	728		72	828			256			461	
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000			0.023			0.132	
Prop RTs		0.023			0.034			0.281			0.241	
Peds		0			0			0			0	
Bikes												
Buses	0	0		0	0			0			0	
%InProtPhase	0.0			0.0								

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0	0.0			0.0			0.0	
Arriv. Type	3	3		3	3			3			3	
Unit Ext.	3.0	3.0		3.0	3.0			3.0			3.0	
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0		2.0	2.0			2.0			2.0	
Ext of g	2.0	2.0		2.0	2.0			2.0			2.0	

Ped Min g	3.2	3.2	3.2	3.2

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A	A			NB Left	A			
Thru		A			Thru	A			
Right		A			Right	A			
Peds					Peds				
WB Left	A	A			SB Left	A			
Thru		A			Thru	A			
Right		A			Right	A			
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	6.0	40.0				29.0			
Yellow	3.0	4.5				4.5			
All Red	0.0	1.5				1.5			

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	90	640	15	65	720	25	5	160	65	55	260	100
PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj flow	100	711	17	72	800	28	6	178	72	61	289	111
No. Lanes	1	1	0	1	1	0	0	1	0	0	1	0
Lane group	L	TR		L	TR			LTR			LTR	
Adj flow	100	728		72	828			256			461	
Prop LTs	1.000	0.000		1.000	0.000			0.023			0.132	
Prop RTs		0.023			0.034			0.281			0.241	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L	TR		L	TR			LTR			LTR	
So	1900	1900		1900	1900			1900			1900	
Lanes	1	1	0	1	1	0	0	1	0	0	1	0
fW	1.000	1.000		1.000	1.000			1.000			1.000	
fHV	1.000	1.000		1.000	1.000			1.000			1.000	
fG	1.000	1.000		1.000	1.000			1.000			1.000	
fP	1.000	1.000		1.000	1.000			1.000			1.000	
fBB	1.000	1.000		1.000	1.000			1.000			1.000	
fA	1.000	1.000		1.000	1.000			1.000			1.000	
fLU	1.000	1.000		1.000	1.000			1.000			1.000	
fRT		0.996			0.995			0.962			0.967	
fLT	0.950	1.000		0.950	1.000			0.988			0.913	
Sec.	0.093			0.093								
fLpb	1.000	1.000		1.000	1.000			1.000			1.000	
fRpb		1.000			1.000			1.000			1.000	
S	1805	1893		1805	1890			1806			1678	
Sec.	177			177								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		100	1805	# 0.06	0.067	120	0.83
Perm		0	177	0.00	0.478	85	0.00
Left	L	100			0.54	205	0.49
Prot							
Perm							
Thru	TR	728	1893	0.38	0.44	841	0.87
Right							
Westbound							
Prot		72	1805	0.04	0.067	120	0.60
Perm		0	177	0.00	0.478	85	0.00
Left	L	72			0.54	205	0.35
Prot							
Perm							
Thru	TR	828	1890	# 0.44	0.44	840	0.99
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	256	1806	0.14	0.32	582	0.44
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	461	1678	# 0.27	0.32	541	0.85
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.77
Total lost time per cycle, L = 18.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.96

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	0.49	0.54	18.8	1.000	205	0.11	1.8	0.0	20.6	C		
TR	0.87	0.44	22.6	1.000	841	0.40	9.4	0.0	32.0	C	30.6	C
Westbound												
L	0.35	0.54	16.7	1.000	205	0.11	1.0	0.0	17.8	B		
TR	0.99	0.44	24.7	1.000	840	0.49	27.4	0.0	52.2	D	49.4	D
Northbound												
LTR	0.44	0.32	24.1	1.000	582	0.11	0.5	0.0	24.6	C	24.6	C
Southbound												

LTR	0.85	0.32	28.5	1.000	541	0.38	12.4	0.0	40.9	D	40.9	D

Intersection delay = 38.9 (sec/veh) Intersection LOS = D

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M		
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	49.0	49.0		
Effective permitted green time for LT lane group, g(s)	43.0	43.0		
Opposing effective green time, go (s)	40.0	40.0		
Number of lanes in LT lane group, N	1	1		
Number of lanes in opposing approach, No	1	1		
Adjusted LT flow rate, VLT (veh/h)	100	72		
Proportion of LT in LT lane group, PLT	1.000	1.000		
Proportion of LT in opposing flow, PLTo	0.00	0.00		
Adjusted opposing flow rate, Vo (veh/h)	828	728		
Lost time for LT lane group, tL	6.00	6.00		
Computation				
LT volume per cycle, LTC=VLTC/3600	2.50	1.80		
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	20.70	18.20		
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g	0.0	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.56	0.56		
gq, (see Exhibit C16-4,5,6,7,8)	39.00	33.96		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	4.00	9.04		
n=Max(gq-gf)/2,0)	19.50	16.98		
PTHo=1-PLTo	1.00	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00		
EL1 (refer to Exhibit C16-3)	2.82	2.57		
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.09	0.09		
gdiff=max(gq-gf,0)	0.00	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.09	0.09		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.093	0.093		

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach			S	S
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)			29.0	29.0
Effective permitted green time for LT lane group, g(s)			29.0	29.0
Opposing effective green time, go (s)			29.0	29.0
Number of lanes in LT lane group, N			1	1
Number of lanes in opposing approach, No			1	1
Adjusted LT flow rate, VLT (veh/h)			6	61
Proportion of LT in LT lane group, PLT	0.000	0.000	0.023	0.132
Proportion of LT in opposing flow, PLTo			0.13	0.02
Adjusted opposing flow rate, Vo (veh/h)			461	256
Lost time for LT lane group, tL			6.00	6.00
Computation				
LT volume per cycle, LTC=VLTC/3600			0.15	1.53
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			11.52	6.40
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g			16.3	3.4
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.68	0.68
gq, (see Exhibit C16-4,5,6,7,8)			15.07	7.46
gu=g-gq if gq>=gf, or = g-gf if gq<gf			12.66	21.54
n=Max(gq-gf)/2,0)			0.00	2.01
PTHo=1-PLTo			0.87	0.98
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			0.02	0.13
EL1 (refer to Exhibit C16-3)			2.21	1.80
EL2=Max((1-Ptho**n)/Plto, 1.0)			1.00	1.98
fmin=2(1+PL)/g or fmin=2(1+Pl)/g			0.07	0.08
gdiff=max(gq-gf,0)			0.00	4.01
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.99	0.91
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.988	0.913

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 90.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v	100	72		
v/c ratio from Capacity Worksheet, X	0.49	0.35		
Protected phase effective green interval, g (s)	6.0	6.0		
Opposing queue effective green interval, gq	39.00	33.96		
Unopposed green interval, gu	4.00	9.04		
Red time r=(C-g-gq-gu)	41.0	41.0		
Arrival rate, qa=v/(3600(max[X,1.0]))	0.03	0.02		
Protected ph. departure rate, Sp=s/3600	0.501	0.501		
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.53	0.23		
XPerm	0.56	0.41		
XProt	0.43	0.31		
Case	1	1		
Queue at beginning of green arrow, Qa	1.14	0.82		
Queue at beginning of unsaturated green, Qu	1.08	0.68		
Residual queue, Qr	0.00	0.00		
Uniform Delay, d1	18.8	16.7		

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Dur. Unmet Demand Q veh	Unmet Demand t hrs.	Uniform Delay Unadj. ds	Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 38.9 sec/veh Intersection LOS D

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	L	TR	L	TR		LTR		LTR
Init Queue	0.0	0.0	0.0	0.0		0.0		0.0
Flow Rate	100	728	72	828		256		461
So	1900	1900	1900	1900		1900		1900
No.Lanes	1	1 0	1	1 0	0	1 0	0	1 0
SL	376	1893	376	1890		1806		1678
LnCapacity	205	841	205	840		582		541
Flow Ratio	0.27	0.38	0.19	0.44		0.14		0.27
v/c Ratio	0.49	0.87	0.35	0.99		0.44		0.85
Grn Ratio	0.54	0.44	0.54	0.44		0.32		0.32
I Factor		1.000		1.000		1.000		1.000
AT or PVG	3	3	3	3		3		3
Pltn Ratio	1.00	1.00	1.00	1.00		1.00		1.00
PF2	1.00	1.00	1.00	1.00		1.00		1.00
Q1	1.2	16.4	0.8	20.5		5.1		10.8
kB	0.3	0.6	0.3	0.6		0.5		0.5
Q2	0.2	3.3	0.1	7.3		0.4		2.2
Q Average	1.4	19.7	1.0	27.8		5.4		13.0
Q Spacing	25.0	25.0	25.0	25.0		25.0		25.0
Q Storage	0	0	0	0		0		0
Q S Ratio								
70th Percentile Output:								
fB%	1.2	1.2	1.2	1.1		1.2		1.2
BOQ	1.7	22.9	1.2	31.9		6.5		15.3
QSRatio								
85th Percentile Output:								
fB%	1.6	1.5	1.6	1.4		1.6		1.5
BOQ	2.3	28.7	1.6	39.4		8.4		19.4
QSRatio								
90th Percentile Output:								
fB%	1.8	1.5	1.8	1.5		1.7		1.6
BOQ	2.5	30.5	1.7	41.6		9.3		20.9
QSRatio								
95th Percentile Output:								
fB%	2.1	1.7	2.1	1.6		1.9		1.8
BOQ	2.9	33.5	2.0	45.2		10.6		23.3
QSRatio								
98th Percentile Output:								
fB%	2.6	1.9	2.6	1.8		2.4		2.1
BOQ	3.7	37.8	2.6	50.5		12.8		26.9
QSRatio								

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: md
Agency:
Date: 1/4/2005
Period: pm
Project ID: 2007 site+background - no improvements
E/W St: sth 158

Inter.: sth 158/cth h
Area Type: All other areas
Jurisd: wisdot
Year : 2007
N/S St: cth h

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	1	1	0	0	1	0	0	1	0
LGConfig	L	TR		L	TR			LTR			LTR	
Volume	150	880	20	40	625	60	10	310	50	55	280	70
Lane Width	12.0	12.0		12.0	12.0			12.0			12.0	
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A	A			NB Left	A			
Thru		A			Thru	A			
Right		A			Right	A			
Peds					Peds				
WB Left	A	A			SB Left	A			
Thru		A			Thru	A			
Right		A			Right	A			
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	6.0	42.0				27.0			
Yellow	3.0	4.5				4.5			
All Red	0.0	1.5				1.5			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	205	1805	0.81	0.57	39.8	D		
TR	884	1894	1.13	0.47	97.2	F	89.0	F
Westbound								
L	205	1805	0.21	0.57	18.7	B		
TR	875	1875	0.87	0.47	31.0	C	30.3	C
Northbound								
LTR	551	1838	0.75	0.30	33.9	C	33.9	C
Southbound								
LTR	437	1458	1.03	0.30	82.4	F	82.4	F

Intersection Delay = 63.3 (sec/veh) Intersection LOS = E

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/4/2005
Analysis Time Period: pm
Intersection: sth 158/cth h
Area Type: All other areas
Jurisdiction: wisdot
Analysis Year: 2007
Project ID: 2007 site+background - no improvements
East/West Street: sth 158 North/South Street: cth h

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	150	880	20	40	625	60	10	310	50	55	280	70
% Heavy Veh	0	0	0	0	0	0	0	0	0	0	0	0
PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
PK 15 Vol	42	244	6	11	174	17	3	86	14	15	78	19
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900		1900	1900			1900			1900	
ParkExist												
NumPark												
No. Lanes	1	1	0	1	1	0	0	1	0	0	1	0
LGConfig	L	TR		L	TR			LTR			LTR	
Lane Width	12.0	12.0		12.0	12.0			12.0			12.0	
RTOR Vol			0			0			0			0
Adj Flow	167	1000		44	761			411			450	
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000			0.027			0.136	
Prop RTs		0.022			0.088		0.136			0.173		
Peds		0			0		0			0		
Bikes					0			0			0	
Buses	0	0		0	0							
%InProtPhase	0.0			0.0								

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0	0.0			0.0			0.0	
Arriv. Type	3	3		3	3			3			3	
Unit Ext.	3.0	3.0		3.0	3.0			3.0			3.0	
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0		2.0	2.0			2.0			2.0	
Ext of g	2.0	2.0		2.0	2.0			2.0			2.0	
Ped Min g	3.2			3.2				3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A	A			NB Left	A			
Thru		A			Thru	A			
Right		A			Right	A			
Peds					Peds				
WB Left	A	A			SB Left	A			
Thru		A			Thru	A			
Right		A			Right	A			
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	6.0	42.0				27.0			
Yellow	3.0	4.5				4.5			
All Red	0.0	1.5				1.5			

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	150	880	20	40	625	60	10	310	50	55	280	70
PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj flow	167	978	22	44	694	67	11	344	56	61	311	78
No. Lanes	1	1	0	1	1	0	0	1	0	0	1	0
Lane group	L	TR		L	TR			LTR			LTR	
Adj flow	167	1000		44	761			411			450	
Prop LTs	1.000	0.000		1.000	0.000			0.027			0.136	
Prop RTs		0.022			0.088		0.136			0.173		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L	TR		L	TR		LTR			LTR		
So	1900	1900		1900	1900		1900			1900		
Lanes	1	1	0	1	1	0	0	1	0	0	1	0
fW	1.000	1.000		1.000	1.000			1.000			1.000	
fHV	1.000	1.000		1.000	1.000			1.000			1.000	
fG	1.000	1.000		1.000	1.000			1.000			1.000	
fP	1.000	1.000		1.000	1.000			1.000			1.000	
fBB	1.000	1.000		1.000	1.000			1.000			1.000	
fA	1.000	1.000		1.000	1.000			1.000			1.000	
fLU	1.000	1.000		1.000	1.000			1.000			1.000	
fRT		0.997			0.987			0.982			0.977	
fLT	0.950	1.000		0.950	1.000			0.985			0.786	
Sec.	0.089			0.089								
fLpb	1.000	1.000		1.000	1.000			1.000			1.000	
fRpb		1.000			1.000			1.000			1.000	
S	1805	1894		1805	1875			1838			1458	
Sec.	169			169								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		120	1805	# 0.07	0.067	120	1.00
Perm		47	169	0.28	0.500	85	0.55
Left	L	167			0.57	205	0.81
Prot							
Perm							
Thru	TR	1000	1894	# 0.47	0.47	884	1.13
Right							
Westbound							
Prot		44	1805	0.02	0.067	120	0.37
Perm		0	169	0.00	0.500	85	0.00
Left	L	44			0.57	205	0.21
Prot							
Perm							
Thru	TR	761	1875	0.41	0.47	875	0.87
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	411	1838	0.22	0.30	551	0.75
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	450	1458	# 0.31	0.30	437	1.03
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.84
Total lost time per cycle, L = 18.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.05

Control Delay and LOS Determination

Appr/ Lane Grp	v/c	g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	0.81	0.57	18.1	1.000	205	0.36	21.8	0.0	39.8	D		
TR	1.13	0.47	24.0	1.000	884	0.50	73.2	0.0	97.2	F	89.0	F
Westbound												
L	0.21	0.57	18.2	1.000	205	0.11	0.5	0.0	18.7	B		
TR	0.87	0.47	21.5	1.000	875	0.40	9.4	0.0	31.0	C	30.3	C
Northbound												
LTR	0.75	0.30	28.4	1.000	551	0.30	5.5	0.0	33.9	C	33.9	C
Southbound												

LTR	1.03	0.30	31.5	1.000	437	0.50	50.9	0.0	82.4	F	82.4	F

Intersection delay = 63.3 (sec/veh) Intersection LOS = E

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

		EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach		M	M		
Cycle length, C	90.0 sec				
Total actual green time for LT lane group, G (s)		51.0	51.0		
Effective permitted green time for LT lane group, g(s)		45.0	45.0		
Opposing effective green time, go (s)		42.0	42.0		
Number of lanes in LT lane group, N		1	1		
Number of lanes in opposing approach, No		1	1		
Adjusted LT flow rate, VLT (veh/h)		167	44		
Proportion of LT in LT lane group, PLT		1.000	1.000		
Proportion of LT in opposing flow, PLTo		0.00	0.00		
Adjusted opposing flow rate, Vo (veh/h)		761	1000		
Lost time for LT lane group, tL		6.00	6.00		
Computation					
LT volume per cycle, LTC=VLTC/3600		4.18	1.10		
Opposing lane util. factor, fLUo		1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		19.02	25.00		
gf=G[exp(- a * (LTC ** b)]-tl, gf<=g		0.0	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.53	0.53		
gq, (see Exhibit C16-4,5,6,7,8)		35.16	41.00		
gu=g-gq if gq>=gf, or = g-gf if gq<gf		9.84	4.00		
n=Max(gq-gf)/2,0)		17.58	20.50		
PTHo=1-PLTo		1.00	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00	1.00		
EL1 (refer to Exhibit C16-3)		2.65	3.32		
EL2=Max((1-Ptho**n)/Plto, 1.0)					
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.09	0.09		
gdiff=max(gq-gf,0)		0.00	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.09	0.09		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)					
or flt=[fm+0.91(N-1)]/N**					
Left-turn adjustment, fLT		0.089	0.089		

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

		EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				S	S
Cycle length, C	90.0 sec				
Total actual green time for LT lane group, G (s)				27.0	27.0
Effective permitted green time for LT lane group, g(s)				27.0	27.0
Opposing effective green time, go (s)				27.0	27.0
Number of lanes in LT lane group, N				1	1
Number of lanes in opposing approach, No				1	1
Adjusted LT flow rate, VLT (veh/h)				11	61
Proportion of LT in LT lane group, PLT		0.000	0.000	0.027	0.136
Proportion of LT in opposing flow, PLTo				0.14	0.03
Adjusted opposing flow rate, Vo (veh/h)				450	411
Lost time for LT lane group, tL				6.00	6.00
Computation					
LT volume per cycle, LTC=VLTC/3600				0.28	1.53
Opposing lane util. factor, fLUo		1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				11.25	10.27
gf=G[exp(- a * (LTC ** b)]-tl, gf<=g				12.4	2.8
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				1.00	1.00
Opposing Queue Ratio, qro=Max(1-Rpo(go/C),0)				0.70	0.70
gq, (see Exhibit C16-4,5,6,7,8)				15.41	13.98
gu=g-gq if gq>=gf, or = g-gf if gq<gf				11.59	13.02
n=Max(gq-gf)/2,0)				1.49	5.59
PTHo=1-PLTo				0.86	0.97
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				0.03	0.14
EL1 (refer to Exhibit C16-3)				2.19	2.10
EL2=Max((1-Ptho**n)/Plto, 1.0)				1.44	5.26
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				0.08	0.08
gdiff=max(gq-gf,0)				2.98	11.18
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				0.99	0.79
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)					
or flt=[fm+0.91(N-1)]/N**					
Left-turn adjustment, fLT				0.985	0.786

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

		EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v		167	44		
v/c ratio from Capacity Worksheet, X		0.81	0.21		
Protected phase effective green interval, g (s)		6.0	6.0		
Opposing queue effective green interval, gq		35.16	41.00		
Unopposed green interval, gu		9.84	4.00		
Red time r=(C-g-gq-gu)		39.0	39.0		
Arrival rate, qa=v/(3600(max[X,1.0]))		0.05	0.01		
Protected ph. departure rate, Sp=s/3600		0.501	0.501		
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)		0.21	0.53		
XPerm		0.99	0.26		
XProt		0.69	0.18		
Case		1	1		
Queue at beginning of green arrow, Qa		1.81	0.48		
Queue at beginning of unsaturated green, Qu		1.63	0.50		
Residual queue, Qr		0.00	0.00		
Uniform Delay, d1		18.1	18.2		

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Dur. Unmet Demand Q veh	Unmet Demand t hrs.	Uniform Delay Unadj. ds	Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Lane Queue Delay d3 sec	Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 63.3 sec/veh Intersection LOS E

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound	Southbound
LaneGroup	L	TR	L	TR	LTR	LTR
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	167	1000	44	761	411	450
So	1900	1900	1900	1900	1900	1900
No.Lanes	1	1 0	1	1 0	0 1 0	0 1 0
SL	361	1894	361	1875	1838	1458
LnCapacity	205	884	205	875	551	437
Flow Ratio	0.46	0.53	0.12	0.41	0.22	0.31
v/c Ratio	0.81	1.13	0.21	0.87	0.75	1.03
Grn Ratio	0.57	0.47	0.57	0.47	0.30	0.30
I Factor		1.000		1.000	1.000	1.000
AT or PVG	3	3	3	3	3	3
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00	1.00	1.00	1.00	1.00	1.00
Q1	1.9	25.0	0.5	17.1	9.3	11.3
kB	0.3	0.6	0.3	0.6	0.5	0.4
Q2	1.0	18.8	0.1	3.4	1.3	5.7
Q Average	2.9	43.8	0.6	20.5	10.6	17.0
Q Spacing	25.0	25.0	25.0	25.0	25.0	25.0
Q Storage	0	0	0	0	0	0
Q S Ratio						
70th Percentile Output:						
fB%	1.2	1.1	1.2	1.2	1.2	1.2
BOQ	3.4	49.6	0.7	23.8	12.5	19.8
QSRatio						
85th Percentile Output:						
fB%	1.6	1.4	1.6	1.5	1.5	1.5
BOQ	4.5	59.9	0.9	29.8	16.0	25.0
QSRatio						
90th Percentile Output:						
fB%	1.7	1.4	1.8	1.5	1.6	1.6
BOQ	5.0	63.2	1.0	31.6	17.3	26.7
QSRatio						
95th Percentile Output:						
fB%	2.0	1.6	2.1	1.7	1.8	1.7
BOQ	5.8	68.0	1.2	34.7	19.4	29.5
QSRatio						
98th Percentile Output:						
fB%	2.5	1.7	2.7	1.9	2.1	2.0
BOQ	7.2	75.9	1.5	39.1	22.7	33.5
QSRatio						

ERROR MESSAGES

No errors to report.

HCS2000: Unsignalized Intersections Release 4.1d

TWO-WAY STOP CONTROL SUMMARY

Analyst:
Agency/Co.:
Date Performed: 11/12/2004
Analysis Time Period: am
Intersection: sth 158/104th avenue
Jurisdiction: wisdot
Units: U. S. Customary
Analysis Year: 2004
Project ID: 2007 site+background - no improvements
East/West Street: sth 158
North/South Street: 104th Avenue
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	5	540	65	170	600	5
Peak-Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate, HFR	5	540	65	170	600	5
Percent Heavy Vehicles	0	--	--	0	--	--
Median Type/Storage	Undivided			/		
RT Channelized?			No			No
Lanes	1	2	1	1	2	1
Configuration	L	T	R	L	T	R
Upstream Signal?		No			No	

Minor Street: Approach	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	455	5	240	5	10	5
Peak Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate, HFR	455	5	240	5	10	5
Percent Heavy Vehicles	0	0	0	0	0	0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No /			No /
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	L	L		LTR			LTR	
v (vph)	5	170		700			20	
C(m) (vph)	983	983		160			112	
v/c	0.01	0.17		4.38			0.18	
95% queue length	0.02	0.62		71.19			0.62	
Control Delay	8.7	9.4		1575			44.0	
LOS	A	A		F			E	
Approach Delay				1575			44.0	
Approach LOS				F			E	

HCS2000: Unsignalized Intersections Release 4.1d

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TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst:
Agency/Co.:
Date Performed: 11/12/2004
Analysis Time Period: am
Intersection: sth 158/104th avenue
Jurisdiction: wisdot
Units: U. S. Customary
Analysis Year: 2004
Project ID: 2007 site+background - no improvements
East/West Street: sth 158
North/South Street: 104th Avenue
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	5	540	65	170	600	5
Peak-Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Peak-15 Minute Volume	1	135	16	42	150	1
Hourly Flow Rate, HFR	5	540	65	170	600	5
Percent Heavy Vehicles	0	--	--	0	--	--
Median Type/Storage	Undivided			/		
RT Channelized?			No			No
Lanes	1	2	1	1	2	1
Configuration	L	T	R	L	T	R
Upstream Signal?		No			No	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	455	5	240	5	10	5
Peak Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Peak-15 Minute Volume	114	1	60	1	2	1
Hourly Flow Rate, HFR	455	5	240	5	10	5
Percent Heavy Vehicles	0	0	0	0	0	0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No /			No /
RT Channelized?						
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

		Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2	Left-Turn							
	Through							
S5	Left-Turn							
	Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1	4	7	8	9	10	11	12
		L	L	L	T	R	L	T	R
t(c,base)		4.1	4.1	7.5	6.5	6.9	7.5	6.5	6.9
t(c,hv)		2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
P(hv)		0	0	0	0	0	0	0	0
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Grade/100				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage	4.1	4.1	7.5	6.5	6.9	7.5	6.5	6.9
	2-stage								

Follow-Up Time Calculations

Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)	2.20	2.20	3.50	4.00	3.30	3.50	4.00	3.30
t(f,HV)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(HV)	0	0	0	0	0	0	0	0
t(f)	2.2	2.2	3.5	4.0	3.3	3.5	4.0	3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				
Total Saturation Flow Rate, s (vph)				
Arrival Type				
Effective Green, g (sec)				
Cycle Length, C (sec)				
Rp (from Exhibit 16-11)				
Proportion vehicles arriving on green P				
g(q1)				
g(q2)				
g(q)				

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p		0.000		0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5
Single-Stage Process

Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
V c,x	605	605	1195	1495	270	1222	1555	300
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process

	7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		3000		3000		3000		3000
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	270	300
Potential Capacity	734	702
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	734	702
Probability of Queue free St.	0.67	0.99

Step 2: LT from Major St.	4	1
Conflicting Flows	605	605
Potential Capacity	983	983
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	983	983
Probability of Queue free St.	0.83	0.99
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows	1495	1555
Potential Capacity	124	114
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.82	0.82
Movement Capacity	102	94
Probability of Queue free St.	0.95	0.89

Step 4: LT from Minor St.	7	10
Conflicting Flows	1195	1222
Potential Capacity	144	138
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.74	0.78
Maj. L, Min T Adj. Imp Factor.	0.80	0.83
Cap. Adj. factor due to Impeding mvmnt	0.79	0.56
Movement Capacity	114	77

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	1495	1555
Potential Capacity	124	114
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.82	0.82
Movement Capacity	102	94
Result for 2 stage process:		
a		
y		
C t	102	94
Probability of Queue free St.	0.95	0.89

Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	1195	1222
Potential Capacity	144	138
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.74	0.78
Maj. L, Min T Adj. Imp Factor.	0.80	0.83
Cap. Adj. factor due to Impeding mvmnt	0.79	0.56
Movement Capacity	114	77
Results for Two-stage process:		
a		
y		
C t	114	77

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	455	5	240	5	10	5
Movement Capacity (vph)	114	102	734	77	94	702
Shared Lane Capacity (vph)		160			112	

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	114	102	734	77	94	702
Volume	455	5	240	5	10	5
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh		160			112	
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	L	L		LTR			LTR	
v (vph)	5	170		700			20	
C(m) (vph)	983	983		160			112	
v/c	0.01	0.17		4.38			0.18	
95% queue length	0.02	0.62		71.19			0.62	
Control Delay	8.7	9.4		1575			44.0	
LOS	A	A		F			E	
Approach Delay				1575			44.0	
Approach LOS				F			E	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.99	0.83
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4	8.7	9.4
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS2000: Unsignalized Intersections Release 4.1d

TWO-WAY STOP CONTROL SUMMARY

Analyst:
Agency/Co.:
Date Performed: 11/12/2004
Analysis Time Period: pm
Intersection: sth 158/104th avenue
Jurisdiction: wisdot
Units: U. S. Customary
Analysis Year: 2004
Project ID: 2007 site+background - no improvements
East/West Street: sth 158
North/South Street: 104th Avenue
Intersection Orientation: EW
Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1 L	2 T	3 R	4 L	5 T	6 R
Volume	5	615	45	140	610	5
Peak-Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate, HFR	5	615	45	140	610	5
Percent Heavy Vehicles	0	--	--	0	--	--
Median Type/Storage	Undivided			/		
RT Channelized?			No			No
Lanes	1	2	1	1	2	1
Configuration	L	T	R	L	T	R
Upstream Signal?		No			No	

Minor Street: Approach	Northbound			Southbound		
Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume	740	5	405	10	5	10
Peak Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate, HFR	740	5	405	10	5	10
Percent Heavy Vehicles	0	0	0	0	0	0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No /			No /
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	L	L		LTR			LTR	
v (vph)	5	140		1150			25	
C(m) (vph)	974	938		165			94	
v/c	0.01	0.15		6.97			0.27	
95% queue length	0.02	0.52		126.53			0.98	
Control Delay	8.7	9.5		2738			56.6	
LOS	A	A		F			F	
Approach Delay				2738			56.6	
Approach LOS				F			F	

HCS2000: Unsignalized Intersections Release 4.1d

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TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst:
Agency/Co.:
Date Performed: 11/12/2004
Analysis Time Period: pm
Intersection: sth 158/104th avenue
Jurisdiction: wisdot
Units: U. S. Customary
Analysis Year: 2004
Project ID: 2007 site+background - no improvements
East/West Street: sth 158
North/South Street: 104th Avenue
Intersection Orientation: EW
Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume	5	615	45	140	610	5
Peak-Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Peak-15 Minute Volume	1	154	11	35	152	1
Hourly Flow Rate, HFR	5	615	45	140	610	5
Percent Heavy Vehicles	0	--	--	0	--	--
Median Type/Storage	Undivided			/		
RT Channelized?			No			No
Lanes	1	2	1	1	2	1
Configuration	L	T	R	L	T	R
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume	740	5	405	10	5	10
Peak Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Peak-15 Minute Volume	185	1	101	2	1	2
Hourly Flow Rate, HFR	740	5	405	10	5	10
Percent Heavy Vehicles	0	0	0	0	0	0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No /			No /
RT Channelized?						
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn							
Through							
S5 Left-Turn							
Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1	4.1	7.5	6.5	6.9	7.5	6.5	6.9
t(c,hv)		2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
P(hv)		0	0	0	0	0	0	0	0
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Grade/100				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage	4.1	4.1	7.5	6.5	6.9	7.5	6.5	6.9
	2-stage								

Follow-Up Time Calculations Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20	2.20	3.50	4.00	3.30	3.50	4.00	3.30
t(f,HV)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(HV)	0	0	0	0	0	0	0	0
t(f)	2.2	2.2	3.5	4.0	3.3	3.5	4.0	3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2 V(t)	Movement 2 V(1,prot)	Movement 5 V(t)	Movement 5 V(1,prot)
V prog				
Total Saturation Flow Rate, s (vph)				
Arrival Type				
Effective Green, g (sec)				
Cycle Length, C (sec)				
Rp (from Exhibit 16-11)				
Proportion vehicles arriving on green P				
g(q1)				
g(q2)				
g(q)				

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2 V(t)	Movement 2 V(1,prot)	Movement 5 V(t)	Movement 5 V(1,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p		0.000		0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x	615	660	1213	1520	308	1210	1560	305
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		3000		3000		3000		3000
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	308	305
Potential Capacity	694	697
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	694	697
Probability of Queue free St.	0.42	0.99

Step 2: LT from Major St.	4	1
Conflicting Flows	660	615
Potential Capacity	938	974
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	938	974
Probability of Queue free St.	0.85	0.99
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows	1520	1560
Potential Capacity	120	113
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.85	0.85
Movement Capacity	102	96
Probability of Queue free St.	0.95	0.95

Step 4: LT from Minor St.	7	10
Conflicting Flows	1213	1210
Potential Capacity	140	141
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.80	0.80
Maj. L, Min T Adj. Imp Factor.	0.85	0.85
Cap. Adj. factor due to Impeding mvmnt	0.84	0.35
Movement Capacity	117	50

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	1520	1560
Potential Capacity	120	113
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.85	0.85
Movement Capacity	102	96
Result for 2 stage process:		
a		
y		
C t	102	96
Probability of Queue free St.	0.95	0.95

Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	1213	1210
Potential Capacity	140	141
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.80	0.80
Maj. L, Min T Adj. Imp Factor.	0.85	0.85
Cap. Adj. factor due to Impeding mvmnt	0.84	0.35
Movement Capacity	117	50
Results for Two-stage process:		
a		
y		
C t	117	50

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	740	5	405	10	5	10
Movement Capacity (vph)	117	102	694	50	96	697
Shared Lane Capacity (vph)		165			94	

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	117	102	694	50	96	697
Volume	740	5	405	10	5	10
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh		165			94	
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	L	L		LTR			LTR	
v (vph)	5	140		1150			25	
C(m) (vph)	974	938		165			94	
v/c	0.01	0.15		6.97			0.27	
95% queue length	0.02	0.52		126.53			0.98	
Control Delay	8.7	9.5		2738			56.6	
LOS	A	A		F			F	
Approach Delay				2738			56.6	
Approach LOS				F			F	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.99	0.85
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4	8.7	9.5
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS2000: Signalized Intersections Release 4.1e

Analyst: md
Agency:
Date: 1/3/2005
Period: am
Project ID: 2007 site+background - no improvements
E/W St: sth 158

Inter.: sth 158/greyhound access
Area Type: All other areas
Jurisd: wisdot
Year : 2007
N/S St: greyhound access

SIGNALIZED INTERSECTION SUMMARY

	Eastbound L	Eastbound T	Eastbound R	Westbound L	Westbound T	Westbound R	Northbound L	Northbound T	Northbound R	Southbound L	Southbound T	Southbound R
No. Lanes	0	2	1	1	2	0	2	0	1	0	0	0
LGConfig		TR	R	L	T		L		R			
Volume		600	365	260	800		10		10			
Lane Width		12.0	12.0	12.0	12.0		12.0		12.0			
RTOR Vol			0						0			

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left	A		
Thru		A			Thru			
Right		A			Right	A		
Peds					Peds			
WB Left	A	A			SB Left			
Thru	A	A			Thru			
Right					Right			
Peds					Peds			
NB Right	A				EB Right			
SB Right					WB Right			
Green	15.0	47.0			10.0			
Yellow	3.0	4.5			4.5			
All Red	0.0	1.5			1.5			

Cycle Length: 87.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
TR	1955	3618	0.34	0.54	11.4	B	11.9	B
R	872	1615	0.47	0.54	12.7	B		
Westbound								
L	662	1805	0.44	0.75	4.6	A		
T	2703	3618	0.33	0.75	3.8	A	4.0	A
Northbound								
L	403	3505	0.03	0.11	34.2	C	26.2	C
R	575	1615	0.02	0.36	18.2	B		
Southbound								

Intersection Delay = 7.9 (sec/veh) Intersection LOS = A

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/3/2005
Analysis Time Period: am
Intersection: sth 158/greyhound access
Area Type: All other areas
Jurisdiction: wisdot
Analysis Year: 2007
Project ID: 2007 site+background - no improvements
East/West Street: sth 158 North/South Street: greyhound access

VOLUME DATA

	Eastbound L	Eastbound T	Eastbound R	Westbound L	Westbound T	Westbound R	Northbound L	Northbound T	Northbound R	Southbound L	Southbound T	Southbound R
Volume		600	365	260	800		10		10			
% Heavy Veh		0	0	0	0		0		0			
PHF		0.90	0.90	0.90	0.90		0.90		0.90			
PK 15 Vol		167	101	72	222		3		3			
Hi Ln Vol												
% Grade		0			0			0				
Ideal Sat		1900	1900	1900	1900		1900		1900			
ParkExist												
NumPark												
No. Lanes	0	2	1	1	2	0	2	0	1	0	0	0
LGConfig		TR	R	L	T		L		R			
Lane Width		12.0	12.0	12.0	12.0		12.0		12.0			
RTOR Vol			0						0			
Adj Flow		667	406	289	889		11		11			
%InSharedLn			0									
Prop LTs		0.000		1.000	0.000							
Prop RTs	0.000	1.000			0.000				1.000			
Peds Bikes	0						0			0		
Buses		0	0	0	0		0		0			
%InProtPhase				0.0								

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound L	Eastbound T	Eastbound R	Westbound L	Westbound T	Westbound R	Northbound L	Northbound T	Northbound R	Southbound L	Southbound T	Southbound R
Init Unmet		0.0	0.0	0.0	0.0		0.0		0.0			
Arriv. Type		3	3	3	3		3		3			
Unit Ext.		3.0	3.0	3.0	3.0		3.0		3.0			
I Factor		1.000			1.000			1.000				
Lost Time		2.0	2.0	2.0	2.0		2.0		2.0			
Ext of g		2.0	2.0	2.0	2.0		2.0		2.0			

Ped Min g	3.2			3.2		3.2		

PHASE DATA

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left	A		
Thru		A			Thru			
Right		A			Right	A		
Peds					Peds			
WB Left	A	A			SB Left			
Thru	A	A			Thru			
Right					Right			
Peds					Peds			
NB Right	A				EB Right			
SB Right					WB Right			
Green	15.0	47.0			10.0			
Yellow	3.0	4.5			4.5			
All Red	0.0	1.5			1.5			

Cycle Length: 87.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound L	Eastbound T	Eastbound R	Westbound L	Westbound T	Westbound R	Northbound L	Northbound T	Northbound R	Southbound L	Southbound T	Southbound R
Volume, V		600	365	260	800		10		10			
PHF		0.90	0.90	0.90	0.90		0.90		0.90			
Adj flow		667	406	289	889		11		11			
No. Lanes	0	2	1	1	2	0	2	0	1	0	0	0
Lane group		TR	R	L	T		L		R			
Adj flow		667	406	289	889		11		11			
Prop LTs		0.000		1.000	0.000							
Prop RTs		0.000	1.000		0.000				1.000			

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	TR	R	L	T	L	R		
So	1900	1900	1900	1900	1900	1900		
Lanes	2	1	1	2	0	2	1	0
fW	1.000	1.000	1.000	1.000		1.000	1.000	
fHV	1.000	1.000	1.000	1.000		1.000	1.000	
fG	1.000	1.000	1.000	1.000		1.000	1.000	
fP	1.000	1.000	1.000	1.000		1.000	1.000	
fBB	1.000	1.000	1.000	1.000		1.000	1.000	
fA	1.000	1.000	1.000	1.000		1.000	1.000	
fLU	0.952	1.000	1.000	0.952		0.971	1.000	
fRT	1.000	0.850		1.000			0.850	
fLT	1.000		0.950	1.000		0.950		
Sec.			0.322					
fLpb	1.000		1.000	1.000		1.000		
fRpb	1.000	1.000		1.000			1.000	
S	3618	1615	1805	3618		3505	1615	
Sec.			611					

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	667	3618	0.18	0.54	1955	0.34
Right	R	406	1615	# 0.25	0.54	872	0.47
Westbound							
Prot		289	1805	# 0.16	0.172	311	0.93
Perm		0	611	0.00	0.575	351	0.00
Left	L	289			0.75	662	0.44
Prot							
Perm							
Thru	T	889	3618	0.25	0.75	2703	0.33
Right							
Northbound							
Prot							
Perm							
Left	L	11	3505	# 0.00	0.11	403	0.03
Prot							
Perm							
Thru							
Right	R	11	1615	0.01	0.36	575	0.02
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.41
Total lost time per cycle, L = 18.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.52

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
TR	0.34	0.54	11.3	1.000	1955	0.11	0.1	0.0	11.4	B	11.9	B
R	0.47	0.54	12.3	1.000	872	0.11	0.4	0.0	12.7	B		
Westbound												
L	0.44	0.75	4.2	1.000	662	0.11	0.5	0.0	4.6	A		
T	0.33	0.75	3.7	1.000	2703	0.11	0.1	0.0	3.8	A	4.0	A
Northbound												
L	0.03	0.11	34.2	1.000	403	0.11	0.0	0.0	34.2	C	26.2	C
R	0.02	0.36	18.1	1.000	575	0.11	0.0	0.0	18.2	B		
Southbound												

Intersection delay = 7.9 (sec/veh) Intersection LOS = A

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach		M		
Cycle length, C	87.0 sec			
Total actual green time for LT lane group, G (s)		65.0		
Effective permitted green time for LT lane group, g(s)		50.0		
Opposing effective green time, go (s)		47.0		
Number of lanes in LT lane group, N		1		
Number of lanes in opposing approach, No		2		
Adjusted LT flow rate, VLT (veh/h)		289		
Proportion of LT in LT lane group, PLT		1.000		
Proportion of LT in opposing flow, PLTo		0.00		
Adjusted opposing flow rate, Vo (veh/h)		667		
Lost time for LT lane group, tL		6.00		
Computation				
LT volume per cycle, LTC=VLTC/3600		6.98		
Opposing lane util. factor, fLUo	0.952	0.952		
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		8.47		
gf=G[exp(- a * (LTC ** b)]-tl, gf<=g		0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.46		
gq, (see Exhibit C16-4,5,6,7,8)		9.67		
gu=g-gq if gq>=gf, or = g-gf if gq<gf		40.33		
n=Max(gq-gf)/2,0)		4.83		
PTHo=1-PLTo		1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00		
EL1 (refer to Exhibit C16-3)		2.51		
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.08		
gdiff=max(gq-gf,0)		0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.32		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.322		

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	87.0 sec			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT		0.000	0.000	
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo		0.952	0.952	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b)]-tl, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	87.0 sec			
Adj. LT vol from Vol Adjustment Worksheet, v		289		
v/c ratio from Capacity Worksheet, X		0.44		
Protected phase effective green interval, g (s)		15.0		
Opposing queue effective green interval, gq		9.67		
Unopposed green interval, gu		40.33		
Red time r=(C-g-gq-gu)		22.0		
Arrival rate, qa=v/(3600(max[X,1.0]))		0.08		
Protected ph. departure rate, Sp=s/3600		0.501		
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)		0.21		
XPerm		0.47		
XProt		0.39		
Case		1		
Queue at beginning of green arrow, Qa		1.77		
Queue at beginning of unsaturated green, Qu		0.78		
Residual queue, Qr		0.00		
Uniform Delay, d1		4.2		

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Dur. Unmet Demand Q veh	Unmet Demand t hrs.	Uniform Delay Unadj. ds	Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 7.9 sec/veh Intersection LOS A

BACK OF QUEUE WORKSHEET

LaneGroup	Eastbound TR	R	Westbound L	T	Northbound L	R	Southbound	
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0		
Flow Rate	350	406	289	466	5	11		
So	1900	1900	1900	1900	1900	1900		
No.Lanes	0 2	1	1	2 0	2 0	1	0 0	0
SL	1900	1615	887	1900	1805	1615		
LnCapacity	1026	872	662	1419	207	575		
Flow Ratio	0.18	0.25	0.33	0.25	0.00	0.01		
v/c Ratio	0.34	0.47	0.44	0.33	0.02	0.02		
Grn Ratio	0.54	0.54	0.75	0.75	0.11	0.36		
I Factor	1.000		1.000		1.000			
AT or PVG	3	3	3	3	3	3		
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00		
PF2	1.00	1.00	1.00	1.00	1.00	1.00		
Q1	4.8	6.0	1.9	3.8	0.1	0.2		
kB	0.7	0.6	0.5	0.8	0.3	0.5		
Q2	0.4	0.5	0.4	0.4	0.0	0.0		
Q Average	5.1	6.6	2.3	4.2	0.1	0.2		
Q Spacing	25.0	25.0	25.0	25.0	25.0	25.0		
Q Storage	0	0	0	0	0	0		
Q S Ratio								
70th Percentile Output:								
fB%	1.2	1.2	1.2	1.2	1.2	1.2		
BOQ	6.1	7.8	2.8	5.0	0.1	0.2		
QSRatio								
85th Percentile Output:								
fB%	1.6	1.5	1.6	1.6	1.6	1.6		
BOQ	8.0	10.1	3.7	6.5	0.2	0.3		
QSRatio								
90th Percentile Output:								
fB%	1.7	1.7	1.8	1.7	1.8	1.8		
BOQ	8.8	11.1	4.1	7.2	0.2	0.3		
QSRatio								
95th Percentile Output:								
fB%	2.0	1.9	2.0	2.0	2.1	2.1		
BOQ	10.0	12.6	4.7	8.3	0.2	0.4		
QSRatio								
98th Percentile Output:								
fB%	2.4	2.3	2.5	2.4	2.7	2.7		
BOQ	12.2	15.1	5.9	10.1	0.3	0.5		
QSRatio								

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: md
Agency:
Date: 1/3/2005
Period: pm
Project ID: 2007 site+background - no improvements
E/W St: sth 158

Inter.: sth 158/greyhound access
Area Type: All other areas
Jurisd: wisdot
Year : 2007
N/S St: greyhound access

SIGNALIZED INTERSECTION SUMMARY

	Eastbound L	Eastbound T	Eastbound R	Westbound L	Westbound T	Westbound R	Northbound L	Northbound T	Northbound R	Southbound L	Southbound T	Southbound R
No. Lanes	0	2	1	1	2	0	2	0	1	0	0	0
LGConfig		TR	R	L	T		L		R			
Volume		655	605	465	895		20		10			
Lane Width		12.0	12.0	12.0	12.0		12.0		12.0			
RTOR Vol			0						0			

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left								
Thru		A						
Right		A						
Peds								
WB Left	A	A						
Thru	A	A						
Right								
Peds								
NB Right	A							
SB Right								
Green	20.0	42.0			10.0			
Yellow	3.0	4.5			4.5			
All Red	0.0	1.5			1.5			

NB Left	A							
Thru								
Right	A							
Peds								
SB Left								
Thru								
Right								
Peds								
EB Right								
WB Right								

Cycle Length: 87.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
TR	1747	3618	0.42	0.48	14.7	B	21.9	C
R	780	1615	0.86	0.48	29.7	C		
Westbound								
L	684	1805	0.76	0.48	11.8	B		
T	2703	3618	0.37	0.75	3.9	A	6.6	A
Northbound								
L	403	3505	0.05	0.11	34.3	C	27.9	C
R	668	1615	0.02	0.41	15.1	B		
Southbound								

Intersection Delay = 14.1 (sec/veh) Intersection LOS = B

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/3/2005
Analysis Time Period: pm
Intersection: sth 158/greyhound access
Area Type: All other areas
Jurisdiction: wisdot
Analysis Year: 2007
Project ID: 2007 site+background - no improvements
East/West Street: sth 158
North/South Street: greyhound access

VOLUME DATA

	Eastbound L	Eastbound T	Eastbound R	Westbound L	Westbound T	Westbound R	Northbound L	Northbound T	Northbound R	Southbound L	Southbound T	Southbound R
Volume		655	605	465	895		20		10			
% Heavy Veh		0	0	0	0		0		0			
PHF		0.90	0.90	0.90	0.90		0.90		0.90			
PK 15 Vol		182	168	129	249		6		3			
Hi Ln Vol												
% Grade		0			0			0				
Ideal Sat		1900	1900	1900	1900		1900		1900			
ParkExist												
NumPark												
No. Lanes	0	2	1		1	2	0	2	0	1	0	0	0
LGConfig		TR	R	L	T			L		R			
Lane Width		12.0	12.0	12.0	12.0			12.0		12.0			
RTOR Vol			0							0			
Adj Flow		728	672	517	994			22		11			
%InSharedLn			0										
Prop LTs		0.000		1.000	0.000								
Prop RTs		0.000	1.000		0.000					1.000			
Peds	Bikes 0							0			0		
Buses		0	0	0	0			0		0			
%InProtPhase				0.0									

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound L	Eastbound T	Eastbound R	Westbound L	Westbound T	Westbound R	Northbound L	Northbound T	Northbound R	Southbound L	Southbound T	Southbound R
Init Unmet		0.0	0.0	0.0	0.0		0.0		0.0			
Arriv. Type		3	3	3	3		3		3			
Unit Ext.		3.0	3.0	3.0	3.0		3.0		3.0			
I Factor		1.000			1.000			1.000				
Lost Time		2.0	2.0	2.0	2.0		2.0		2.0			
Ext of g		2.0	2.0	2.0	2.0		2.0		2.0			
Ped Min g		3.2						3.2		3.2		

PHASE DATA

Phase Combination	1	2	3	4	5	6	7	8
EB Left								
Thru		A						
Right		A						
Peds								
WB Left	A	A						
Thru	A	A						
Right								
Peds								
NB Right	A							
SB Right								
Green	20.0	42.0			10.0			
Yellow	3.0	4.5			4.5			
All Red	0.0	1.5			1.5			

NB Left	A							
Thru								
Right	A							
Peds								
SB Left								
Thru								
Right								
Peds								
EB Right								
WB Right								

Cycle Length: 87.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound L	Eastbound T	Eastbound R	Westbound L	Westbound T	Westbound R	Northbound L	Northbound T	Northbound R	Southbound L	Southbound T	Southbound R
Volume, V		655	605	465	895		20		10			
PHF		0.90	0.90	0.90	0.90		0.90		0.90			
Adj flow		728	672	517	994		22		11			
No. Lanes	0	2	1	1	2	0	2	0	1	0	0	0
Lane group		TR	R	L	T		L		R			
Adj flow		728	672	517	994		22		11			
Prop LTs		0.000		1.000	0.000							
Prop RTs		0.000	1.000		0.000				1.000			

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound TR	Eastbound R	Westbound L	Westbound T	Northbound L	Northbound R	Southbound
So	1900	1900	1900	1900	1900	1900	
Lanes	2	1	1	2	2	1	0 0 0
fW	1.000	1.000	1.000	1.000	1.000	1.000	
fHV	1.000	1.000	1.000	1.000	1.000	1.000	
fG	1.000	1.000	1.000	1.000	1.000	1.000	
fP	1.000	1.000	1.000	1.000	1.000	1.000	
fBB	1.000	1.000	1.000	1.000	1.000	1.000	
fA	1.000	1.000	1.000	1.000	1.000	1.000	
fLU	0.952	1.000	1.000	0.952	0.971	1.000	
fRT	1.000	0.850		1.000		0.850	
fLT	1.000		0.950	1.000	0.950		
Sec.			0.274				
fLpb	1.000		1.000	1.000	1.000		
fRpb	1.000	1.000		1.000		1.000	
S	3618	1615	1805	3618	3505	1615	
Sec.			521				

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	Lane Group Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	728	3618	0.20	0.48	1747	0.42
Right	R	672	1615	# 0.42	0.48	780	0.86
Westbound							
Prot		415	1805	# 0.23	0.230	415	1.00
Perm		102	521	0.20	0.517	269	0.38
Left	L	517			0.75	684	0.76
Prot							
Perm							
Thru	T	994	3618	0.27	0.75	2703	0.37
Right							
Northbound							
Prot							
Perm							
Left	L	22	3505	# 0.01	0.11	403	0.05
Prot							
Perm							
Thru							
Right	R	11	1615	0.01	0.41	668	0.02
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.65
Total lost time per cycle, L = 18.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.82

Control Delay and LOS Determination

Appr/ Lane Grp	v/c	g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
TR	0.42	0.48	14.6	1.000	1747	0.11	0.2	0.0	14.7	B	21.9	C
R	0.86	0.48	19.9	1.000	780	0.39	9.7	0.0	29.7	C		
Westbound												
L	0.76	0.75	7.0	1.000	684	0.31	4.8	0.0	11.8	B		
T	0.37	0.75	3.8	1.000	2703	0.11	0.1	0.0	3.9	A	6.6	A
Northbound												
L	0.05	0.11	34.3	1.000	403	0.11	0.1	0.0	34.3	C	27.9	C
R	0.02	0.41	15.1	1.000	668	0.11	0.0	0.0	15.1	B		
Southbound												

Intersection delay = 14.1 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach		M		
Cycle length, C 87.0 sec				
Total actual green time for LT lane group, G (s)		65.0		
Effective permitted green time for LT lane group, g(s)		45.0		
Opposing effective green time, go (s)		42.0		
Number of lanes in LT lane group, N		1		
Number of lanes in opposing approach, No		2		
Adjusted LT flow rate, VLT (veh/h)		517		
Proportion of LT in LT lane group, PLT		1.000		
Proportion of LT in opposing flow, PLTo		0.00		
Adjusted opposing flow rate, Vo (veh/h)		728		
Lost time for LT lane group, tL		6.00		
Computation				
LT volume per cycle, LTC=VLTC/3600		12.49		
Opposing lane util. factor, fLUo	0.952	0.952		
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		9.24		
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g		0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.52		
gq, (see Exhibit C16-4,5,6,7,8)		12.14		
gu=g-gq if gq>=gf, or = g-gf if gq<gf		32.86		
n=Max(gq-gf)/2,0)		6.07		
PTHo=1-PLTo		1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00		
EL1 (refer to Exhibit C16-3)		2.66		
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.09		
gdiff=max(gq-gf,0)		0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.27		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.274		

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 87.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000		
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	0.952	0.952		
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 87.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v		517		
v/c ratio from Capacity Worksheet, X		0.76		
Protected phase effective green interval, g (s)		20.0		
Opposing queue effective green interval, gq		12.14		
Unopposed green interval, gu		32.86		
Red time r=(C-g-gq-gu)		22.0		
Arrival rate, qa=v/(3600(max(X,1.0)))		0.14		
Protected ph. departure rate, Sp=s/3600		0.501		
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)		0.20		
XPerm		0.99		
XProt		0.60		
Case		1		
Queue at beginning of green arrow, Qa		3.16		
Queue at beginning of unsaturated green, Qu		1.74		
Residual queue, Qr		0.00		
Uniform Delay, d1		7.0		

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Dur. Unmet Demand Q veh	Unmet Demand t hrs.	Uniform Delay Unadj. ds	Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 14.1 sec/veh Intersection LOS B

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	TR	R	L	T	L	R		
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0		
Flow Rate	382	672	517	522	11	11		
So	1900	1900	1900	1900	1900	1900		
No.Lanes	0 2	1	1	2 0	2 0	1	0 0	0
SL	1900	1615	916	1900	1805	1615		
LnCapacity	917	780	684	1419	207	668		
Flow Ratio	0.20	0.42	0.56	0.27	0.01	0.01		
v/c Ratio	0.42	0.86	0.76	0.37	0.05	0.02		
Grn Ratio	0.48	0.48	0.75	0.75	0.11	0.41		
I Factor	1.000			1.000	1.000			
AT or PVG	3	3	3	3	3	3		
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00		
PF2	1.00	1.00	1.00	1.00	1.00	1.00		
Q1	6.0	14.4	3.8	4.4	0.2	0.2		
kB	0.6	0.6	0.5	0.8	0.3	0.5		
Q2	0.5	3.0	1.6	0.5	0.0	0.0		
Q Average	6.4	17.4	5.4	4.9	0.3	0.2		
Q Spacing	25.0	25.0	25.0	25.0	25.0	25.0		
Q Storage	0	0	0	0	0	0		
Q S Ratio								
70th Percentile Output:								
fB%	1.2	1.2	1.2	1.2	1.2	1.2		
BOQ	7.6	20.2	6.4	5.8	0.3	0.2		
QSRatio								
85th Percentile Output:								
fB%	1.5	1.5	1.6	1.6	1.6	1.6		
BOQ	9.9	25.5	8.3	7.6	0.4	0.3		
QSRatio								
90th Percentile Output:								
fB%	1.7	1.6	1.7	1.7	1.8	1.8		
BOQ	10.9	27.2	9.2	8.4	0.5	0.3		
QSRatio								
95th Percentile Output:								
fB%	1.9	1.7	1.9	2.0	2.1	2.1		
BOQ	12.3	30.0	10.5	9.6	0.5	0.3		
QSRatio								
98th Percentile Output:								
fB%	2.3	2.0	2.4	2.4	2.7	2.7		
BOQ	14.9	34.1	12.7	11.7	0.7	0.4		
QSRatio								

ERROR MESSAGES

No errors to report.

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ALL-WAY STOP CONTROL(AWSC) ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 11/15/2004
Analysis Time Period: am
Intersection: STH 158/Eastern Frontage
Jurisdiction: WisDOT
Units: U. S. Customary
Analysis Year: 2004
Project ID: 2007 site+background - no improvements
East/West Street: sth 158
North/South Street: Eastern Frontage Road

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	20	620	55	125	460	1	5	35	35	5	0	10

% Thrus Left Lane

	Eastbound L1	Eastbound L2	Westbound L1	Westbound L2	Northbound L1	Northbound L2	Southbound L1	Southbound L2
Configuration	LT		TR		LT		LR	
PHF	1.00		1.00		1.00		1.00	
Flow Rate	640		461		40		15	
% Heavy Veh	0		0		0		0	
No. Lanes	1		1		1		1	
Opposing-Lanes	1		1		1		1	
Conflicting-lanes	1		1		1		1	
Geometry group	1		1		1		1	

Duration, T 0.25 hrs.

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound L1	Eastbound L2	Westbound L1	Westbound L2	Northbound L1	Northbound L2	Southbound L1	Southbound L2
Flow Rates:								
Total in Lane	640		461		40		15	
Left-Turn	20		0		5		5	
Right-Turn	0		1		0		10	
Prop. Left-Turns	0.0		0.0		0.1		0.3	
Prop. Right-Turns	0.0		0.0		0.0		0.7	
Prop. Heavy Vehicle	0.0		0.0		0.0		0.0	
Geometry Group	1		1		1		1	
Adjustments Exhibit 17-33:								
hLT-adj	0.2		0.2		0.2		0.2	
hRT-adj	-0.6		-0.6		-0.6		-0.6	
hHV-adj	1.7		1.7		1.7		1.7	
hadj, computed	0.0		-0.0		0.0		-0.3	

Worksheet 4 - Departure Headway and Service Time

	Eastbound L1	Eastbound L2	Westbound L1	Westbound L2	Northbound L1	Northbound L2	Southbound L1	Southbound L2
Flow rate	640		461		40		15	
hd, initial value	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20
x, initial	0.57		0.41		0.04		0.01	
hd, final value	4.63		4.80		6.43		6.15	
x, final value	0.82		0.61		0.07		0.03	
Move-up time, m	2.0		2.0		2.0		2.0	
Service Time	2.6		2.8		4.4		4.2	

Worksheet 5 - Capacity and Level of Service

	Eastbound L1	Eastbound L2	Westbound L1	Westbound L2	Northbound L1	Northbound L2	Southbound L1	Southbound L2
Flow Rate	640		461		40		15	
Service Time	2.6		2.8		4.4		4.2	
Utilization, x	0.82		0.61		0.07		0.03	
Dep. headway, hd	4.63		4.80		6.43		6.15	
Capacity	774		711		290		265	
Delay	25.21		15.15		9.92		9.31	
LOS	D		C		A		A	
Approach:								
Delay	25.21		15.15		9.92		9.31	
LOS	D		C		A		A	

Intersection Delay 20.46 Intersection LOS C

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ALL-WAY STOP CONTROL(AWSC) ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 11/15/2004
Analysis Time Period: pm
Intersection: STH 158/Eastern Frontage
Jurisdiction: WisDOT
Units: U. S. Customary
Analysis Year: 2004
Project ID: 2007 site+background - no improvements
East/West Street: sth 158
North/South Street: Eastern Frontage Road

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	15	670	55	125	435	1	30	65	35	5	0	5
% Thrus Left Lane												

	Eastbound L1	Eastbound L2	Westbound L1	Westbound L2	Northbound L1	Northbound L2	Southbound L1	Southbound L2
Configuration	LT		TR		LT		LR	
PHF	1.00		1.00		1.00		1.00	
Flow Rate	685		436		95		10	
% Heavy Veh	0		0		0		0	
No. Lanes	1		1		1		1	
Opposing-Lanes	1		1		1		1	
Conflicting-lanes	1		1		1		1	
Geometry group	1		1		1		1	

Duration, T 0.25 hrs.

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound L1	Eastbound L2	Westbound L1	Westbound L2	Northbound L1	Northbound L2	Southbound L1	Southbound L2
Flow Rates:								
Total in Lane	685		436		95		10	
Left-Turn	15		0		30		5	
Right-Turn	0		1		0		5	
Prop. Left-Turns	0.0		0.0		0.3		0.5	
Prop. Right-Turns	0.0		0.0		0.0		0.5	
Prop. Heavy Vehicle	0.0		0.0		0.0		0.0	
Geometry Group	1		1		1		1	
Adjustments Exhibit 17-33:								
hLT-adj	0.2		0.2		0.2		0.2	
hRT-adj	-0.6		-0.6		-0.6		-0.6	
hHV-adj	1.7		1.7		1.7		1.7	
hadj, computed	0.0		-0.0		0.1		-0.2	

Worksheet 4 - Departure Headway and Service Time

	Eastbound L1	Eastbound L2	Westbound L1	Westbound L2	Northbound L1	Northbound L2	Southbound L1	Southbound L2
Flow rate	685		436		95		10	
hd, initial value	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20
x, initial	0.61		0.39		0.08		0.01	
hd, final value	4.84		5.11		6.61		6.67	
x, final value	0.92		0.62		0.17		0.02	
Move-up time, m	2.0		2.0		2.0		2.0	
Service Time	2.8		3.1		4.6		4.7	

Worksheet 5 - Capacity and Level of Service

	Eastbound L1	Eastbound L2	Westbound L1	Westbound L2	Northbound L1	Northbound L2	Southbound L1	Southbound L2
Flow Rate	685		436		95		10	
Service Time	2.8		3.1		4.6		4.7	
Utilization, x	0.92		0.62		0.17		0.02	
Dep. headway, hd	4.84		5.11		6.61		6.67	
Capacity	741		686		345		260	
Delay	38.34		16.06		11.01		9.79	
LOS	E		C		B		A	
Approach:								
Delay	38.34		16.06		11.01		9.79	
LOS	E		C		B		A	

Intersection Delay 28.06 Intersection LOS D

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ALL-WAY STOP CONTROL(AWSC) ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 11/15/2004
Analysis Time Period: am
Intersection: STH 158/Western Frontage
Jurisdiction: WisDOT
Units: U. S. Customary
Analysis Year: 2004
Project ID: 2007 site+background - no improvements
East/West Street: sth 158
North/South Street: Western Frontage Road

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	0	570	30	70	405	0	10	0	70	0	0	0
% Thrus Left Lane												

	Eastbound L1	Eastbound L2	Westbound L1	Westbound L2	Northbound L1	Northbound L2	Southbound L1	Southbound L2
Configuration	T	R	LT		LR			
PHF	1.00	1.00	1.00		1.00			
Flow Rate	570	30	475		80			
% Heavy Veh	0	0	0		0			
No. Lanes	2		1		1			
Opposing-Lanes	1		2		0			
Conflicting-lanes	1		1		2			
Geometry group	5		3a		1			

Duration, T 0.25 hrs.

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound L1	Eastbound L2	Westbound L1	Westbound L2	Northbound L1	Northbound L2	Southbound L1	Southbound L2
Flow Rates:								
Total in Lane	570	30	475		80			
Left-Turn	0	0	70		10			
Right-Turn	0	30	0		70			
Prop. Left-Turns	0.0	0.0	0.1		0.1			
Prop. Right-Turns	0.0	1.0	0.0		0.9			
Prop. Heavy Vehicle	0.0	0.0	0.0		0.0			
Geometry Group	5		3a		1			
Adjustments Exhibit 17-33:								
hLT-adj	0.5		0.2		0.2			
hRT-adj	-0.7		-0.6		-0.6			
hHV-adj	1.7		1.7		1.7			
hadj, computed	0.0	-0.7	0.0		-0.5			

Worksheet 4 - Departure Headway and Service Time

	Eastbound L1	Eastbound L2	Westbound L1	Westbound L2	Northbound L1	Northbound L2	Southbound L1	Southbound L2
Flow rate	570	30	475		80			
hd, initial value	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20
x, initial	0.51	0.03	0.42		0.07			
hd, final value	5.17	4.47	5.00		5.87			
x, final value	0.82	0.04	0.66		0.13			
Move-up time, m	2.3		2.0		2.0			
Service Time	2.9	2.2	3.0		3.9			

Worksheet 5 - Capacity and Level of Service

	Eastbound L1	Eastbound L2	Westbound L1	Westbound L2	Northbound L1	Northbound L2	Southbound L1	Southbound L2
Flow Rate	570	30	475		80			
Service Time	2.9	2.2	3.0		3.9			
Utilization, x	0.82	0.04	0.66		0.13			
Dep. headway, hd	5.17	4.47	5.00		5.87			
Capacity	693	280	712		330			
Delay	26.82	7.34	17.12		9.76			
LOS	D	A	C		A			
Approach:								
Delay	25.85		17.12		9.76			
LOS	D		C		A			

Intersection Delay 21.14 Intersection LOS C

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ALL-WAY STOP CONTROL(AWSC) ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 11/15/2004
Analysis Time Period: pm
Intersection: STH 158/Western Frontage
Jurisdiction: WisDOT
Units: U. S. Customary
Analysis Year: 2004
Project ID: 2007 site+background - no improvements
East/West Street: sth 158
North/South Street: Western Frontage Road

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	0	630	65	120	350	0	10	0	55	0	0	0

% Thrus Left Lane

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	T	R	LT		LR			
PHF	1.00	1.00	1.00		1.00			
Flow Rate	630	65	470		65			
% Heavy Veh	0	0	0		0			
No. Lanes	2		1		1			
Opposing-Lanes	1		2		0			
Conflicting-lanes	1		1		2			
Geometry group	5		3a		1			

Duration, T 0.25 hrs.

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	630	65	470		65			
Left-Turn	0	0	120		10			
Right-Turn	0	65	0		55			
Prop. Left-Turns	0.0	0.0	0.3		0.2			
Prop. Right-Turns	0.0	1.0	0.0		0.8			
Prop. Heavy Vehicle	0.0	0.0	0.0		0.0			
Geometry Group	5		3a		1			
Adjustments Exhibit 17-33:								
hLT-adj	0.5		0.2		0.2			
hRT-adj	-0.7		-0.6		-0.6			
hHV-adj	1.7		1.7		1.7			
hadj, computed	0.0	-0.7	0.1		-0.5			

Worksheet 4 - Departure Headway and Service Time

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow rate	630	65	470		65			
hd, initial value	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20
x, initial	0.56	0.06	0.42		0.06			
hd, final value	5.12	4.41	5.03		6.01			
x, final value	0.90	0.08	0.66		0.11			
Move-up time, m	2.3		2.0		2.0			
Service Time	2.8	2.1	3.0		4.0			

Worksheet 5 - Capacity and Level of Service

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rate	630	65	470		65			
Service Time	2.8	2.1	3.0		4.0			
Utilization, x	0.90	0.08	0.66		0.11			
Dep. headway, hd	5.12	4.41	5.03		6.01			
Capacity	702	315	708		315			
Delay	35.38	7.49	17.13		9.74			
LOS	E	A	C		A			
Approach:								
Delay	32.77		17.13		9.74			
LOS	D		C		A			

Intersection Delay 25.58 Intersection LOS D

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ALL-WAY STOP CONTROL(AWSC) ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 11/15/2004
Analysis Time Period: am
Intersection: CTH K/104th
Jurisdiction: Kenosha County
Units: U. S. Customary
Analysis Year: 2004
Project ID: 2007 site+background - no improvements
East/West Street: CTH K
North/South Street: 104th

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	10	160	30	85	110	85	5	185	80	60	185	25

% Thrus Left Lane

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	LT	R	LTR		L	TR	LT	R
PHF	1.00	1.00	1.00		1.00	1.00	1.00	1.00
Flow Rate	170	30	280		5	265	245	25
% Heavy Veh	0	0	0		0	0	0	0
No. Lanes	2		1		2		2	
Opposing-Lanes	1		2		2		2	
Conflicting-lanes	2		2		2		2	
Geometry group	5		4b		5		5	

Duration, T 0.25 hrs.

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	170	30	280		5	265	245	25
Left-Turn	10	0	85		5	0	60	0
Right-Turn	0	30	85		0	80	0	25
Prop. Left-Turns	0.1	0.0	0.3		1.0	0.0	0.2	0.0
Prop. Right-Turns	0.0	1.0	0.3		0.0	0.3	0.0	1.0
Prop. Heavy Vehicle	0.0	0.0	0.0		0.0	0.0	0.0	0.0
Geometry Group	5		4b		5		5	
Adjustments Exhibit 17-33:								
hLT-adj	0.5		0.2		0.5		0.5	
hRT-adj	-0.7		-0.6		-0.7		-0.7	
hHV-adj	1.7		1.7		1.7		1.7	
hadj, computed	0.0	-0.7	-0.1		0.5	-0.2	0.1	-0.7

Worksheet 4 - Departure Headway and Service Time

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow rate	170	30	280		5	265	245	25
hd, initial value	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20
x, initial	0.15	0.03	0.25		0.00	0.24	0.22	0.02
hd, final value	6.77	6.03	6.42		7.08	6.36	6.69	5.85
x, final value	0.32	0.05	0.50		0.01	0.47	0.46	0.04
Move-up time, m	2.3		2.3		2.3		2.3	
Service Time	4.5	3.7	4.1		4.8	4.1	4.4	3.6

Worksheet 5 - Capacity and Level of Service

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rate	170	30	280		5	265	245	25
Service Time	4.5	3.7	4.1		4.8	4.1	4.4	3.6
Utilization, x	0.32	0.05	0.50		0.01	0.47	0.46	0.04
Dep. headway, hd	6.77	6.03	6.42		7.08	6.36	6.69	5.85
Capacity	420	280	530		255	515	495	275
Delay	12.62	9.05	15.35		9.85	14.53	14.85	8.80
LOS	B	A	C		A	B	B	A
Approach:								
Delay	12.08		15.35		14.45		14.29	
LOS	B		C		B		B	

Intersection Delay 14.19 Intersection LOS B

HCS2000: Unsignalized Intersections Release 4.1d

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ALL-WAY STOP CONTROL(AWSC) ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 11/15/2004
Analysis Time Period: pm
Intersection: CTH K/104th
Jurisdiction: Kenosha County
Units: U. S. Customary
Analysis Year: 2004
Project ID: 2007 site+background - no improvements
East/West Street: CTH K
North/South Street: 104th

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	10	215	20	75	175	130	15	245	90	110	215	25
% Thrus Left Lane												

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	LT	R	LTR		L	TR	LT	R
PHF	1.00	1.00	1.00		1.00	1.00	1.00	1.00
Flow Rate	225	20	380		15	335	325	25
% Heavy Veh	0	0	0		0	0	0	0
No. Lanes	2		1		2		2	
Opposing-Lanes	1		2		2		2	
Conflicting-lanes	2		2		2		2	
Geometry group	5		4b		5		5	

Duration, T 0.25 hrs.

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	225	20	380		15	335	325	25
Left-Turn	10	0	75		15	0	110	0
Right-Turn	0	20	130		0	90	0	25
Prop. Left-Turns	0.0	0.0	0.2		1.0	0.0	0.3	0.0
Prop. Right-Turns	0.0	1.0	0.3		0.0	0.3	0.0	1.0
Prop. Heavy Vehicle	0.0	0.0	0.0		0.0	0.0	0.0	0.0
Geometry Group	5		4b		5		5	
Adjustments Exhibit 17-33:								
hLT-adj	0.5		0.2		0.5		0.5	
hRT-adj	-0.7		-0.6		-0.7		-0.7	
hHV-adj	1.7		1.7		1.7		1.7	
hadj, computed	0.0	-0.7	-0.2		0.5	-0.2	0.2	-0.7

Worksheet 4 - Departure Headway and Service Time

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow rate	225	20	380		15	335	325	25
hd, initial value	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20
x, initial	0.20	0.02	0.34		0.01	0.30	0.29	0.02
hd, final value	8.28	7.54	7.57		8.46	7.75	8.09	7.20
x, final value	0.52	0.04	0.80		0.04	0.72	0.73	0.05
Move-up time, m	2.3		2.3		2.3		2.3	
Service Time	6.0	5.2	5.3		6.2	5.4	5.8	4.9

Worksheet 5 - Capacity and Level of Service

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rate	225	20	380		15	335	325	25
Service Time	6.0	5.2	5.3		6.2	5.4	5.8	4.9
Utilization, x	0.52	0.04	0.80		0.04	0.72	0.73	0.05
Dep. headway, hd	8.28	7.54	7.57		8.46	7.75	8.09	7.20
Capacity	395	270	460		265	444	426	275
Delay	19.52	10.57	34.15		11.46	28.00	29.75	10.27
LOS	C	B	D		B	D	D	B
Approach:								
Delay	18.79		34.15		27.29		28.36	
LOS	C		D		D		D	

Intersection Delay 27.97 Intersection LOS D

2007 TOTAL TRAFFIC CAPACITY ANALYSIS – WITH IMPROVEMENTS

HCS2000: Signalized Intersections Release 4.1e

Analyst: md
Agency:
Date: 1/4/2005
Period: am
Project ID: 2007 total traffic - with improvements
E/W St: sth 158

Inter.: sth 158/cth h
Area Type: All other areas
Jurisd: wisdot
Year : 2007
N/S St: cth h

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	2	1	1	2	0	0	1	0	0	1	1
LGConfig	L	T	R	L	TR			LTR			LT	R
Volume	95	680	110	65	765	25	5	160	65	55	260	105
Lane Width	12.0	12.0	12.0	12.0	12.0			12.0			12.0	12.0
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A	A			NB Left		A		
Thru		A			Thru		A		
Right		A			Right		A		
Peds					Peds				
WB Left	A	A			SB Left	A	A		
Thru		A			Thru	A	A		
Right		A			Right	A	A		
Peds					Peds				
NB Right					EB Right				
SB Right	A				WB Right				
Green	5.0	35.0				7.0	25.0		
Yellow	3.0	4.5				3.0	4.5		
All Red	0.0	1.5				0.0	1.5		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	211	1752	0.51	0.48	17.8	B		
T	1311	3370	0.59	0.39	22.5	C	21.5	C
R	628	1615	0.20	0.39	18.4	B		
Westbound								
L	259	1752	0.29	0.48	15.0	B		
TR	1310	3368	0.68	0.39	24.4	C	23.7	C
Northbound								
LTR	493	1774	0.53	0.28	28.6	C	28.6	C
Southbound								
LT	517	1783	0.69	0.39	27.0	C	23.2	C
R	794	1553	0.15	0.51	11.7	B		

Intersection Delay = 23.3 (sec/veh) Intersection LOS = C

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/4/2005
Analysis Time Period: am
Intersection: sth 158/cth h
Area Type: All other areas
Jurisdiction: wisdot
Analysis Year: 2007
Project ID: 2007 total traffic - with improvements
East/West Street: sth 158 North/South Street: cth h

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	95	680	110	65	765	25	5	160	65	55	260	105
% Heavy Veh	3	13	0	3	7	4	20	1	3	4	6	4
PHF	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
PK 15 Vol	27	193	31	18	217	7	2	45	18	16	74	30
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	2000	1900	1900	1900			1900			1900	1900
ParkExist												
NumPark												
No. Lanes	1	2	1	1	2	0	0	1	0	0	1	1
LGConfig	L	T	R	L	TR			LTR			LT	R
Lane Width	12.0	12.0	12.0	12.0	12.0			12.0			12.0	12.0
RTOR Vol			0			0			0			0
Adj Flow	108	773	125	74	897			262			358	119
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000			0.023			0.176	
Prop RTs		0.000	1.000		0.031		0.282			0.000	1.000	
Peds Bikes	0			0			0			0		
Buses	0	0	0	0	0		0			0	0	
%InProtPhase	0.0			0.0						0.0		

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0	0.0	0.0	0.0			0.0			0.0	0.0
Arriv. Type	3	3	3	3	3			3			3	3
Unit Ext.	3.0	3.0	3.0	3.0	3.0			3.0			3.0	3.0
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0	2.0	2.0	2.0			2.0			2.0	2.0
Ext of g	2.0	2.0	2.0	2.0	2.0			2.0			2.0	2.0
Ped Min g	3.2			3.2			3.2			3.2		

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A	A			NB Left		A		
Thru		A			Thru		A		
Right		A			Right		A		
Peds					Peds				
WB Left	A	A			SB Left	A	A		
Thru		A			Thru	A	A		
Right		A			Right	A	A		
Peds					Peds				
NB Right					EB Right				
SB Right	A				WB Right				
Green	5.0	35.0				7.0	25.0		
Yellow	3.0	4.5				3.0	4.5		
All Red	0.0	1.5				0.0	1.5		

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	95	680	110	65	765	25	5	160	65	55	260	105
PHF	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Adj flow	108	773	125	74	869	28	6	182	74	63	295	119
No. Lanes	1	2	1	1	2	0	0	1	0	0	1	1
Lane group	L	T	R	L	TR			LTR			LT	R
Adj flow	108	773	125	74	897			262			358	119
Prop LTs	1.000	0.000		1.000	0.000			0.023			0.176	
Prop RTs		0.000	1.000		0.031		0.282			0.000	1.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L	T	R	L	TR			LTR			LT	R
So	1900	2000	1900	1900	1900			1900			1900	1900
Lanes	1	2	1	1	2	0	0	1	0	0	1	1
fW	1.000	1.000	1.000	1.000	1.000			1.000			1.000	1.000
fHV	0.971	0.885	1.000	0.971	0.935			0.980			0.947	0.962
fG	1.000	1.000	1.000	1.000	1.000			1.000			1.000	1.000
fP	1.000	1.000	1.000	1.000	1.000			1.000			1.000	1.000
fBB	1.000	1.000	1.000	1.000	1.000			1.000			1.000	1.000
fA	1.000	1.000	1.000	1.000	1.000			1.000			1.000	1.000
fLU	1.000	0.952	1.000	1.000	0.952			1.000			1.000	1.000
fRT		1.000	0.850		0.995			0.962			1.000	0.850
fLT	0.950	1.000		0.950	1.000			0.990			0.991	
Sec.	0.147			0.208							0.676	
fLpb	1.000	1.000		1.000	1.000			1.000			1.000	
fRpb		1.000	1.000		1.000			1.000			1.000	1.000
S	1752	3370	1615	1752	3368			1774			1783	1553
Sec.	271			383							1215	

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		97	1752	# 0.06	0.056	97	1.00
Perm		11	271	0.04	0.422	114	0.10
Left	L	108			0.48	211	0.51
Prot							
Perm							
Thru	T	773	3370	0.23	0.39	1311	0.59
Right	R	125	1615	0.08	0.39	628	0.20
Westbound							
Prot		74	1752	0.04	0.056	97	0.76
Perm		0	383	0.00	0.422	162	0.00
Left	L	74			0.48	259	0.29
Prot							
Perm							
Thru	TR	897	3368	# 0.27	0.39	1310	0.68
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	262	1774	0.15	0.28	493	0.53
Right							
Southbound							
Prot							
Perm							
Left							
Prot		139	1783	# 0.08	0.078	139	1.00
Perm		219	1215	# 0.18	0.311	378	0.58
Thru	LT	358			0.39	517	0.69
Right	R	119	1553	0.08	0.51	794	0.15

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.58
Total lost time per cycle, L = 18.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.72

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	0.51	0.48	15.7	1.000	211	0.12	2.1	0.0	17.8	B		
T	0.59	0.39	21.8	1.000	1311	0.18	0.7	0.0	22.5	C	21.5	C
R	0.20	0.39	18.2	1.000	628	0.11	0.2	0.0	18.4	B		
Westbound												
L	0.29	0.48	14.4	1.000	259	0.11	0.6	0.0	15.0	B		
TR	0.68	0.39	22.9	1.000	1310	0.25	1.5	0.0	24.4	C	23.7	C
Northbound												
LTR	0.53	0.28	27.5	1.000	493	0.13	1.1	0.0	28.6	C	28.6	C
Southbound												

LT	0.69	0.39	23.0	1.000	517	0.26	4.0	0.0	27.0	C	23.2	C
R	0.15	0.51	11.6	1.000	794	0.11	0.1	0.0	11.7	B		

Intersection delay = 23.3 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M		
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	43.0	43.0		
Effective permitted green time for LT lane group, g(s)	38.0	38.0		
Opposing effective green time, go (s)	35.0	35.0		
Number of lanes in LT lane group, N	1	1		
Number of lanes in opposing approach, No	2	2		
Adjusted LT flow rate, VLT (veh/h)	108	74		
Proportion of LT in LT lane group, PLT	1.000	1.000		
Proportion of LT in opposing flow, PLTo	0.00	0.00		
Adjusted opposing flow rate, Vo (veh/h)	897	773		
Lost time for LT lane group, tL	6.00	6.00		
Computation				
LT volume per cycle, LTC=VLTC/3600	2.70	1.85		
Opposing lane util. factor, fLUo	0.952	0.952	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	11.78	10.15		
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g	0.0	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.61	0.61		
gq, (see Exhibit C16-4,5,6,7,8)	19.50	16.02		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	18.50	21.98		
n=Max(gq-gf)/2,0)	9.75	8.01		
PTHo=1-PLTo	1.00	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00		
EL1 (refer to Exhibit C16-3)	3.31	2.78		
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.11	0.11		
gdiff=max(gq-gf,0)	0.00	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.15	0.21		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/{1+PL(EL2-1)},(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.147	0.208		

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach			M	S
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)			25.0	35.0
Effective permitted green time for LT lane group, g(s)			25.0	28.0
Opposing effective green time, go (s)			35.0	25.0
Number of lanes in LT lane group, N			1	1
Number of lanes in opposing approach, No			1	1
Adjusted LT flow rate, VLT (veh/h)			6	63
Proportion of LT in LT lane group, PLT	0.000	0.000	0.023	0.176
Proportion of LT in opposing flow, PLTo			0.18	0.02
Adjusted opposing flow rate, Vo (veh/h)			358	262
Lost time for LT lane group, tL			6.00	6.00
Computation				
LT volume per cycle, LTC=VLTC/3600			0.15	1.58
Opposing lane util. factor, fLUo	0.952	0.952	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			8.95	6.55
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g			13.9	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.61	0.72
gq, (see Exhibit C16-4,5,6,7,8)			0.00	14.66
gu=g-gq if gq>=gf, or = g-gf if gq<gf			11.06	13.34
n=Max(gq-gf)/2,0)			0.00	7.33
PTHo=1-PLTo			0.82	0.98
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			0.02	0.18
EL1 (refer to Exhibit C16-3)			2.00	1.81
EL2=Max((1-Ptho**n)/Plto, 1.0)			1.00	6.82
fmin=2(1+PL)/g or fmin=2(1+Pl)/g			0.08	0.08
gdiff=max(gq-gf,0)			0.00	14.66
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.99	0.68
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.990	0.676

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 90.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v	108	74		
v/c ratio from Capacity Worksheet, X	0.51	0.29		
Protected phase effective green interval, g (s)	5.0	5.0		
Opposing queue effective green interval, gq	19.50	16.02		
Unopposed green interval, gu	18.50	21.98		
Red time r=(C-g-gq-gu)	47.0	47.0		
Arrival rate, qa=v/(3600(max[X,1.0]))	0.03	0.02		
Protected ph. departure rate, Sp=s/3600	0.487	0.487		
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.15	0.18		
XPerm	0.40	0.19		
XProt	0.64	0.44		
Case	1	1		
Queue at beginning of green arrow, Qa	1.41	0.97		
Queue at beginning of unsaturated green, Qu	0.58	0.33		
Residual queue, Qr	0.00	0.00		
Uniform Delay, d1	15.7	14.4		

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Dur. Unmet Demand Q veh	Unmet Demand t hrs.	Uniform Delay Unadj. ds	Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 23.3 sec/veh Intersection LOS C

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound		Northbound		Southbound	
LaneGroup	L	T	R	L	TR	LTR		LT	R
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0
Flow Rate	108	405	125	74	471	262		358	119
So	1900	2000	1900	1900	1900	1900		1900	1900
No.Lanes	1	2	1	1	2 0	0 1 0		0 1	1
SL	443	1769	1615	542	1768	1774		1328	1553
LnCapacity	211	688	628	259	688	493		517	794
Flow Ratio	0.24	0.23	0.08	0.14	0.27	0.15		0.27	0.08
v/c Ratio	0.51	0.59	0.20	0.29	0.68	0.53		0.69	0.15
Grn Ratio	0.48	0.39	0.39	0.48	0.39	0.28		0.39	0.51
I Factor		1.000			1.000	1.000		1.000	
AT or PVG	3	3	3	3	3	3		3	3
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00
PF2	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00
Q1	1.5	8.0	2.1	1.0	9.8	5.5		5.8	1.6
kB	0.3	0.6	0.5	0.3	0.6	0.5		0.5	0.6
Q2	0.3	0.8	0.1	0.1	1.1	0.5		1.0	0.1
Q Average	1.7	8.8	2.2	1.1	11.0	6.1		6.8	1.7
Q Spacing	25.0	25.0	25.0	25.0	25.0	25.0		25.0	25.0
Q Storage	0	0	0	0	0	0		0	0
Q S Ratio									
70th Percentile Output:									
fB%	1.2	1.2	1.2	1.2	1.2	1.2		1.2	1.2
BOQ	2.1	10.4	2.6	1.3	12.9	7.2		8.0	2.0
QSRatio									
85th Percentile Output:									
fB%	1.6	1.5	1.6	1.6	1.5	1.5		1.5	1.6
BOQ	2.7	13.4	3.5	1.8	16.5	9.4		10.4	2.7
QSRatio									
90th Percentile Output:									
fB%	1.8	1.7	1.8	1.8	1.6	1.7		1.7	1.8
BOQ	3.1	14.6	3.9	2.0	17.9	10.3		11.4	3.0
QSRatio									
95th Percentile Output:									
fB%	2.0	1.9	2.0	2.1	1.8	1.9		1.9	2.0
BOQ	3.5	16.4	4.5	2.3	20.0	11.7		13.0	3.4
QSRatio									
98th Percentile Output:									
fB%	2.6	2.2	2.5	2.6	2.1	2.3		2.3	2.6
BOQ	4.5	19.4	5.6	2.9	23.3	14.1		15.5	4.3
QSRatio									

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: md
Agency:
Date: 1/4/2005
Period: pm
Project ID: 2007 site+background
E/W St: sth 158

Inter.: sth 158/cth h
Area Type: All other areas
Jurisd: wisdot
Year : 2007

N/S St: cth h

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	2	1	1	2	0	0	1	0	0	1	1
LGConfig	L	T	R	L	TR			LTR			LT	R
Volume	160	930	165	40	665	60	10	310	50	55	280	75
Lane Width	12.0	12.0	12.0	12.0	12.0			12.0			12.0	12.0
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A	A			NB Left		A		
Thru		A			Thru		A		
Right		A			Right		A		
Peds					Peds				
WB Left	A	A			SB Left	A	A		
Thru		A			Thru	A	A		
Right		A			Right	A	A		
Peds					Peds				
NB Right					EB Right				
SB Right	A				WB Right				
Green	6.0	31.0				7.0	28.0		
Yellow	3.0	4.5				3.0	4.5		
All Red	0.0	1.5				0.0	1.5		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	225	1805	0.81	0.44	37.6	D		
T	1249	3627	0.85	0.34	32.9	C	32.1	C
R	556	1615	0.34	0.34	22.3	C		
Westbound								
L	205	1805	0.22	0.44	18.8	B		
TR	1187	3446	0.69	0.34	27.2	C	26.8	C
Northbound								
LTR	558	1795	0.75	0.31	33.6	C	33.6	C
Southbound								
LT	511	1832	0.75	0.42	27.8	C	24.5	C
R	808	1455	0.11	0.56	9.5	A		

Intersection Delay = 29.7 (sec/veh) Intersection LOS = C

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/4/2005
Analysis Time Period: pm
Intersection: sth 158/cth h
Area Type: All other areas
Jurisdiction: wisdot
Analysis Year: 2007
Project ID: 2007 site+background
East/West Street: sth 158
North/South Street: cth h

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	160	930	165	40	665	60	10	310	50	55	280	75
% Heavy Veh	0	5	0	0	4	0	10	2	4	2	3	11
PHF	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
PK 15 Vol	45	264	47	11	189	17	3	88	14	16	80	21
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	2000	1900	1900	1900			1900			1900	1900
ParkExist												
NumPark												
No. Lanes	1	2	1	1	2	0	0	1	0	0	1	1
LGConfig	L	T	R	L	TR			LTR			LT	R
Lane Width	12.0	12.0	12.0	12.0	12.0			12.0			12.0	12.0
RTOR Vol			0			0			0			0
Adj Flow	182	1057	188	45	824			420			381	85
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000			0.026			0.165	
Prop RTs		0.000	1.000		0.083		0.136			0.000	1.000	
Peds Bikes	0			0			0			0		
Buses	0	0	0	0	0			0			0	0
%InProtPhase	0.0			0.0						0.0		

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0	0.0	0.0	0.0			0.0			0.0	0.0
Arriv. Type	3	3	3	3	3			3			3	3
Unit Ext.	3.0	3.0	3.0	3.0	3.0			3.0			3.0	3.0
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0	2.0	2.0	2.0			2.0			2.0	2.0
Ext of g	2.0	2.0	2.0	2.0	2.0			2.0			2.0	2.0
Ped Min g	3.2			3.2				3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A	A			NB Left		A		
Thru		A			Thru		A		
Right		A			Right		A		
Peds					Peds				
WB Left	A	A			SB Left	A	A		
Thru		A			Thru	A	A		
Right		A			Right	A	A		
Peds					Peds				
NB Right					EB Right				
SB Right	A				WB Right				
Green	6.0	31.0				7.0	28.0		
Yellow	3.0	4.5				3.0	4.5		
All Red	0.0	1.5				0.0	1.5		

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	160	930	165	40	665	60	10	310	50	55	280	75
PHF	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Adj flow	182	1057	188	45	756	68	11	352	57	63	318	85
No. Lanes	1	2	1	1	2	0	0	1	0	0	1	1
Lane group	L	T	R	L	TR			LTR			LT	R
Adj flow	182	1057	188	45	824			420			381	85
Prop LTs	1.000	0.000		1.000	0.000			0.026			0.165	
Prop RTs		0.000	1.000		0.083		0.136			0.000	1.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L	T	R	L	TR			LTR			LT	R
So	1900	2000	1900	1900	1900			1900			1900	1900
Lanes	1	2	1	1	2	0	0	1	0	0	1	1
fW	1.000	1.000	1.000	1.000	1.000			1.000			1.000	1.000
fHV	1.000	0.952	1.000	1.000	0.965			0.976			0.972	0.901
fG	1.000	1.000	1.000	1.000	1.000			1.000			1.000	1.000
fP	1.000	1.000	1.000	1.000	1.000			1.000			1.000	1.000
fBB	1.000	1.000	1.000	1.000	1.000			1.000			1.000	1.000
fA	1.000	1.000	1.000	1.000	1.000			1.000			1.000	1.000
fLU	1.000	0.952	1.000	1.000	0.952			0.982			1.000	1.000
fRT		1.000	0.850		0.988			0.986			1.000	0.850
fLT	0.950	1.000		0.950	1.000						0.992	
Sec.	0.146			0.118				1.000			0.580	
fLpb	1.000	1.000		1.000	1.000			1.000			1.000	
fRpb		1.000	1.000		1.000			1.000			1.000	1.000
S	1805	3627	1615	1805	3446			1795			1832	1455
Sec.	278			224							1071	

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	Lane Group Capacity (c)	v/c Ratio
Eastbound							
Prot		120	1805	# 0.07	0.067	120	1.00
Perm		62	278	0.22	0.378	105	0.59
Left	L	182			0.44	225	0.81
Prot							
Perm							
Thru	T	1057	3627	# 0.29	0.34	1249	0.85
Right	R	188	1615	0.12	0.34	556	0.34
Westbound							
Prot		45	1805	0.02	0.067	120	0.38
Perm		0	224	0.00	0.378	85	0.00
Left	L	45			0.44	205	0.22
Prot							
Perm							
Thru	TR	824	3446	0.24	0.34	1187	0.69
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	420	1795	# 0.23	0.31	558	0.75
Right							
Southbound							
Prot							
Perm							
Left							
Prot		142	1832	# 0.08	0.078	142	1.00
Perm		239	1071	0.22	0.344	369	0.65
Thru	LT	381			0.42	511	0.75
Right	R	85	1455	0.06	0.56	808	0.11

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.67
Total lost time per cycle, L = 24.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.91

Control Delay and LOS Determination

Appr/ Lane Grp	v/c	g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	0.81	0.44	18.2	1.000	225	0.35	19.4	0.0	37.6	D		
T	0.85	0.34	27.3	1.000	1249	0.38	5.6	0.0	32.9	C	32.1	C
R	0.34	0.34	21.9	1.000	556	0.11	0.4	0.0	22.3	C		
Westbound												
L	0.22	0.44	18.3	1.000	205	0.11	0.5	0.0	18.8	B		
TR	0.69	0.34	25.4	1.000	1187	0.26	1.8	0.0	27.2	C	26.8	C
Northbound												
LTR	0.75	0.31	27.9	1.000	558	0.31	5.7	0.0	33.6	C	33.6	C
Southbound												

LT	0.75	0.42	21.9	1.000	511	0.30	5.9	0.0	27.8	C	24.5	C
R	0.11	0.56	9.4	1.000	808	0.11	0.1	0.0	9.5	A		

Intersection delay = 29.7 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M		
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	40.0	40.0		
Effective permitted green time for LT lane group, g(s)	34.0	34.0		
Opposing effective green time, go (s)	31.0	31.0		
Number of lanes in LT lane group, N	1	1		
Number of lanes in opposing approach, No	2	2		
Adjusted LT flow rate, VLT (veh/h)	182	45		
Proportion of LT in LT lane group, PLT	1.000	1.000		
Proportion of LT in opposing flow, PLTo	0.00	0.00		
Adjusted opposing flow rate, Vo (veh/h)	824	1057		
Lost time for LT lane group, tL	6.00	6.00		
Computation				
LT volume per cycle, LTC=VLTC/3600	4.55	1.13		
Opposing lane util. factor, fLUo	0.952	0.952	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	10.82	13.88		
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g	0.0	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.66	0.66		
gq, (see Exhibit C16-4,5,6,7,8)	18.68	26.31		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	15.32	7.69		
n=Max(gq-gf)/2,0)	9.34	13.16		
PTHo=1-PLTo	1.00	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00		
EL1 (refer to Exhibit C16-3)	3.08	3.68		
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.12	0.12		
gdiff=max(gq-gf,0)	0.00	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.15	0.12		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.146	0.118		

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach			M	S
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)			28.0	38.0
Effective permitted green time for LT lane group, g(s)			28.0	31.0
Opposing effective green time, go (s)			38.0	28.0
Number of lanes in LT lane group, N			1	1
Number of lanes in opposing approach, No			1	1
Adjusted LT flow rate, VLT (veh/h)			11	63
Proportion of LT in LT lane group, PLT	0.000	0.000	0.026	0.165
Proportion of LT in opposing flow, PLTo			0.17	0.03
Adjusted opposing flow rate, Vo (veh/h)			381	420
Lost time for LT lane group, tL			6.00	6.00
Computation				
LT volume per cycle, LTC=VLTC/3600			0.28	1.58
Opposing lane util. factor, fLUo	0.952	0.952	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			9.52	10.50
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g			13.7	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.58	0.69
gq, (see Exhibit C16-4,5,6,7,8)			0.00	19.97
gu=g-gq if gq>=gf, or = g-gf if gq<gf			14.26	11.03
n=Max(gq-gf)/2,0)			0.00	9.99
PTHo=1-PLTo			0.83	0.97
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			0.03	0.17
EL1 (refer to Exhibit C16-3)			2.04	2.12
EL2=Max((1-Ptho**n)/Plto, 1.0)			1.00	8.89
fmin=2(1+PL)/g or fmin=2(1+Pl)/g			0.07	0.08
gdiff=max(gq-gf,0)			0.00	19.97
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.99	0.58
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.986	0.580

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 90.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v	182	45		
v/c ratio from Capacity Worksheet, X	0.81	0.22		
Protected phase effective green interval, g (s)	6.0	6.0		
Opposing queue effective green interval, gq	18.68	26.31		
Unopposed green interval, gu	15.32	7.69		
Red time r=(C-g-gq-gu)	50.0	50.0		
Arrival rate, qa=v/(3600(max[X,1.0]))	0.05	0.01		
Protected ph. departure rate, Sp=s/3600	0.501	0.501		
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.17	0.28		
XPerm	0.65	0.20		
XProt	0.94	0.23		
Case	1	1		
Queue at beginning of green arrow, Qa	2.53	0.63		
Queue at beginning of unsaturated green, Qu	0.94	0.33		
Residual queue, Qr	0.00	0.00		
Uniform Delay, d1	18.2	18.3		

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Dur. Unmet Demand Q veh	Unmet Demand t hrs.	Uniform Delay Unadj. ds	Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 29.7 sec/veh Intersection LOS C

BACK OF QUEUE WORKSHEET

LaneGroup	Eastbound L	T	R	Westbound L	TR	Northbound LTR	Southbound LT	R
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	182	555	188	45	432	420	381	85
So	1900	2000	1900	1900	1900	1900	1900	1900
No.Lanes	1	2	1	1	2 0	0 1 0	0 1	1
SL	507	1904	1615	461	1809	1795	1211	1455
LnCapacity	225	655	556	205	623	558	511	808
Flow Ratio	0.36	0.29	0.12	0.10	0.24	0.23	0.31	0.06
v/c Ratio	0.81	0.85	0.34	0.22	0.69	0.75	0.75	0.11
Grn Ratio	0.44	0.34	0.34	0.44	0.34	0.31	0.42	0.56
I Factor		1.000			1.000	1.000	1.000	
AT or PVG	3	3	3	3	3	3	3	3
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Q1	2.7	12.8	3.5	0.6	9.3	9.4	5.8	1.0
kB	0.3	0.5	0.5	0.3	0.5	0.5	0.5	0.6
Q2	1.0	2.5	0.2	0.1	1.1	1.4	1.3	0.1
Q Average	3.7	15.3	3.7	0.7	10.4	10.8	7.1	1.1
Q Spacing	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0
Q Storage	0	0	0	0	0	0	0	0
Q S Ratio								
70th Percentile Output:								
fB%	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
BOQ	4.4	17.9	4.4	0.8	12.3	12.7	8.4	1.3
QSRatio								
85th Percentile Output:								
fB%	1.6	1.5	1.6	1.6	1.5	1.5	1.5	1.6
BOQ	5.8	22.7	5.8	1.1	15.8	16.3	10.9	1.7
QSRatio								
90th Percentile Output:								
fB%	1.7	1.6	1.7	1.8	1.6	1.6	1.7	1.8
BOQ	6.4	24.3	6.5	1.3	17.1	17.7	11.9	1.9
QSRatio								
95th Percentile Output:								
fB%	2.0	1.8	2.0	2.1	1.8	1.8	1.9	2.1
BOQ	7.3	26.9	7.4	1.5	19.1	19.8	13.5	2.2
QSRatio								
98th Percentile Output:								
fB%	2.5	2.0	2.5	2.6	2.1	2.1	2.3	2.6
BOQ	9.0	30.8	9.1	1.9	22.4	23.1	16.2	2.8
QSRatio								

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: md
Agency:
Date: 1/10/2005
Period: am
Project ID: 2007 total traffic - with improvements
E/W St: STH 158

Inter.: STH 158/104th
Area Type: All other areas
Jurisd: WisDOT
Year : 2007
N/S St: 104th Ave

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	2	1	1	2	1	1	1	1	1	1	0
LGConfig	L	T	R	L	T	R	L	LT	R	L	TR	
Volume	5	715	235	185	635	5	495	5	370	5	10	5
Lane Width	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A		A		NB Left	A			
Thru			A		Thru	A			
Right			A		Right	A			
Peds					Peds				
WB Left	A	A	A		SB Left		A		
Thru		A	A		Thru		A		
Right		A	A		Right		A		
Peds					Peds				
NB Right	A	A			EB Right	A			
SB Right					WB Right		A		
Green	5.0	4.0	26.0			23.0	8.0		
Yellow	3.0	3.0	4.5			4.5	4.5		
All Red	0.0	0.0	1.5			1.5	1.5		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	281	1770	0.02	0.34	19.4	B		
T	957	3311	0.90	0.29	42.1	D	33.7	C
R	967	1583	0.29	0.61	8.5	A		
Westbound								
L	319	1770	0.70	0.46	25.2	C		
T	1293	3526	0.59	0.37	23.8	C	24.0	C
R	721	1583	0.01	0.46	13.4	B		
Northbound								
L	461	1805	0.65	0.26	33.0	C		
LT	463	1811	0.66	0.26	33.3	C	30.7	C
R	622	1599	0.72	0.39	27.3	C		
Southbound								
L	157	1770	0.04	0.09	37.6	D		
TR	156	1758	0.12	0.09	38.1	D	38.0	D

Intersection Delay = 29.8 (sec/veh) Intersection LOS = C

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/10/2005
Analysis Time Period: am
Intersection: STH 158/104th
Area Type: All other areas
Jurisdiction: WisDOT
Analysis Year: 2007
Project ID: 2007 total traffic - with improvements
East/West Street: STH 158 North/South Street: 104th Ave

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	5	715	235	185	635	5	495	5	370	5	10	5
% Heavy Veh	2	15	2	2	8	2	0	0	1	2	3	2
PHF	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83
PK 15 Vol	2	215	71	56	191	2	149	2	111	2	3	2
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	2000	1900	1900	2000	1900	1900	1900	1900	1900	1900	
ParkExist												
NumPark												
No. Lanes	1	2	1	1	2	1	1	1	1	1	1	0
LGConfig	L	T	R	L	T	R	L	LT	R	L	TR	
Lane Width	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	
RTOR Vol			0			0			0			0
Adj Flow	6	861	283	223	765	6	298	304	446	6	18	
%InSharedLn							50					
Prop LTs	1.000	0.000		1.000	0.000			0.980			0.000	
Prop RTs		0.000	1.000		0.000	1.000		0.000	1.000		0.333	
Peds Bikes	0			0			0			0		
Buses	0	0	0	0	0	0	0	0	0	0	0	
%InProtPhase	0.0			0.0								

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Arriv. Type	3	3	3	3	3	3	3	3	3	3	3	
Unit Ext.	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	
Ext of g	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	

Ped Min g	3.2	3.2	3.2	3.2

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A		A		NB Left	A			
Thru			A		Thru	A			
Right			A		Right	A			
Peds					Peds				
WB Left	A	A	A		SB Left		A		
Thru		A	A		Thru		A		
Right		A	A		Right		A		
Peds					Peds				
NB Right	A	A			EB Right	A			
SB Right					WB Right		A		
Green	5.0	4.0	26.0			23.0	8.0		
Yellow	3.0	3.0	4.5			4.5	4.5		
All Red	0.0	0.0	1.5			1.5	1.5		

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	5	715	235	185	635	5	495	5	370	5	10	5
PHF	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83
Adj flow	6	861	283	223	765	6	596	6	446	6	12	6
No. Lanes	1	2	1	1	2	1	1	1	1	1	1	0
Lane group	L	T	R	L	T	R	L	LT	R	L	TR	
Adj flow	6	861	283	223	765	6	298	304	446	6	18	
Prop LTs	1.000	0.000		1.000	0.000			0.980			0.000	
Prop RTs		0.000	1.000		0.000	1.000		0.000	1.000		0.333	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound L	T	R	Westbound L	T	R	Northbound L	LT	R	Southbound L	TR	
So	1900	2000	1900	1900	2000	1900	1900	1900	1900	1900	1900	
Lanes	1	2	1	1	2	1	1	1	1	1	1	0
fW	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
fHV	0.980	0.870	0.980	0.980	0.926	0.980	1.000	1.000	0.990	0.980	0.974	
fG	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
fP	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
fBB	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
fA	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
fLU	1.000	0.952	1.000	1.000	0.952	1.000	1.000	1.000	1.000	1.000	1.000	
fRT		1.000	0.850		1.000	0.850		1.000	0.850		0.950	
fLT	0.950	1.000		0.950	1.000		0.950	0.953		0.950	1.000	
Sec.	0.339			0.138								
fLpb	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fRpb		1.000	1.000		1.000	1.000		1.000	1.000		1.000	
S	1770	3311	1583	1770	3526	1583	1805	1811	1599	1770	1758	
Sec.	632			257								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		6	1770	0.00	0.056	98	0.06
Perm		0	632	0.00	0.289	183	0.00
Left	L	6			0.34	281	0.02
Prot							
Perm							
Thru	T	861	3311	# 0.26	0.29	957	0.90
Right	R	283	1583	0.18	0.61	967	0.29
Westbound							
Prot		223	1770	# 0.13	0.133	236	0.94
Perm		0	257	0.00	0.322	83	0.00
Left	L	223			0.46	319	0.70
Prot							
Perm							
Thru	T	765	3526	0.22	0.37	1293	0.59
Right	R	6	1583	0.00	0.46	721	0.01
Northbound							
Prot							
Perm							
Left	L	298	1805	0.17	0.26	461	0.65
Prot							
Perm							
Thru	LT	304	1811	# 0.17	0.26	463	0.66
Right	R	446	1599	0.28	0.39	622	0.72
Southbound							
Prot							
Perm							
Left	L	6	1770	0.00	0.09	157	0.04
Prot							
Perm							
Thru	TR	18	1758	# 0.01	0.09	156	0.12
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.56
Total lost time per cycle, L = 24.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.77

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	0.02	0.34	19.4	1.000	281	0.11	0.0	0.0	19.4	B		
T	0.90	0.29	30.7	1.000	957	0.42	11.4	0.0	42.1	D	33.7	C
R	0.29	0.61	8.3	1.000	967	0.11	0.2	0.0	8.5	A		
Westbound												
L	0.70	0.46	18.6	1.000	319	0.27	6.6	0.0	25.2	C		
T	0.59	0.37	23.1	1.000	1293	0.18	0.7	0.0	23.8	C	24.0	C
R	0.01	0.46	13.4	1.000	721	0.11	0.0	0.0	13.4	B		
Northbound												
L	0.65	0.26	29.9	1.000	461	0.22	3.1	0.0	33.0	C		
LT	0.66	0.26	30.0	1.000	463	0.23	3.4	0.0	33.3	C	30.7	C
R	0.72	0.39	23.3	1.000	622	0.28	4.0	0.0	27.3	C		
Southbound												
L	0.04	0.09	37.5	1.000	157	0.11	0.1	0.0	37.6	D		

TR	0.12	0.09	37.7	1.000	156	0.11	0.3	0.0	38.1	D	38.0	D

Intersection delay = 29.8 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M		
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	31.0	41.0		
Effective permitted green time for LT lane group, g(s)	26.0	29.0		
Opposing effective green time, go (s)	33.0	26.0		
Number of lanes in LT lane group, N	1	1		
Number of lanes in opposing approach, No	2	2		
Adjusted LT flow rate, VLT (veh/h)	6	223		
Proportion of LT in LT lane group, PLT	1.000	1.000		
Proportion of LT in opposing flow, PLTo	0.00	0.00		
Adjusted opposing flow rate, Vo (veh/h)	765	861		
Lost time for LT lane group, tL	9.00	6.00		
Computation				
LT volume per cycle, LTC=VLTC/3600	0.15	5.58		
Opposing lane util. factor, fLUo	0.952	0.952	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	10.04	11.31		
gf=G[exp(- a * (LTC ** b)]-tl, gf<=g	0.0	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.63	0.71		
gq, (see Exhibit C16-4,5,6,7,8)	0.38	21.47		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	25.62	7.53		
n=Max(gq-gf)/2,0)	0.19	10.74		
PTHo=1-PLTo	1.00	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00		
EL1 (refer to Exhibit C16-3)	2.91	3.19		
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.15	0.14		
gdiff=max(gq-gf,0)	0.00	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.34	0.14		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.339	0.138		

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000	0.980	0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	0.952	0.952	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b)]-tl, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 90.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v	6	223		
v/c ratio from Capacity Worksheet, X	0.02	0.70		
Protected phase effective green interval, g (s)	5.0	12.0		
Opposing queue effective green interval, gq	0.38	21.47		
Unopposed green interval, gu	25.62	7.53		
Red time r=(C-g-gq-gu)	59.0	49.0		
Arrival rate, qa=v/(3600(max[X,1.0]))	0.00	0.06		
Protected ph. departure rate, Sp=s/3600	0.492	0.492		
Permitted ph. departure rate, Sa=s(gq+gu)/(gu*3600)	0.18	0.28		
XPerm	0.01	0.87		
XProt	0.04	0.64		
Case	1	1		
Queue at beginning of green arrow, Qa	0.10	3.04		
Queue at beginning of unsaturated green, Qu	0.00	1.33		
Residual queue, Qr	0.00	0.00		
Uniform Delay, d1	19.4	18.6		

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Dur. Unmet Demand Q veh	Initial Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Lane Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 29.8 sec/veh Intersection LOS C

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	T	R	L	T	R	L	LT	R	L	TR	
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Flow Rate	6	452	283	223	401	6	298	304	446	6	18	
So	1900	2000	1900	1900	2000	1900	1900	1900	1900	1900	1900	
No.Lanes	1	2	1	1	2	1	1	1	1	1	1	0
SL	816	1738	1583	700	1851	1583	1805	1811	1599	1770	1758	
LnCapacity	281	502	967	319	679	721	461	463	622	157	156	
Flow Ratio	0.01	0.26	0.18	0.32	0.22	0.00	0.17	0.17	0.28	0.00	0.01	
v/c Ratio	0.02	0.90	0.29	0.70	0.59	0.01	0.65	0.66	0.72	0.04	0.12	
Grn Ratio	0.34	0.29	0.61	0.46	0.37	0.46	0.26	0.26	0.39	0.09	0.09	
I Factor		1.000			1.000			1.000			1.000	
AT or PVG	3	3	3	3	3	3	3	3	3	3	3	
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
PF2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Q1	0.1	10.9	3.4	3.3	8.1	0.1	6.6	6.8	9.4	0.1	0.4	
kB	0.3	0.5	0.7	0.3	0.5	0.6	0.4	0.4	0.5	0.2	0.2	
Q2	0.0	2.8	0.3	0.8	0.8	0.0	0.8	0.8	1.2	0.0	0.0	
Q Average	0.1	13.7	3.6	4.1	8.9	0.1	7.4	7.6	10.7	0.1	0.4	
Q Spacing	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	
Q Storage	0	0	0	0	0	0	0	0	0	0	0	
Q S Ratio												
70th Percentile Output:												
fB%	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	
BOQ	0.1	16.0	4.3	4.9	10.5	0.1	8.8	9.0	12.6	0.2	0.5	
QSRatio												
85th Percentile Output:												
fB%	1.6	1.5	1.6	1.6	1.5	1.6	1.5	1.5	1.5	1.6	1.6	
BOQ	0.2	20.4	5.7	6.4	13.5	0.1	11.4	11.6	16.1	0.2	0.7	
QSRatio												
90th Percentile Output:												
fB%	1.8	1.6	1.7	1.7	1.7	1.8	1.7	1.7	1.6	1.8	1.8	
BOQ	0.2	21.9	6.3	7.1	14.7	0.2	12.4	12.7	17.5	0.3	0.8	
QSRatio												
95th Percentile Output:												
fB%	2.1	1.8	2.0	2.0	1.9	2.1	1.9	1.9	1.8	2.1	2.1	
BOQ	0.2	24.4	7.2	8.1	16.6	0.2	14.1	14.4	19.6	0.3	0.9	
QSRatio												
98th Percentile Output:												
fB%	2.7	2.0	2.5	2.4	2.2	2.7	2.3	2.3	2.1	2.7	2.7	
BOQ	0.3	28.1	8.9	10.0	19.6	0.2	16.8	17.2	22.9	0.4	1.2	
QSRatio												

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: md
Agency:
Date: 12/10/2004
Period: pm
Project ID: 2007 total traffic - with improvements
E/W St: STH 158

Inter.: STH 158/104th
Area Type: All other areas
Jurisd: WisDOT
Year : 2007
N/S St: 104th Ave

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	2	1	1	2	1	1	1	1	1	1	0
LGConfig	L	T	R	L	T	R	L	LT	R	L	TR	
Volume	5	660	90	175	775	5	920	5	575	10	5	10
Lane Width	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	
RTOR Vol			0			0			60			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A		A		NB Left	A			
Thru			A		Thru	A			
Right			A		Right	A			
Peds					Peds				
WB Left	A	A	A		SB Left		A		
Thru		A	A		Thru		A		
Right		A	A		Right		A		
Peds					Peds				
NB Right	A	A			EB Right				
SB Right					WB Right				
Green	4.0	2.0	23.0			33.0	4.0		
Yellow	3.0	3.0	4.5			4.5	4.5		
All Red	0.0	0.0	1.5			1.5	1.5		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Group	Adj Sat Flow Rate (s)	Ratios v/c	g/C	Lane Group Delay	LOS	Approach Delay	LOS
Eastbound								
L	162	1770	0.04	0.30	23.0	C		
T	927	3627	0.92	0.26	47.3	D	44.8	D
R	413	1615	0.28	0.26	27.3	C		
Westbound								
L	262	1787	0.87	0.39	47.2	D		
T	1118	3592	0.90	0.31	39.6	D	40.9	D
R	492	1583	0.01	0.31	21.4	C		
Northbound								
L	662	1805	0.90	0.37	42.8	D		
LT	664	1810	0.91	0.37	43.5	D	40.5	D
R	746	1599	0.90	0.47	35.6	D		
Southbound								
L	79	1770	0.16	0.04	42.4	D		
TR	74	1672	0.26	0.04	43.4	D	43.0	D

Intersection Delay = 41.6 (sec/veh) Intersection LOS = D

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 12/10/2004
Analysis Time Period: pm
Intersection: STH 158/104th
Area Type: All other areas
Jurisdiction: WisDOT
Analysis Year: 2007
Project ID: 2007 total traffic - with improvements
East/West Street: STH 158 North/South Street: 104th Ave

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	5	660	90	175	775	5	920	5	575	10	5	10
% Heavy Veh	2	5	0	1	6	2	0	0	1	2	2	2
PHF	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77
PK 15 Vol	2	214	29	57	252	2	299	2	187	3	2	3
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	2000	1900	1900	2000	1900	1900	1900	1900	1900	1900	
ParkExist												
NumPark												
No. Lanes	1	2	1	1	2	1	1	1	1	1	1	0
LGConfig	L	T	R	L	T	R	L	LT	R	L	TR	
Lane Width	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	
RTOR Vol			0			0			60			0
Adj Flow	6	857	117	227	1006	6	598	603	669	13	19	
%InSharedLn							50					
Prop LTs	1.000	0.000		1.000	0.000		0.991			0.000		
Prop RTs	0.000	1.000		0.000	1.000		0.000	1.000		0.684		
Peds Bikes	0			0			0			0		
Buses	0	0	0	0	0	0	0	0	0	0	0	
%InProtPhase	0.0			0.0								

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Arriv. Type	3	3	3	3	3	3	3	3	3	3	3	
Unit Ext.	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	
Ext of g	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	

Ped Min g	3.2	3.2	3.2	3.2

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A		A		NB Left	A			
Thru			A		Thru	A			
Right			A		Right	A			
Peds					Peds				
WB Left	A	A	A		SB Left		A		
Thru		A	A		Thru		A		
Right		A	A		Right		A		
Peds					Peds				
NB Right	A	A			EB Right				
SB Right					WB Right				
Green	4.0	2.0	23.0			33.0	4.0		
Yellow	3.0	3.0	4.5			4.5	4.5		
All Red	0.0	0.0	1.5			1.5	1.5		

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	5	660	90	175	775	5	920	5	575	10	5	10
PHF	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77
Adj flow	6	857	117	227	1006	6	1195	6	669	13	6	13
No. Lanes	1	2	1	1	2	1	1	1	1	1	1	0
Lane group	L	T	R	L	T	R	L	LT	R	L	TR	
Adj flow	6	857	117	227	1006	6	598	603	669	13	19	
Prop LTs	1.000	0.000		1.000	0.000			0.991			0.000	
Prop RTs	0.000	1.000		0.000	1.000		0.000	1.000		0.684		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L	T	R	L	T	R	L	LT	R	L	TR	
So	1900	2000	1900	1900	2000	1900	1900	1900	1900	1900	1900	
Lanes	1	2	1	1	2	1	1	1	1	1	1	0
fW	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
fHV	0.980	0.952	1.000	0.990	0.943	0.980	1.000	1.000	0.990	0.980	0.980	
fG	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
fP	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
fBB	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
fA	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
fLU	1.000	0.952	1.000	1.000	0.952	1.000	1.000	1.000	1.000	1.000	1.000	
fRT		1.000	0.850		1.000	0.850		1.000	0.850			0.897
fLT	0.950	1.000		0.950	1.000		0.950	0.953		0.950	1.000	
Sec.	0.174			0.154								
fLpb	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fRpb		1.000	1.000		1.000	1.000		1.000	1.000			1.000
S	1770	3627	1615	1787	3592	1583	1805	1810	1599	1770	1672	
Sec.	324			289								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		6	1770	0.00	0.044	79	0.08
Perm		0	324	0.00	0.256	83	0.00
Left	L	6			0.30	162	0.04
Prot							
Perm							
Thru	T	857	3627	# 0.24	0.26	927	0.92
Right	R	117	1615	0.07	0.26	413	0.28
Westbound							
Prot		179	1787	# 0.10	0.100	179	1.00
Perm		48	289	0.17	0.289	83	0.58
Left	L	227			0.39	262	0.87
Prot							
Perm							
Thru	T	1006	3592	0.28	0.31	1118	0.90
Right	R	6	1583	0.00	0.31	492	0.01
Northbound							
Prot							
Perm							
Left	L	598	1805	0.33	0.37	662	0.90
Prot							
Perm							
Thru	LT	603	1810	# 0.33	0.37	664	0.91
Right	R	669	1599	0.42	0.47	746	0.90
Southbound							
Prot							
Perm							
Left	L	13	1770	0.01	0.04	79	0.16
Prot							
Perm							
Thru	TR	19	1672	# 0.01	0.04	74	0.26
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (V/S) = 0.68
Total lost time per cycle, L = 24.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.93

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	LOS	Approach Delay	LOS
Eastbound												
L	0.04	0.30	22.9	1.000	162	0.11	0.1	0.0	23.0	C		
T	0.92	0.26	32.7	1.000	927	0.44	14.7	0.0	47.3	D	44.8	D
R	0.28	0.26	26.9	1.000	413	0.11	0.4	0.0	27.3	C		
Westbound												
L	0.87	0.39	22.3	1.000	262	0.40	24.9	0.0	47.2	D		
T	0.90	0.31	29.7	1.000	1118	0.42	10.0	0.0	39.6	D	40.9	D
R	0.01	0.31	21.4	1.000	492	0.11	0.0	0.0	21.4	C		
Northbound												
L	0.90	0.37	27.0	1.000	662	0.42	15.8	0.0	42.8	D		
LT	0.91	0.37	27.1	1.000	664	0.43	16.4	0.0	43.5	D	40.5	D
R	0.90	0.47	22.0	1.000	746	0.42	13.6	0.0	35.6	D		
Southbound												
L	0.16	0.04	41.4	1.000	79	0.11	1.0	0.0	42.4	D		

TR	0.26	0.04	41.6	1.000	74	0.11	1.8	0.0	43.4	D	43.0	D

Intersection delay = 41.6 (sec/veh) Intersection LOS = D

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M		
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	27.0	35.0		
Effective permitted green time for LT lane group, g(s)	23.0	26.0		
Opposing effective green time, go (s)	28.0	23.0		
Number of lanes in LT lane group, N	1	1		
Number of lanes in opposing approach, No	2	2		
Adjusted LT flow rate, VLT (veh/h)	6	227		
Proportion of LT in LT lane group, PLT	1.000	1.000		
Proportion of LT in opposing flow, PLTo	0.00	0.00		
Adjusted opposing flow rate, Vo (veh/h)	1006	857		
Lost time for LT lane group, tL	9.00	6.00		
Computation				
LT volume per cycle, LTC=VLTC/3600	0.15	5.68		
Opposing lane util. factor, fLUo	0.952	0.952	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	13.21	11.25		
gf=G[exp(- a * (LTC ** b)]-tl, gf<=g	0.0	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.69	0.74		
gq, (see Exhibit C16-4,5,6,7,8)	11.76	22.00		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	11.24	4.00		
n=Max(gq-gf)/2,0)	5.88	11.00		
PTHo=1-PLTo	1.00	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00		
EL1 (refer to Exhibit C16-3)	3.69	3.18		
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.17	0.15		
gdiff=max(gq-gf,0)	0.00	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.17	0.15		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.174	0.154		

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000	0.991	0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	0.952	0.952	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b)]-tl, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 90.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v	6	227		
v/c ratio from Capacity Worksheet, X	0.04	0.87		
Protected phase effective green interval, g (s)	4.0	9.0		
Opposing queue effective green interval, gq	11.76	22.00		
Unopposed green interval, gu	11.24	4.00		
Red time r=(C-g-gq-gu)	63.0	55.0		
Arrival rate, qa=v/(3600(max[X,1.0]))	0.00	0.06		
Protected ph. departure rate, Sp=s/3600	0.492	0.496		
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.18	0.52		
XPerm	0.02	0.79		
XProt	0.06	0.90		
Case	1	1		
Queue at beginning of green arrow, Qa	0.11	3.47		
Queue at beginning of unsaturated green, Qu	0.02	1.39		
Residual queue, Qr	0.00	0.00		
Uniform Delay, d1	22.9	22.3		

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Dur. Unmet Demand Q veh	Unmet Demand t hrs.	Uniform Delay Unadj. ds	Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 41.6 sec/veh Intersection LOS D

BACK OF QUEUE WORKSHEET

LaneGroup	Eastbound L	T	R	Westbound L	T	R	Northbound L	LT	R	Southbound L	TR
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	6	450	117	227	528	6	598	603	669	13	19
So	1900	2000	1900	1900	2000	1900	1900	1900	1900	1900	1900
No.Lanes	1	2	1	1	2	1	1	1	1	1	1 0
SL	538	1904	1615	674	1886	1583	1805	1810	1599	1770	1672
LnCapacity	162	486	413	262	587	492	662	664	746	79	74
Flow Ratio	0.01	0.24	0.07	0.34	0.28	0.00	0.33	0.33	0.42	0.01	0.01
v/c Ratio	0.04	0.93	0.28	0.87	0.90	0.01	0.90	0.91	0.90	0.16	0.26
Grn Ratio	0.30	0.26	0.26	0.39	0.31	0.31	0.37	0.37	0.47	0.04	0.04
I Factor	1.000			1.000			1.000			1.000	
AT or PVG	3	3	3	3	3	3	3	3	3	3	3
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Q1	0.1	11.0	2.3	3.8	12.6	0.1	14.2	14.3	15.3	0.3	0.5
kB	0.2	0.4	0.4	0.3	0.5	0.5	0.5	0.5	0.6	0.2	0.1
Q2	0.0	3.2	0.2	1.5	3.1	0.0	3.5	3.6	3.6	0.0	0.0
Q Average	0.1	14.2	2.5	5.3	15.8	0.1	17.7	17.9	19.0	0.3	0.5
Q Spacing	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0
Q Storage	0	0	0	0	0	0	0	0	0	0	0
Q S Ratio											
70th Percentile Output:											
fB%	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
BOQ	0.1	16.6	3.0	6.3	18.4	0.1	20.6	20.9	22.1	0.4	0.6
QSRatio											
85th Percentile Output:											
fB%	1.6	1.5	1.6	1.6	1.5	1.6	1.5	1.5	1.5	1.6	1.6
BOQ	0.2	21.1	4.0	8.2	23.3	0.2	25.9	26.3	27.7	0.5	0.8
QSRatio											
90th Percentile Output:											
fB%	1.8	1.6	1.8	1.7	1.6	1.8	1.6	1.6	1.6	1.8	1.8
BOQ	0.2	22.7	4.4	9.0	24.9	0.2	27.6	28.0	29.5	0.6	0.9
QSRatio											
95th Percentile Output:											
fB%	2.1	1.8	2.0	1.9	1.7	2.1	1.7	1.7	1.7	2.1	2.1
BOQ	0.2	25.2	5.1	10.3	27.6	0.2	30.5	30.9	32.4	0.7	1.1
QSRatio											
98th Percentile Output:											
fB%	2.7	2.0	2.5	2.4	2.0	2.7	2.0	2.0	1.9	2.7	2.7
BOQ	0.3	28.9	6.3	12.5	31.5	0.3	34.6	35.0	36.7	0.9	1.4
QSRatio											

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: md
Agency:
Date: 1/3/2005
Period: am
Project ID: 2007 total traffic - with improvements
E/W St: sth 158

Inter.: sth 158/greyhound access
Area Type: All other areas
Jurisd: wisdot
Year : 2007
N/S St: greyhound access

SIGNALIZED INTERSECTION SUMMARY

	Eastbound L	Eastbound T	Eastbound R	Westbound L	Westbound T	Westbound R	Northbound L	Northbound T	Northbound R	Southbound L	Southbound T	Southbound R
No. Lanes	0	2	0	1	2	0	2	0	1	0	0	0
LGConfig		T		L	T		L		R			
Volume		945		260	875		10		10			
Lane Width		12.0		12.0	12.0		12.0		12.0			
RTOR Vol									0			

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left					NB Left	A			
Thru		A			Thru				
Right					Right	A			
Peds					Peds				
WB Left	A	A			SB Left				
Thru	A	A			Thru				
Right					Right				
Peds					Peds				
NB Right	A				EB Right				
SB Right					WB Right				
Green	15.0	50.0				10.0			
Yellow	3.0	4.5				4.5			
All Red	0.0	1.5				1.5			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
T	1839	3311	0.53	0.56	12.9	B	12.9	B
Westbound								
L	560	1900	0.48	0.76	6.3	A		
T	2531	3350	0.36	0.76	3.8	A	4.4	A
Northbound								
L	389	3505	0.03	0.11	35.7	D	27.6	C
R	556	1615	0.02	0.34	19.5	B		
Southbound								

Intersection Delay = 8.4 (sec/veh) Intersection LOS = A

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/3/2005
Analysis Time Period: am
Intersection: sth 158/greyhound access
Area Type: All other areas
Jurisdiction: wisdot
Analysis Year: 2007
Project ID: 2007 total traffic - with improvements
East/West Street: sth 158
North/South Street: greyhound access

VOLUME DATA

	Eastbound L	Eastbound T	Eastbound R	Westbound L	Westbound T	Westbound R	Northbound L	Northbound T	Northbound R	Southbound L	Southbound T	Southbound R
Volume		945		260	875		10		10			
% Heavy Veh		15		0	8		0		0			
PHF		0.97		0.97	0.97		0.97		0.97			
PK 15 Vol		244		67	226		3		3			
Hi Ln Vol								0				
% Grade		0			0		1900		1900			
Ideal Sat		2000		2000	1900							
ParkExist												
NumPark												
No. Lanes	0	2	0	1	2	0	2	0	1	0	0	0
LGConfig		T		L	T		L		R			
Lane Width		12.0		12.0	12.0		12.0		12.0			
RTOR Vol									0			
Adj Flow		974		268	902		10		10			
%InSharedLn												
Prop LTs		0.000		1.000	0.000				1.000			
Prop RTs	0.000				0.000			0		0		
Peds	0											
Bikes												
Buses		0		0	0		0		0			
%InProtPhase				0.0								

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound L	Eastbound T	Eastbound R	Westbound L	Westbound T	Westbound R	Northbound L	Northbound T	Northbound R	Southbound L	Southbound T	Southbound R
Init Unmet		0.0		0.0	0.0		0.0		0.0			
Arriv. Type		3		3	3		3		3			
Unit Ext.		3.0		3.0	3.0		3.0		3.0			
I Factor		1.000			1.000			1.000				
Lost Time		2.0		2.0	2.0		2.0		2.0			
Ext of g		2.0		2.0	2.0		2.0		2.0			
Ped Min g		3.2						3.2		3.2		

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left					NB Left	A			
Thru		A			Thru				
Right					Right	A			
Peds					Peds				
WB Left	A	A			SB Left				
Thru	A	A			Thru				
Right					Right				
Peds					Peds				
NB Right	A				EB Right				
SB Right					WB Right				
Green	15.0	50.0				10.0			
Yellow	3.0	4.5				4.5			
All Red	0.0	1.5				1.5			

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound L	Eastbound T	Eastbound R	Westbound L	Westbound T	Westbound R	Northbound L	Northbound T	Northbound R	Southbound L	Southbound T	Southbound R
Volume, V		945		260	875		10		10			
PHF		0.97		0.97	0.97		0.97		0.97			
Adj flow		974		268	902		10		10			
No. Lanes	0	2	0	1	2	0	2	0	1	0	0	0
Lane group		T		L	T		L		R			
Adj flow		974		268	902		10		10			
Prop LTs		0.000		1.000	0.000							
Prop RTs	0.000				0.000				1.000			

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound T	Westbound L	Westbound T	Northbound L	Northbound R	Southbound
So	2000	2000	1900	1900	1900	
Lanes	0 2 0	1	2 0	2 0	1 0	0 0 0
fW	1.000	1.000	1.000	1.000	1.000	
fHV	0.870	1.000	0.926	1.000	1.000	
fG	1.000	1.000	1.000	1.000	1.000	
fP	1.000	1.000	1.000	1.000	1.000	
fBB	1.000	1.000	1.000	1.000	1.000	
fA	1.000	1.000	1.000	1.000	1.000	
fLU	0.952	1.000	0.952	0.971	1.000	
fRT	1.000		1.000		0.850	
fLT	1.000	0.950	1.000	0.950		
Sec.		0.206				
fLpb	1.000	1.000	1.000	1.000		
fRpb	1.000		1.000		1.000	
S	3311	1900	3350	3505	1615	
Sec.		413				

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	974	3311	# 0.29	0.56	1839	0.53
Right							
Westbound							
Prot		268	1900	# 0.14	0.167	317	0.85
Perm		0	413	0.00	0.589	243	0.00
Left	L	268			0.76	560	0.48
Prot							
Perm							
Thru	T	902	3350	0.27	0.76	2531	0.36
Right							
Northbound							
Prot							
Perm							
Left	L	10	3505	# 0.00	0.11	389	0.03
Prot							
Perm							
Thru							
Right	R	10	1615	0.01	0.34	556	0.02
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.44
Total lost time per cycle, L = 18.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.55

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
T	0.53	0.56	12.6	1.000	1839	0.13	0.3	0.0	12.9	B	12.9	B
Westbound												
L	0.48	0.76	5.7	1.000	560	0.11	0.6	0.0	6.3	A		
T	0.36	0.76	3.7	1.000	2531	0.11	0.1	0.0	3.8	A	4.4	A
Northbound												
L	0.03	0.11	35.7	1.000	389	0.11	0.0	0.0	35.7	D	27.6	C
R	0.02	0.34	19.5	1.000	556	0.11	0.0	0.0	19.5	B		
Southbound												

Intersection delay = 8.4 (sec/veh) Intersection LOS = A

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach		M		
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)		68.0		
Effective permitted green time for LT lane group, g(s)		53.0		
Opposing effective green time, go (s)		50.0		
Number of lanes in LT lane group, N		1		
Number of lanes in opposing approach, No		2		
Adjusted LT flow rate, VLT (veh/h)		268		
Proportion of LT in LT lane group, PLT		1.000		
Proportion of LT in opposing flow, PLTo		0.00		
Adjusted opposing flow rate, Vo (veh/h)		974		
Lost time for LT lane group, tL		6.00		
Computation				
LT volume per cycle, LTC=VLTC/3600		6.70		
Opposing lane util. factor, fLUo	0.952	0.952		
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		12.79		
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g		0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.44		
gq, (see Exhibit C16-4,5,6,7,8)		15.88		
gu=g-gq if gq>=gf, or = g-gf if gq<gf		37.12		
n=Max(gq-gf)/2.0)		7.94		
PTHo=1-PLTo		1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00		
EL1 (refer to Exhibit C16-3)		3.39		
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.08		
gdiff=max(gq-gf,0)		0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.21		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.206		

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT		0.000	0.000	
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo		0.952	0.952	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 90.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v		268		
v/c ratio from Capacity Worksheet, X		0.48		
Protected phase effective green interval, g (s)		15.0		
Opposing queue effective green interval, gq		15.88		
Unopposed green interval, gu		37.12		
Red time r=(C-g-gq-gu)		22.0		
Arrival rate, qa=v/(3600(max[X,1.0]))		0.07		
Protected ph. departure rate, Sp=s/3600		0.528		
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)		0.16		
XPerm		0.65		
XProt		0.35		
Case		1		
Queue at beginning of green arrow, Qa		1.64		
Queue at beginning of unsaturated green, Qu		1.18		
Residual queue, Qr		0.00		
Uniform Delay, d1		5.7		

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 8.4 sec/veh Intersection LOS A

BACK OF QUEUE WORKSHEET

	Eastbound	Westbound		Northbound		Southbound		
LaneGroup	T	L	T	L	R			
Init Queue	0.0	0.0	0.0	0.0	0.0			
Flow Rate	511	268	473	5	10			
So	2000	2000	1900	1900	1900			
No.Lanes	0 2 0	1	2 0	2 0	1	0	0	0
SL	1738	741	1759	1805	1615			
LnCapacity	965	560	1329	200	556			
Flow Ratio	0.29	0.36	0.27	0.00	0.01			
v/c Ratio	0.53	0.48	0.36	0.03	0.02			
Grn Ratio	0.56	0.76	0.76	0.11	0.34			
I Factor	1.000		1.000	1.000				
AT or PVG	3	3	3	3	3			
Pltn Ratio	1.00	1.00	1.00	1.00	1.00			
PF2	1.00	1.00	1.00	1.00	1.00			
Q1	8.0	1.8	4.0	0.1	0.2			
kB	0.7	0.5	0.8	0.3	0.5			
Q2	0.8	0.4	0.5	0.0	0.0			
Q Average	8.8	2.2	4.4	0.1	0.2			
Q Spacing	25.0	25.0	25.0	25.0	25.0			
Q Storage	0	0	0	0	0			
Q S Ratio								
70th Percentile Output:								
fB%	1.2	1.2	1.2	1.2	1.2			
BOQ	10.4	2.7	5.2	0.1	0.2			
QSRatio								
85th Percentile Output:								
fB%	1.5	1.6	1.6	1.6	1.6			
BOQ	13.4	3.5	6.9	0.2	0.3			
QSRatio								
90th Percentile Output:								
fB%	1.7	1.8	1.7	1.8	1.8			
BOQ	14.6	3.9	7.6	0.2	0.3			
QSRatio								
95th Percentile Output:								
fB%	1.9	2.0	2.0	2.1	2.1			
BOQ	16.4	4.5	8.7	0.2	0.4			
QSRatio								
98th Percentile Output:								
fB%	2.2	2.5	2.4	2.7	2.7			
BOQ	19.4	5.6	10.6	0.3	0.5			
QSRatio								

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: md
Agency:
Date: 1/3/2005
Period: pm
Project ID: 2007 total traffic - with improvements
E/W St: sth 158

Inter.: sth 158/greyhound access
Area Type: All other areas
Jurisd: wisdot
Year : 2007
N/S St: greyhound access

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	1	2	0	2	0	1	0	0	0
LGConfig		T		L	T		L		R			
Volume		745		465	1235		20		10			
Lane Width		12.0		12.0	12.0		12.0		12.0			
RTOR Vol									0			

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left					NB Left	A			
Thru		A			Thru				
Right					Right	A			
Peds					Peds				
WB Left	A	A			SB Left				
Thru	A	A			Thru				
Right					Right				
Peds					Peds				
NB Right	A				EB Right				
SB Right					WB Right				
Green	20.0	45.0				10.0			
Yellow	3.0	4.5				4.5			
All Red	0.0	1.5				1.5			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
T	1814	3627	0.44	0.50	14.6	B	14.6	B
Westbound								
L	642	1805	0.78	0.76	16.0	B		
T	2714	3592	0.49	0.76	4.4	A	7.6	A
Northbound								
L	389	3505	0.06	0.11	35.8	D		
							29.3	C
R	646	1615	0.02	0.40	16.3	B		
Southbound								

Intersection Delay = 10.0- (sec/veh) Intersection LOS = A

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/3/2005
Analysis Time Period: pm
Intersection: sth 158/greyhound access
Area Type: All other areas
Jurisdiction: wisdot
Analysis Year: 2007
Project ID: 2007 total traffic - with improvements
East/West Street: sth 158 North/South Street: greyhound access

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume		745		465	1235		20		10			
% Heavy Veh		5		0	6		0		0			
PHF		0.93		0.93	0.93		0.93		0.93			
PK 15 Vol		200		125	332		5		3			
Hi Ln Vol								0				
% Grade		0			0							
Ideal Sat		2000		1900	2000		1900		1900			
ParkExist												
NumPark												
No. Lanes	0	2	0	1	2	0	2	0	1	0	0	0
LGConfig		T		L	T		L		R			
Lane Width		12.0		12.0	12.0		12.0		12.0			
RTOR Vol									0			
Adj Flow		801		500	1328		22		11			
%InSharedLn												
Prop LTs		0.000		1.000	0.000							
Prop RTs	0.000				0.000				1.000			
Peds	0						0			0		
Bikes												
Buses	0			0	0		0		0			
%InProtPhase				0.0								

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0		0.0	0.0		0.0		0.0			
Arriv. Type		3		3	3		3		3			
Unit Ext.		3.0		3.0	3.0		3.0		3.0			
I Factor		1.000			1.000			1.000				
Lost Time		2.0		2.0	2.0		2.0		2.0			
Ext of g		2.0		2.0	2.0		2.0		2.0			
Ped Min g		3.2						3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left					NB Left	A			
Thru		A			Thru				
Right					Right	A			
Peds					Peds				
WB Left	A	A			SB Left				
Thru	A	A			Thru				
Right					Right				
Peds					Peds				
NB Right	A				EB Right				
SB Right					WB Right				
Green	20.0	45.0				10.0			
Yellow	3.0	4.5				4.5			
All Red	0.0	1.5				1.5			

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V		745		465	1235		20		10			
PHF		0.93		0.93	0.93		0.93		0.93			
Adj flow		801		500	1328		22		11			
No. Lanes	0	2	0	1	2	0	2	0	1	0	0	0
Lane group		T		L	T		L		R			
Adj flow		801		500	1328		22		11			
Prop LTs		0.000		1.000	0.000							
Prop RTs	0.000				0.000				1.000			

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG		T		L	T		L		R			
So		2000		1900	2000		1900		1900			
Lanes	0	2	0	1	2	0	2	0	1	0	0	0
fW		1.000		1.000	1.000		1.000		1.000			
fHV		0.952		1.000	0.943		1.000		1.000			
fG		1.000		1.000	1.000		1.000		1.000			
fP		1.000		1.000	1.000		1.000		1.000			
fBB		1.000		1.000	1.000		1.000		1.000			
fA		1.000		1.000	1.000		1.000		1.000			
fLU		0.952		1.000	0.952		0.971		1.000			
fRT		1.000			1.000				0.850			
fLT		1.000		0.950	1.000		0.950					
Sec.				0.237								
fLpb		1.000		1.000	1.000		1.000					
fRpb		1.000			1.000				1.000			
S		3627		1805	3592		3505		1615			
Sec.				451								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	801	3627	# 0.22	0.50	1814	0.44
Right							
Westbound							
Prot		401	1805	# 0.22	0.222	401	1.00
Perm		99	451	0.22	0.533	241	0.41
Left	L	500			0.76	642	0.78
Prot							
Perm							
Thru	T	1328	3592	0.37	0.76	2714	0.49
Right							
Northbound							
Prot							
Perm							
Left	L	22	3505	# 0.01	0.11	389	0.06
Prot							
Perm							
Thru							
Right	R	11	1615	0.01	0.40	646	0.02
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.45
Total lost time per cycle, L = 18.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.56

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
T	0.44	0.50	14.4	1.000	1814	0.11	0.2	0.0	14.6	B	14.6	B
Westbound												
L	0.78	0.76	9.9	1.000	642	0.33	6.1	0.0	16.0	B		
T	0.49	0.76	4.3	1.000	2714	0.11	0.1	0.0	4.4	A	7.6	A
Northbound												
L	0.06	0.11	35.8	1.000	389	0.11	0.1	0.0	35.8	D		
											29.3	C
R	0.02	0.40	16.3	1.000	646	0.11	0.0	0.0	16.3	B		
Southbound												

Intersection delay = 10.0- (sec/veh) Intersection LOS = A

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach		M		
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)		68.0		
Effective permitted green time for LT lane group, g(s)		48.0		
Opposing effective green time, go (s)		45.0		
Number of lanes in LT lane group, N		1		
Number of lanes in opposing approach, No		2		
Adjusted LT flow rate, VLT (veh/h)		500		
Proportion of LT in LT lane group, PLT		1.000		
Proportion of LT in opposing flow, PLTo		0.00		
Adjusted opposing flow rate, Vo (veh/h)		801		
Lost time for LT lane group, tL		6.00		
Computation				
LT volume per cycle, LTC=VLTC/3600		12.50		
Opposing lane util. factor, fLUo	0.952	0.952		
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		10.52		
gf=G[exp(- a * (LTC ** b)]-tl, gf<=g		0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.50		
gq, (see Exhibit C16-4,5,6,7,8)		13.73		
gu=g-gq if gq>=gf, or = g-gf if gq<gf		34.27		
n=Max(gq-gf)/2,0)		6.86		
PTHo=1-PLTo		1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00		
EL1 (refer to Exhibit C16-3)		3.01		
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.08		
gdiff=max(gq-gf,0)		0.00		
fm=[gf/g]+[gu/g)/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.24		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.237		

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT		0.000	0.000	
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo		0.952	0.952	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b)]-tl, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g)/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 90.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v		500		
v/c ratio from Capacity Worksheet, X		0.78		
Protected phase effective green interval, g (s)		20.0		
Opposing queue effective green interval, gq		13.73		
Unopposed green interval, gu		34.27		
Red time r=(C-g-gq-gu)		22.0		
Arrival rate, qa=v/(3600(max[X,1.0]))		0.14		
Protected ph. departure rate, Sp=s/3600		0.501		
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)		0.18		
XPerm		1.11		
XProt		0.58		
Case		3		
Queue at beginning of green arrow, Qa		3.71		
Queue at beginning of unsaturated green, Qu		1.91		
Residual queue, Qr		0.65		
Uniform Delay, d1		9.9		

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Dur. Unmet Demand Q veh	Unmet Demand t hrs.	Uniform Delay Unadj. ds	Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 10.0- sec/veh Intersection LOS A

BACK OF QUEUE WORKSHEET

	Eastbound				Westbound				Northbound				Southbound			
LaneGroup		T			L	T			L		R					
Init Queue		0.0			0.0	0.0			0.0		0.0					
Flow Rate		420			500	697			11		11					
So		2000			1900	2000			1900		1900					
No.Lanes	0	2	0		1	2	0		2	0	1		0	0	0	
SL		1904			849	1886			1805		1615					
LnCapacity		952			642	1425			200		646					
Flow Ratio		0.22			0.59	0.37			0.01		0.01					
v/c Ratio		0.44			0.78	0.49			0.05		0.02					
Grn Ratio		0.50			0.76	0.76			0.11		0.40					
I Factor		1.000				1.000				1.000						
AT or PVG		3			3	3			3		3					
Pltn Ratio		1.00			1.00	1.00			1.00		1.00					
PF2		1.00			1.00	1.00			1.00		1.00					
Q1		6.7			3.7	6.8			0.2		0.2					
kB		0.7			0.5	0.9			0.3		0.5					
Q2		0.5			1.7	0.8			0.0		0.0					
Q Average		7.3			5.4	7.6			0.3		0.2					
Q Spacing		25.0			25.0	25.0			25.0		25.0					
Q Storage		0			0	0			0		0					
Q S Ratio																
70th Percentile Output:																
fB%		1.2			1.2	1.2			1.2		1.2					
BOQ		8.6			6.4	8.9			0.3		0.2					
QSRatio																
85th Percentile Output:																
fB%		1.5			1.6	1.5			1.6		1.6					
BOQ		11.1			8.4	11.6			0.4		0.3					
QSRatio																
90th Percentile Output:																
fB%		1.7			1.7	1.7			1.8		1.8					
BOQ		12.2			9.2	12.7			0.5		0.3					
QSRatio																
95th Percentile Output:																
fB%		1.9			1.9	1.9			2.1		2.1					
BOQ		13.8			10.5	14.3			0.5		0.4					
QSRatio																
98th Percentile Output:																
fB%		2.3			2.4	2.3			2.7		2.7					
BOQ		16.5			12.7	17.1			0.7		0.5					
QSRatio																

ERROR MESSAGES

No errors to report.

HCS2000: Unsignalized Intersections Release 4.1d

TWO-WAY STOP CONTROL SUMMARY

Analyst: md
Agency/Co.:
Date Performed: 1/4/2005
Analysis Time Period: am
Intersection: sth 158/eastern frontage road
Jurisdiction: wisdot
Units: U. S. Customary
Analysis Year: 2007
Project ID: 2007 total traffic - with improvements
East/West Street: sth 158
North/South Street: eastern frontage road
Intersection Orientation: EW
Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1 L	2 T	3 R	4 L	5 T	6 R
Volume	20	795			495	1
Peak-Hour Factor, PHF	1.00	1.00			1.00	1.00
Hourly Flow Rate, HFR	20	795			495	1
Percent Heavy Vehicles	0	--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?					1	0
Lanes	0	1				TR
Configuration	LT					
Upstream Signal?		No			No	

Minor Street: Approach	Northbound			Southbound		
Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume	135	170		5		10
Peak Hour Factor, PHF	1.00	1.00		1.00		1.00
Hourly Flow Rate, HFR	135	170		5		10
Percent Heavy Vehicles	0	0		0		0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/		No	/
Lanes	0	1		0	0	
Configuration	LT				LR	

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	LT		LT				LR	
v (vph)	20		305				15	
C(m) (vph)	1078		139				0	
v/c	0.02		2.19					
95% queue length	0.06		25.28					
Control Delay	8.4		612.3				F	
LOS	A		F					
Approach Delay				612.3				
Approach LOS				F				

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TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/4/2005
Analysis Time Period: am
Intersection: sth 158/eastern frontage road
Jurisdiction: wisdot
Units: U. S. Customary
Analysis Year: 2007
Project ID: 2007 total traffic - with improvements
East/West Street: sth 158
North/South Street: eastern frontage road
Intersection Orientation: EW
Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume	20	795			495	1
Peak-Hour Factor, PHF	1.00	1.00			1.00	1.00
Peak-15 Minute Volume	5	199			124	0
Hourly Flow Rate, HFR	20	795			495	1
Percent Heavy Vehicles	0	--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?					1	0
Lanes	0	1				TR
Configuration	LT					
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume	135	170		5		10
Peak Hour Factor, PHF	1.00	1.00		1.00		1.00
Peak-15 Minute Volume	34	42		1		2
Hourly Flow Rate, HFR	135	170		5		10
Percent Heavy Vehicles	0	0		0		0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/		No	/
RT Channelized?				0	0	
Lanes	0	1			LR	
Configuration	LT					

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

		Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2	Left-Turn							
	Through							
S5	Left-Turn							
	Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:	795	
Shared ln volume, major rt vehicles:	0	
Sat flow rate, major th vehicles:	1700	
Sat flow rate, major rt vehicles:	1700	
Number of major street through lanes:	1	

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1		7.1	6.5		7.1		6.2
t(c,hv)		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		0		0	0		0		0
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Grade/100				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00		0.00	0.00		0.00		0.00
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage	4.1		7.1	6.5		7.1		6.2
	2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20		3.50	4.00		3.50		3.30
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)	0		0	0		0		0
t(f)	2.2		3.5	4.0		3.5		3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2 V(t)	Movement 2 V(l,prot)	Movement 5 V(t)	Movement 5 V(l,prot)
V prog				
Total Saturation Flow Rate, s (vph)				
Arrival Type				
Effective Green, g (sec)				
Cycle Length, C (sec)				
Rp (from Exhibit 16-11)				
Proportion vehicles arriving on green P				
g(q1)				
g(q2)				
g(q)				

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2 V(t)	Movement 2 V(l,prot)	Movement 5 V(t)	Movement 5 V(l,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p		0.000		0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5
Single-Stage Process

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x	496		1335	1331		1416		496
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
a		1500		1500		1500		
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		496
Potential Capacity		578
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		578
Probability of Queue free St.	1.00	0.98

Step 2: LT from Major St.	4	1
Conflicting Flows		496
Potential Capacity		1078
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		1078
Probability of Queue free St.	1.00	0.98
Maj L-Shared Prob Q free St.		0.97

Step 3: TH from Minor St.	8	11
Conflicting Flows	1331	
Potential Capacity	156	
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.97	0.97
Movement Capacity	151	
Probability of Queue free St.	0.00	1.00

Step 4: LT from Minor St.	7	10
Conflicting Flows	1335	1416
Potential Capacity	132	116
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.97	0.00
Maj. L, Min T Adj. Imp Factor.	0.97	0.00
Cap. Adj. factor due to Impeding mvmnt	0.96	0.00
Movement Capacity	126	0

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	1331	
Potential Capacity	156	
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.97	0.97
Movement Capacity	151	
Result for 2 stage process:		
a		
y		
C t	151	
Probability of Queue free St.	0.00	1.00

Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	1335	1416
Potential Capacity	132	116
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.97	0.00
Maj. L, Min T Adj. Imp Factor.	0.97	0.00
Cap. Adj. factor due to Impeding mvmnt	0.96	0.00
Movement Capacity	126	0
Results for Two-stage process:		
a		
y		
C t	126	0

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	135	170		5		10
Movement Capacity (vph)	126	151		0		578
Shared Lane Capacity (vph)	139				0	

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	126	151		0		578
Volume	135	170		5		10
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh	139				0	
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	LT		LT				LR	
v (vph)	20		305				15	
C(m) (vph)	1078		139				0	
v/c	0.02		2.19					
95% queue length	0.06		25.28					
Control Delay	8.4		612.3					
LOS	A		F				F	
Approach Delay				612.3				
Approach LOS				F				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.98	1.00
v(i1), Volume for stream 2 or 5	795	
v(i2), Volume for stream 3 or 6	0	
s(i1), Saturation flow rate for stream 2 or 5	1700	
s(i2), Saturation flow rate for stream 3 or 6	1700	
P*(oj)	0.97	
d(M,LT), Delay for stream 1 or 4	8.4	
N, Number of major street through lanes	1	
d(rank,1) Delay for stream 2 or 5	0.3	

HCS2000: Unsignalized Intersections Release 4.1d

TWO-WAY STOP CONTROL SUMMARY

Analyst: md
Agency/Co.:
Date Performed: 1/4/2005
Analysis Time Period: pm
Intersection: sth 158/eastern frontage road
Jurisdiction: wisdot
Units: U. S. Customary
Analysis Year: 2007
Project ID: 2007 total traffic - with improvements
East/West Street: sth 158
North/South Street: eastern frontage road
Intersection Orientation: EW
Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	15	715			600	1
Peak-Hour Factor, PHF	1.00	1.00			1.00	1.00
Hourly Flow Rate, HFR	15	715			600	1
Percent Heavy Vehicles	0	--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes	0	1				
Configuration	LT					TR
Upstream Signal?		No			No	

Minor Street: Approach	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	115	150		5		5
Peak Hour Factor, PHF	1.00	1.00		1.00		1.00
Hourly Flow Rate, HFR	115	150		5		5
Percent Heavy Vehicles	0	0		0		0
Percent Grade (%)		0				
Flared Approach: Exists?/Storage				/	0	
Lanes	0	1				No /
Configuration	LT			0		0
					LR	

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	LT		LT				LR	
v (vph)	15		265				10	
C(m) (vph)	986		138				0	
v/c	0.02		1.92					
95% queue length	0.05		20.68					
Control Delay	8.7		493.9					
LOS	A		F				F	
Approach Delay				493.9				
Approach LOS				F				

HCS2000: Unsignalized Intersections Release 4.1d

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TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/4/2005
Analysis Time Period: pm
Intersection: sth 158/eastern frontage road
Jurisdiction: wisdot
Units: U. S. Customary
Analysis Year: 2007
Project ID: 2007 total traffic - with improvements
East/West Street: sth 158
North/South Street: eastern frontage road
Intersection Orientation: EW
Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	15	715			600	1
Peak-Hour Factor, PHF	1.00	1.00			1.00	1.00
Peak-15 Minute Volume	4	179			150	0
Hourly Flow Rate, HFR	15	715			600	1
Percent Heavy Vehicles	0	--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes	0	1				
Configuration	LT					TR
Upstream Signal?		No			No	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	115	150		5		5
Peak Hour Factor, PHF	1.00	1.00		1.00		1.00
Peak-15 Minute Volume	29	38		1		1
Hourly Flow Rate, HFR	115	150		5		5
Percent Heavy Vehicles	0	0		0		0
Percent Grade (%)		0				
Flared Approach: Exists?/Storage				/	0	
RT Channelized?						No /
Lanes	0	1				
Configuration	LT			0		0
					LR	

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn							
Through							
S5 Left-Turn							
Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:	715	
Shared ln volume, major rt vehicles:	0	
Sat flow rate, major th vehicles:	1700	
Sat flow rate, major rt vehicles:	1700	
Number of major street through lanes:	1	

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)	4.1		7.1	6.5		7.1		6.2
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)	0		0	0		0		0
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Grade/100			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)	0.00		0.00	0.00		0.00		0.00
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage	4.1		7.1	6.5		7.1		6.2
2-stage								

Follow-Up Time Calculations

Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)	2.20		3.50	4.00		3.50		3.30
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)	0		0	0		0		0
t(f)	2.2		3.5	4.0		3.5		3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2 V(t)	Movement 2 V(1,prot)	Movement 5 V(t)	Movement 5 V(1,prot)
Total Saturation Flow Rate, s (vph)				
Arrival Type				
Effective Green, g (sec)				
Cycle Length, C (sec)				
Rp (from Exhibit 16-11)				
Proportion vehicles arriving on green P				
g(q1)				
g(q2)				
g(q)				

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2 V(t)	Movement 2 V(1,prot)	Movement 5 V(t)	Movement 5 V(1,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p			0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	
p(5)	0.000
p(dom)	0.000
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5
Single-Stage Process

Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
V c,x	601		1348	1346		1420		600
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process

	7	8	10	11
prog				

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		1500		1500		1500		
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		600
Potential Capacity		505
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		505
Probability of Queue free St.	1.00	0.99
Step 2: LT from Major St.	4	1
Conflicting Flows		601
Potential Capacity		986
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		986
Probability of Queue free St.	1.00	0.98
Maj L-Shared Prob Q free St.		0.97
Step 3: TH from Minor St.	8	11
Conflicting Flows	1346	
Potential Capacity	153	
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.97	0.97
Movement Capacity	149	
Probability of Queue free St.	0.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows	1348	1420
Potential Capacity	129	115
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.97	0.00
Maj. L, Min T Adj. Imp Factor.	0.98	0.00
Cap. Adj. factor due to Impeding mvmnt	0.97	0.00
Movement Capacity	125	0

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	1346	
Potential Capacity	153	
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.97	0.97
Movement Capacity	149	
Result for 2 stage process:		
a		
y	149	
C t	0.00	1.00
Probability of Queue free St.		
Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	1348	1420
Potential Capacity	129	115
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.97	0.00
Maj. L, Min T Adj. Imp Factor.	0.98	0.00
Cap. Adj. factor due to Impeding mvmnt	0.97	0.00
Movement Capacity	125	0
Results for Two-stage process:		
a		
y	125	0
C t		

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	115	150		5		5
Movement Capacity (vph)	125	149		0		505
Shared Lane Capacity (vph)	138				0	

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	125	149		0		505
Volume	115	150		5		5
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max					0	
C sh	138					
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	LT		LT				LR	
v (vph)	15		265				10	
C(m) (vph)	986		138				0	
v/c	0.02		1.92					
95% queue length	0.05		20.68					
Control Delay	8.7		493.9					
LOS	A		F				F	
Approach Delay				493.9				
Approach LOS				F				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.98	1.00
v(i1), Volume for stream 2 or 5	715	
v(i2), Volume for stream 3 or 6	0	
s(i1), Saturation flow rate for stream 2 or 5	1700	
s(i2), Saturation flow rate for stream 3 or 6	1700	
P*(oj)	0.97	
d(M,LT), Delay for stream 1 or 4	8.7	
N, Number of major street through lanes	1	
d(rank,1) Delay for stream 2 or 5	0.2	

HCS2000: Unsignalized Intersections Release 4.1d

TWO-WAY STOP CONTROL SUMMARY

Analyst: md
Agency/Co.:
Date Performed: 1/4/2005
Analysis Time Period: am
Intersection: sth 158_Western Frontage Road
Jurisdiction: wisdot
Units: U. S. Customary
Analysis Year: 2007
Project ID: 2007 total traffic - with improvements
East/West Street: sth 158
North/South Street: western frontage road
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1 L	2 T	3 R	4 L	5 T	6 R
Volume		745	75	70	570	
Peak-Hour Factor, PHF		1.00	1.00	1.00	1.00	
Hourly Flow Rate, HFR		745	75	70	570	
Percent Heavy Vehicles		--	--	0	--	--
Median Type/Storage	Undivided			/		
RT Channelized?			No			
Lanes		1	1	0	1	
Configuration		T	R		LT	
Upstream Signal?		No			No	

Minor Street: Approach	Northbound			Southbound		
Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume	10		70			
Peak Hour Factor, PHF	1.00		1.00			
Hourly Flow Rate, HFR	10		70			
Percent Heavy Vehicles	0		0			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No	/		/
Lanes		0	0			
Configuration		LR				

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config		LT		LR				
v (vph)		70		80				
C(m) (vph)		818		329				
v/c		0.09		0.24				
95% queue length		0.28		0.94				
Control Delay		9.8		19.4				
LOS		A		C				
Approach Delay				19.4				
Approach LOS				C				

HCS2000: Unsignalized Intersections Release 4.1d

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TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/4/2005
Analysis Time Period: am
Intersection: sth 158_Western Frontage Road
Jurisdiction: wisdot
Units: U. S. Customary
Analysis Year: 2007
Project ID: 2007 total traffic - with improvements
East/West Street: sth 158
North/South Street: western frontage road
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume		745	75	70	570	
Peak-Hour Factor, PHF		1.00	1.00	1.00	1.00	
Peak-15 Minute Volume		186	19	18	142	
Hourly Flow Rate, HFR		745	75	70	570	
Percent Heavy Vehicles		--	--	0	--	--
Median Type/Storage	Undivided			/		
RT Channelized?			No			
Lanes		1	1	0	1	
Configuration		T	R		LT	
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume	10		70			
Peak Hour Factor, PHF	1.00		1.00			
Peak-15 Minute Volume	2		18			
Hourly Flow Rate, HFR	10		70			
Percent Heavy Vehicles	0		0			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No	/		/
RT Channelized?						
Lanes	0		0			
Configuration		LR				

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn							
Through							
S5 Left-Turn							
Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		570
Shared ln volume, major rt vehicles:		0
Sat flow rate, major th vehicles:		1700
Sat flow rate, major rt vehicles:		1700
Number of major street through lanes:		1

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)			4.1	7.1		6.2			
t(c,hv)		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)			0	0		0			
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Grade/100				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)			0.00	0.70		0.00			
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage		4.1	6.4		6.2			
	2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)		2.20	3.50		3.30			
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)		0	0		0			
t(f)		2.2	3.5		3.3			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2 V(t)	Movement 2 V(l,prot)	Movement 5 V(t)	Movement 5 V(l,prot)
V prog				
Total Saturation Flow Rate, s (vph)				
Arrival Type				
Effective Green, g (sec)				
Cycle Length, C (sec)				
Rp (from Exhibit 16-11)				
Proportion vehicles arriving on green P				
g(q1)				
g(q2)				
g(q)				

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2 V(t)	Movement 2 V(l,prot)	Movement 5 V(t)	Movement 5 V(l,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p		0.000		0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5
Single-Stage Process

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x		820	1455		745			
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process

	7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		1500						
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	745	
Potential Capacity	417	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	417	
Probability of Queue free St.	0.83	1.00

Step 2: LT from Major St.	4	1
Conflicting Flows	820	
Potential Capacity	818	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	818	
Probability of Queue free St.	0.91	1.00
Maj L-Shared Prob Q free St.	0.87	

Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.87	0.87
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Conflicting Flows	1455	
Potential Capacity	145	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.87
Maj. L, Min T Adj. Imp Factor.		0.90
Cap. Adj. factor due to Impeding mvmnt	0.91	0.75
Movement Capacity	133	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.87	0.87
Movement Capacity		
Result for 2 stage process:		
a		
y		
C t		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	1455	
Potential Capacity	145	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.87
Maj. L, Min T Adj. Imp Factor.		0.90
Cap. Adj. factor due to Impeding mvmnt	0.91	0.75
Movement Capacity	133	
Results for Two-stage process:		
a		
y		
C t	133	

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	10		70			
Movement Capacity (vph)	133		417			
Shared Lane Capacity (vph)		329				

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	133		417			
Volume	10		70			
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh		329				
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		LT		LR				
v (vph)		70		80				
C(m) (vph)		818		329				
v/c		0.09		0.24				
95% queue length		0.28		0.94				
Control Delay		9.8		19.4				
LOS		A		C				
Approach Delay				19.4				
Approach LOS				C				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.91
v(i1), Volume for stream 2 or 5		570
v(i2), Volume for stream 3 or 6		0
s(i1), Saturation flow rate for stream 2 or 5		1700
s(i2), Saturation flow rate for stream 3 or 6		1700
P*(oj)		0.87
d(M,LT), Delay for stream 1 or 4		9.8
N, Number of major street through lanes		1
d(rank,1) Delay for stream 2 or 5		1.3

HCS2000: Unsignalized Intersections Release 4.1d

TWO-WAY STOP CONTROL SUMMARY

Analyst: md
Agency/Co.:
Date Performed: 1/4/2005
Analysis Time Period: pm
Intersection: sth 158_Western Frontage Road
Jurisdiction: wisdot
Units: U. S. Customary
Analysis Year: 2007
Project ID: 2007 total traffic - with improvements
East/West Street: sth 158
North/South Street: western frontage road
Intersection Orientation: EW
Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1 L	2 T	3 R	4 L	5 T	6 R
Volume		675	210	120	600	
Peak-Hour Factor, PHF		1.00	1.00	1.00	1.00	
Hourly Flow Rate, HFR		675	210	120	600	
Percent Heavy Vehicles		--	--	0	--	--
Median Type/Storage	Undivided			/		
RT Channelized?			No			
Lanes		1	1		0	1
Configuration		T	R		LT	
Upstream Signal?		No			No	

Minor Street: Approach	Northbound			Southbound		
Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume	10		55			
Peak Hour Factor, PHF	1.00		1.00			
Hourly Flow Rate, HFR	10		55			
Percent Heavy Vehicles	0		0			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No	/		/
Lanes		0	0			
Configuration		LR				

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config		LT		LR				
v (vph)		120		65				
C(m) (vph)		773		310				
v/c		0.16		0.21				
95% queue length		0.55		0.78				
Control Delay		10.5		19.7				
LOS		B		C				
Approach Delay				19.7				
Approach LOS				C				

HCS2000: Unsignalized Intersections Release 4.1d

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TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/4/2005
Analysis Time Period: pm
Intersection: sth 158_Western Frontage Road
Jurisdiction: wisdot
Units: U. S. Customary
Analysis Year: 2007
Project ID: 2007 total traffic - with improvements
East/West Street: sth 158
North/South Street: western frontage road
Intersection Orientation: EW
Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume		675	210	120	600	
Peak-Hour Factor, PHF		1.00	1.00	1.00	1.00	
Peak-15 Minute Volume		169	52	30	150	
Hourly Flow Rate, HFR		675	210	120	600	
Percent Heavy Vehicles		--	--	0	--	--
Median Type/Storage	Undivided			/		
RT Channelized?			No			
Lanes		1	1		0	1
Configuration		T	R		LT	
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume	10		55			
Peak Hour Factor, PHF	1.00		1.00			
Peak-15 Minute Volume	2		14			
Hourly Flow Rate, HFR	10		55			
Percent Heavy Vehicles	0		0			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No	/		/
RT Channelized?						
Lanes	0		0			
Configuration		LR				

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

		Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2	Left-Turn							
	Through							
S5	Left-Turn							
	Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		600
Shared ln volume, major rt vehicles:		0
Sat flow rate, major th vehicles:		1700
Sat flow rate, major rt vehicles:		1700
Number of major street through lanes:		1

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)			4.1	7.1		6.2			
t(c,hv)		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)			0	0		0			
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Grade/100				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)			0.00	0.70		0.00			
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage		4.1	6.4		6.2			
	2-stage								

Follow-Up Time Calculations Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)		2.20	3.50		3.30			
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)		0	0		0			
t(f)		2.2	3.5		3.3			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal	Movement 2 V(t)	Movement 2 V(1,prot)	Movement 5 V(t)	Movement 5 V(1,prot)
V proq				
Total Saturation Flow Rate, s (vph)				
Arrival Type				
Effective Green, g (sec)				
Cycle Length, C (sec)				
Rp (from Exhibit 16-11)				
Proportion vehicles arriving on green P				
g(q1)				
g(q2)				
g(q)				

Computation 2-Proportion of TWSC Intersection Time blocked	Movement 2 V(t)	Movement 2 V(1,prot)	Movement 5 V(t)	Movement 5 V(1,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p		0.000		0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x		885	1515		675			
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		1500						
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	675	
Potential Capacity	457	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	457	
Probability of Queue free St.	0.88	1.00

Step 2: LT from Major St.	4	1
Conflicting Flows	885	
Potential Capacity	773	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	773	
Probability of Queue free St.	0.84	1.00
Maj L-Shared Prob Q free St.	0.76	

Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.76	0.76
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Conflicting Flows	1515	
Potential Capacity	133	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.76
Maj. L, Min T Adj. Imp Factor.		0.82
Cap. Adj. factor due to Impeding mvmnt	0.84	0.72
Movement Capacity	112	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.76	0.76
Movement Capacity		
Result for 2 stage process:		
a		
y		
C t		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	1515	
Potential Capacity	133	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.76
Maj. L, Min T Adj. Imp Factor.		0.82
Cap. Adj. factor due to Impeding mvmnt	0.84	0.72
Movement Capacity	112	
Results for Two-stage process:		
a		
y		
C t	112	

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	10		55			
Movement Capacity (vph)	112		457			
Shared Lane Capacity (vph)		310				

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	112		457			
Volume	10		55			
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh		310				
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		LT		LR				
v (vph)		120		65				
C(m) (vph)		773		310				
v/c		0.16		0.21				
95% queue length		0.55		0.78				
Control Delay		10.5		19.7				
LOS		B		C				
Approach Delay				19.7				
Approach LOS				C				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.84
v(i1), Volume for stream 2 or 5		600
v(i2), Volume for stream 3 or 6		0
s(i1), Saturation flow rate for stream 2 or 5		1700
s(i2), Saturation flow rate for stream 3 or 6		1700
P*(oj)		0.76
d(M,LT), Delay for stream 1 or 4		10.5
N, Number of major street through lanes		1
d(rank,1) Delay for stream 2 or 5		2.5

HCS2000: Signalized Intersections Release 4.1e

Analyst: md
Agency:
Date: 1/4/2005
Period: am
Project ID: 2007 total traffic - with improvements
E/W St: cth k

Inter.: cth k/104th ave
Area Type: All other areas
Jurisd: kenosha county
Year : 2007
N/S St: 104th ave

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	1	1	0	1	1	0	1	1	0
LGConfig	L	TR		L	TR		L	TR		L	TR	
Volume	25	225	30	130	260	145	5	185	80	25	135	30
Lane Width	12.0	12.0		12.0	12.0		12.0	12.0		12.0	12.0	
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A	A			NB Left	A	A		
Thru		A			Thru		A		
Right		A			Right		A		
Peds					Peds				
WB Left	A	A			SB Left	A	A		
Thru		A			Thru		A		
Right		A			Right		A		
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	7.0	33.0				7.0	25.0		
Yellow	3.0	4.5				3.0	4.5		
All Red	0.0	1.5				0.0	1.5		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	268	1770	0.12	0.48	15.7	B		
TR	671	1830	0.48	0.37	22.5	C	21.9	C
Westbound								
L	413	1770	0.40	0.48	15.2	B		
TR	646	1763	0.79	0.37	32.3	C	28.1	C
Northbound								
L	391	1770	0.02	0.39	17.3	B		
TR	494	1779	0.68	0.28	32.6	C	32.4	C
Southbound								
L	290	1770	0.11	0.39	18.6	B		
TR	503	1812	0.42	0.28	27.1	C	26.0	C

Intersection Delay = 27.3 (sec/veh) Intersection LOS = C

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/4/2005
Analysis Time Period: am
Intersection: cth k/104th ave
Area Type: All other areas
Jurisdiction: kenosha county
Analysis Year: 2007
Project ID: 2007 total traffic - with improvements
East/West Street: cth k
North/South Street: 104th ave

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	25	225	30	130	260	145	5	185	80	25	135	30
% Heavy Veh	2	2	2	2	2	2	2	2	2	2	2	2
PHF	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79
PK 15 Vol	8	71	9	41	82	46	2	59	25	8	43	9
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900		1900	1900		1900	1900		1900	1900	
ParkExist												
NumPark												
No. Lanes	1	1	0	1	1	0	1	1	0	1	1	0
LGConfig	L	TR		L	TR		L	TR		L	TR	
Lane Width	12.0	12.0		12.0	12.0		12.0	12.0		12.0	12.0	
RTOR Vol			0			0			0			0
Adj Flow	32	323		165	513		6	335		32	209	
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.118			0.359			0.301			0.182	
Peds Bikes	0			0			0			0		
Buses	0	0		0	0		0	0		0	0	
%InProtPhase	0.0			0.0			0.0			0.0		

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Arriv. Type	3	3		3	3		3	3		3	3	
Unit Ext.	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Ext of g	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Ped Min g	3.2			3.2			3.2			3.2		

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A	A			NB Left	A	A		
Thru		A			Thru		A		
Right		A			Right		A		
Peds					Peds				
WB Left	A	A			SB Left	A	A		
Thru		A			Thru		A		
Right		A			Right		A		
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	7.0	33.0				7.0	25.0		
Yellow	3.0	4.5				3.0	4.5		
All Red	0.0	1.5				0.0	1.5		

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	25	225	30	130	260	145	5	185	80	25	135	30
PHF	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79
Adj flow	32	285	38	165	329	184	6	234	101	32	171	38
No. Lanes	1	1	0	1	1	0	1	1	0	1	1	0
Lane group	L	TR		L	TR		L	TR		L	TR	
Adj flow	32	323		165	513		6	335		32	209	
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.118			0.359			0.301			0.182	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	L	TR	L	TR	L	TR	L	TR
So	1900	1900	1900	1900	1900	1900	1900	1900
Lanes	1	1 0	1	1 0	1	1 0	1	1 0
fW	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fHV	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980
fG	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fP	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fBB	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fA	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fLU	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fRT		0.982		0.946		0.955		0.973
fLT	0.950	1.000	0.950	1.000	0.950	1.000	0.950	1.000
Sec.	0.175		0.369		0.436		0.262	
fLpb	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fRpb		1.000		1.000		1.000		1.000
S	1770	1830	1770	1763	1770	1779	1770	1812
Sec.	326		688		812		488	

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		32	1770	0.02	0.078	138	0.23
Perm		0	326	0.00	0.400	130	0.00
Left	L	32			0.48	268	0.12
Prot							
Perm							
Thru	TR	323	1830	0.18	0.37	671	0.48
Right							
Westbound							
Prot		138	1770	# 0.08	0.078	138	1.00
Perm		27	688	0.04	0.400	275	0.10
Left	L	165			0.48	413	0.40
Prot							
Perm							
Thru	TR	513	1763	# 0.29	0.37	646	0.79
Right							
Northbound							
Prot		6	1770	0.00	0.078	138	0.04
Perm		0	812	0.00	0.311	253	0.00
Left	L	6			0.39	391	0.02
Prot							
Perm							
Thru	TR	335	1779	# 0.19	0.28	494	0.68
Right							
Southbound							
Prot		32	1770	# 0.02	0.078	138	0.23
Perm		0	488	0.00	0.311	152	0.00
Left	L	32			0.39	290	0.11
Prot							
Perm							
Thru	TR	209	1812	0.12	0.28	503	0.42
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.58
Total lost time per cycle, L = 24.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.78

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	0.12	0.48	15.5	1.000	268	0.11	0.2	0.0	15.7	B		
TR	0.48	0.37	21.9	1.000	671	0.11	0.5	0.0	22.5	C	21.9	C
Westbound												
L	0.40	0.48	14.6	1.000	413	0.11	0.6	0.0	15.2	B		
TR	0.79	0.37	25.5	1.000	646	0.34	6.8	0.0	32.3	C	28.1	C
Northbound												
L	0.02	0.39	17.3	1.000	391	0.11	0.0	0.0	17.3	B		
TR	0.68	0.28	28.9	1.000	494	0.25	3.7	0.0	32.6	C	32.4	C
Southbound												
L	0.11	0.39	18.4	1.000	290	0.11	0.2	0.0	18.6	B		

TR	0.42	0.28	26.5	1.000	503	0.11	0.6	0.0	27.1	C	26.0	C

Intersection delay = 27.3 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M	M	M
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	43.0	43.0	35.0	35.0
Effective permitted green time for LT lane group, g(s)	36.0	36.0	28.0	28.0
Opposing effective green time, go (s)	33.0	33.0	25.0	25.0
Number of lanes in LT lane group, N	1	1	1	1
Number of lanes in opposing approach, No	1	1	1	1
Adjusted LT flow rate, VLT (veh/h)	32	165	6	32
Proportion of LT in LT lane group, PLT	1.000	1.000	1.000	1.000
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	513	323	209	335
Lost time for LT lane group, tL	6.00	6.00	6.00	6.00
Computation				
LT volume per cycle, LTC=VLTC/3600	0.80	4.13	0.15	0.80
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	12.82	8.07	5.22	8.38
gf=G[exp(- a * (LTC ** b)]-tl, gf<=g	0.0	0.0	0.0	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.63	0.63	0.72	0.72
gq, (see Exhibit C16-4,5,6,7,8)	22.72	12.47	8.54	14.86
gu=g-gq if gq>=gf, or = g-gf if gq<gf	13.28	23.53	19.46	13.14
n=Max(gq-gf)/2,0)	11.36	6.23	4.27	7.43
PTHo=1-PLTo	1.00	1.00	1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00	1.00	1.00
EL1 (refer to Exhibit C16-3)	2.11	1.77	1.59	1.79
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.11	0.11	0.14	0.14
gdiff=max(gq-gf,0)	0.00	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.18	0.37	0.44	0.26
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.175	0.369	0.436	0.262

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000	0.000	0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b)]-tl, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

Cycle length, C 90.0 sec

	EBLT	WBLT	NBLT	SBLT
Adj. LT vol from Vol Adjustment Worksheet, v	32	165	6	32
v/c ratio from Capacity Worksheet, X	0.12	0.40	0.02	0.11
Protected phase effective green interval, g (s)	7.0	7.0	7.0	7.0
Opposing queue effective green interval, gq	22.72	12.47	8.54	14.86
Unopposed green interval, gu	13.28	23.53	19.46	13.14
Red time r=(C-g-gq-gu)	47.0	47.0	55.0	55.0
Arrival rate, qa=v/(3600(max[X,1.0]))	0.01	0.05	0.00	0.01
Protected ph. departure rate, Sp=s/3600	0.492	0.492	0.492	0.492
Permittad ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.25	0.29	0.32	0.29
XPerm	0.10	0.24	0.01	0.07
XProt	0.14	0.72	0.03	0.16
Case	1	1	1	1
Queue at beginning of green arrow, Qa	0.42	2.15	0.09	0.49
Queue at beginning of unsaturated green, Qu	0.20	0.57	0.01	0.13
Residual queue, Qr	0.00	0.00	0.00	0.00
Uniform Delay, d1	15.5	14.6	17.3	18.4

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Dur. Unmet Demand Q veh	Unmet Demand t hrs.	Uniform Delay Unadj. ds	Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 27.3 sec/veh Intersection LOS C

BACK OF QUEUE WORKSHEET

LaneGroup	Eastbound L	Eastbound TR	Westbound L	Westbound TR	Northbound L	Northbound TR	Southbound L	Southbound TR
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	32	323	165	513	6	335	32	209
So	1900	1900	1900	1900	1900	1900	1900	1900
No.Lanes	1	1 0	1	1 0	1	1 0	1	1 0
SL	561	1830	864	1763	1004	1779	744	1812
LnCapacity	268	671	413	646	391	494	290	503
Flow Ratio	0.06	0.18	0.19	0.29	0.01	0.19	0.04	0.12
v/c Ratio	0.12	0.48	0.40	0.79	0.02	0.68	0.11	0.42
Grn Ratio	0.48	0.37	0.48	0.37	0.39	0.28	0.39	0.28
I Factor		1.000		1.000		1.000		1.000
AT or PVG	3	3	3	3	3	3	3	3
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Q1	0.4	6.2	2.2	11.5	0.1	7.5	0.5	4.3
kB	0.3	0.5	0.4	0.5	0.4	0.5	0.3	0.5
Q2	0.0	0.5	0.3	1.8	0.0	0.9	0.0	0.3
Q Average	0.5	6.7	2.5	13.3	0.1	8.4	0.5	4.6
Q Spacing	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0
Q Storage	0	0	0	0	0	0	0	0
Q S Ratio								
70th Percentile Output:								
fB%	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
BOQ	0.6	7.9	3.0	15.6	0.1	9.9	0.6	5.5
QSRatio								
85th Percentile Output:								
fB%	1.6	1.5	1.6	1.5	1.6	1.5	1.6	1.6
BOQ	0.7	10.3	3.9	19.9	0.2	12.8	0.9	7.1
QSRatio								
90th Percentile Output:								
fB%	1.8	1.7	1.8	1.6	1.8	1.7	1.8	1.7
BOQ	0.8	11.3	4.4	21.4	0.2	13.9	1.0	7.9
QSRatio								
95th Percentile Output:								
fB%	2.1	1.9	2.0	1.8	2.1	1.9	2.1	2.0
BOQ	1.0	12.8	5.0	23.8	0.2	15.7	1.1	9.0
QSRatio								
98th Percentile Output:								
fB%	2.7	2.3	2.5	2.1	2.7	2.2	2.7	2.4
BOQ	1.2	15.4	6.3	27.4	0.3	18.6	1.4	11.0
QSRatio								

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: md
Agency:
Date: 1/4/2005
Period: pm
Project ID: 2007 total traffic - with improvements
E/W St: cth k

Inter.: cth k/104th ave
Area Type: All other areas
Jurisd: kenosha county
Year : 2007
N/S St: 104th ave

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	1	1	0	1	1	0	1	1	0
LGConfig	L	TR		L	TR		L	TR		L	TR	
Volume	20	385	20	140	280	150	15	245	90	90	135	40
Lane Width	12.0	12.0		12.0	12.0		12.0	12.0		12.0	12.0	
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A	A			NB Left	A	A		
Thru		A			Thru		A		
Right		A			Right		A		
Peds					Peds				
WB Left	A	A			SB Left	A	A		
Thru		A			Thru		A		
Right		A			Right		A		
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	7.0	28.0				7.0	30.0		
Yellow	3.0	4.5				3.0	4.5		
All Red	0.0	1.5				0.0	1.5		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	229	1770	0.10	0.42	18.2	B		
TR	575	1849	0.77	0.31	34.6	C	33.9	C
Westbound								
L	249	1770	0.62	0.42	23.8	C		
TR	549	1765	0.86	0.31	42.4	D	37.8	D
Northbound								
L	479	1770	0.03	0.44	14.3	B		
TR	596	1788	0.62	0.33	27.1	C	26.6	C
Southbound								
L	335	1770	0.30	0.44	16.7	B		
TR	600	1799	0.32	0.33	22.7	C	20.6	C

Intersection Delay = 31.5 (sec/veh) Intersection LOS = C

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/4/2005
Analysis Time Period: pm
Intersection: cth k/104th ave
Area Type: All other areas
Jurisdiction: kenosha county
Analysis Year: 2007
Project ID: 2007 total traffic - with improvements
East/West Street: cth k
North/South Street: 104th ave

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	20	385	20	140	280	150	15	245	90	90	135	40
% Heavy Veh	2	2	2	2	2	2	2	2	2	2	2	2
PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
PK 15 Vol	5	106	5	38	77	41	4	67	25	25	37	11
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900		1900	1900		1900	1900		1900	1900	
ParkExist												
NumPark												
No. Lanes	1	1	0	1	1	0	1	1	0	1	1	0
LGConfig	L	TR		L	TR		L	TR		L	TR	
Lane Width	12.0	12.0		12.0	12.0		12.0	12.0		12.0	12.0	
RTOR Vol			0			0			0			0
Adj Flow	22	445		154	473		16	368		99	192	
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.049			0.349			0.269			0.229	
Peds		0			0			0			0	
Bikes												
Buses	0	0		0	0		0	0		0	0	
%InProtPhase	0.0			0.0			0.0			0.0		

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Arriv. Type	3	3		3	3		3	3		3	3	
Unit Ext.	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Ext of g	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Ped Min g	3.2			3.2			3.2			3.2		

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A	A			NB Left	A	A		
Thru		A			Thru		A		
Right		A			Right		A		
Peds					Peds				
WB Left	A	A			SB Left	A	A		
Thru		A			Thru		A		
Right		A			Right		A		
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	7.0	28.0				7.0	30.0		
Yellow	3.0	4.5				3.0	4.5		
All Red	0.0	1.5				0.0	1.5		

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	20	385	20	140	280	150	15	245	90	90	135	40
PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Adj flow	22	423	22	154	308	165	16	269	99	99	148	44
No. Lanes	1	1	0	1	1	0	1	1	0	1	1	0
Lane group	L	TR		L	TR		L	TR		L	TR	
Adj flow	22	445		154	473		16	368		99	192	
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.049			0.349			0.269			0.229	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L	TR		L	TR		L	TR		L	TR	
So	1900	1900		1900	1900		1900	1900		1900	1900	
Lanes	1	1	0	1	1	0	1	1	0	1	1	0
fW	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fHV	0.980	0.980		0.980	0.980		0.980	0.980		0.980	0.980	
fG	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fP	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fBB	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fA	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fLU	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fRT		0.993			0.948			0.960			0.966	
fLT	0.950	1.000		0.950	1.000		0.950	1.000		0.950	1.000	
Sec.	0.141			0.173			0.499			0.289		
fLpb	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fRpb		1.000			1.000			1.000			1.000	
S	1770	1849		1770	1765		1770	1788		1770	1799	
Sec.	263			323			929			538		

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		22	1770	0.01	0.078	138	0.16
Perm		0	263	0.00	0.344	91	0.00
Left	L	22			0.42	229	0.10
Prot							
Perm							
Thru	TR	445	1849	0.24	0.31	575	0.77
Right							
Westbound							
Prot		138	1770	# 0.08	0.078	138	1.00
Perm		16	323	0.05	0.344	111	0.14
Left	L	154			0.42	249	0.62
Prot							
Perm							
Thru	TR	473	1765	# 0.27	0.31	549	0.86
Right							
Northbound							
Prot		16	1770	0.01	0.078	138	0.12
Perm		0	929	0.00	0.367	341	0.00
Left	L	16			0.44	479	0.03
Prot							
Perm							
Thru	TR	368	1788	# 0.21	0.33	596	0.62
Right							
Southbound							
Prot		99	1770	# 0.06	0.078	138	0.72
Perm		0	538	0.00	0.367	197	0.00
Left	L	99			0.44	335	0.30
Prot							
Perm							
Thru	TR	192	1799	0.11	0.33	600	0.32
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.61
Total lost time per cycle, L = 24.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.83

Control Delay and LOS Determination

Appr/ Lane Grp	v/c	g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	0.10	0.42	18.0	1.000	229	0.11	0.2	0.0	18.2	B		
TR	0.77	0.31	28.1	1.000	575	0.32	6.5	0.0	34.6	C	33.9	C
Westbound												
L	0.62	0.42	19.2	1.000	249	0.20	4.6	0.0	23.8	C		
TR	0.86	0.31	29.2	1.000	549	0.39	13.2	0.0	42.4	D	37.8	D
Northbound												
L	0.03	0.44	14.3	1.000	479	0.11	0.0	0.0	14.3	B		
TR	0.62	0.33	25.2	1.000	596	0.20	1.9	0.0	27.1	C	26.6	C
Southbound												
L	0.30	0.44	16.2	1.000	335	0.11	0.5	0.0	16.7	B		

TR	0.32	0.33	22.4	1.000	600	0.11	0.3	0.0	22.7	C	20.6	C

Intersection delay = 31.5 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M	M	M
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	38.0	38.0	40.0	40.0
Effective permitted green time for LT lane group, g(s)	31.0	31.0	33.0	33.0
Opposing effective green time, go (s)	28.0	28.0	30.0	30.0
Number of lanes in LT lane group, N	1	1	1	1
Number of lanes in opposing approach, No	1	1	1	1
Adjusted LT flow rate, VLT (veh/h)	22	154	16	99
Proportion of LT in LT lane group, PLT	1.000	1.000	1.000	1.000
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	473	445	192	368
Lost time for LT lane group, tL	6.00	6.00	6.00	6.00
Computation				
LT volume per cycle, LTC=VLTC/3600	0.55	3.85	0.40	2.48
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	11.82	11.13	4.80	9.20
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g	0.0	0.0	0.0	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.69	0.69	0.67	0.67
gq, (see Exhibit C16-4,5,6,7,8)	22.10	20.36	7.16	15.42
gu=g-gq if gq>=gf, or = g-gf if gq<gf	8.90	10.64	25.84	17.58
n=Max(gq-gf)/2,0)	11.05	10.18	3.58	7.71
PTHo=1-PLTo	1.00	1.00	1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00	1.00	1.00
EL1 (refer to Exhibit C16-3)	2.03	1.98	1.57	1.84
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.13	0.13	0.12	0.12
gdiff=max(gq-gf,0)	0.00	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.14	0.17	0.50	0.29
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.141	0.173	0.499	0.289

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000	0.000	0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 90.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v	22	154	16	99
v/c ratio from Capacity Worksheet, X	0.10	0.62	0.03	0.30
Protected phase effective green interval, g (s)	7.0	7.0	7.0	7.0
Opposing queue effective green interval, gq	22.10	20.36	7.16	15.42
Unopposed green interval, gu	8.90	10.64	25.84	17.58
Red time r=(C-g-gq-gu)	52.0	52.0	50.0	50.0
Arrival rate, qa=v/(3600(max[X,1.0]))	0.01	0.04	0.00	0.03
Protected ph. departure rate, Sp=s/3600	0.492	0.492	0.492	0.492
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.25	0.26	0.33	0.28
XPerm	0.08	0.48	0.02	0.18
XProt	0.10	0.73	0.07	0.46
Case	1	1	1	1
Queue at beginning of green arrow, Qa	0.32	2.22	0.22	1.38
Queue at beginning of unsaturated green, Qu	0.14	0.87	0.03	0.42
Residual queue, Qr	0.00	0.00	0.00	0.00
Uniform Delay, d1	18.0	19.2	14.3	16.2

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 31.5 sec/veh Intersection LOS C

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	L	TR	L	TR	L	TR	L	TR
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	22	445	154	473	16	368	99	192
So	1900	1900	1900	1900	1900	1900	1900	1900
No.Lanes	1	1 0	1	1 0	1	1 0	1	1 0
SL	541	1849	590	1765	1076	1788	754	1799
LnCapacity	229	575	249	549	479	596	335	600
Flow Ratio	0.04	0.24	0.26	0.27	0.01	0.21	0.13	0.11
v/c Ratio	0.10	0.77	0.62	0.86	0.03	0.62	0.30	0.32
Grn Ratio	0.42	0.31	0.42	0.31	0.44	0.33	0.44	0.33
I Factor		1.000		1.000		1.000		1.000
AT or PVG	3	3	3	3	3	3	3	3
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Q1	0.3	10.1	2.3	11.1	0.2	7.7	1.4	3.6
kB	0.3	0.5	0.3	.0.5	0.4	0.5	0.4	0.5
Q2	0.0	1.5	0.5	2.4	0.0	0.8	0.1	0.2
Q Average	0.4	11.6	2.8	13.5	0.2	8.5	1.6	3.8
Q Spacing	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0
Q Storage	0	0	0	0	0	0	0	0
Q S Ratio								
70th Percentile Output:								
fB%	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
BOQ	0.4	13.7	3.3	15.8	0.3	10.1	1.9	4.5
QSRatio								
85th Percentile Output:								
fB%	1.6	1.5	1.6	1.5	1.6	1.5	1.6	1.6
BOQ	0.6	17.5	4.4	20.2	0.4	13.0	2.5	6.0
QSRatio								
90th Percentile Output:								
fB%	1.8	1.6	1.7	1.6	1.8	1.7	1.8	1.7
BOQ	0.6	18.9	4.9	21.7	0.4	14.1	2.8	6.6
QSRatio								
95th Percentile Output:								
fB%	2.1	1.8	2.0	1.8	2.1	1.9	2.1	2.0
BOQ	0.7	21.1	5.6	24.1	0.5	16.0	3.2	7.6
QSRatio								
98th Percentile Output:								
fB%	2.7	2.1	2.5	2.1	2.7	2.2	2.6	2.4
BOQ	0.9	24.5	7.0	27.8	0.6	18.9	4.0	9.3
QSRatio								

ERROR MESSAGES

No errors to report.

HCS2000: Unsignalized Intersections Release 4.1d

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ALL-WAY STOP CONTROL(AWSC) ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/4/2005
Analysis Time Period: am
Intersection: cth k/eastern frontage road
Jurisdiction: kenosha county
Units: U. S. Customary
Analysis Year: 2007
Project ID: 2007 total traffic - with improvements
East/West Street: cth k
North/South Street: eastern frontage road

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	10	230	25	45	85	270	5	75	125	1	1	1
% Thrus Left Lane												

	Eastbound L1	Eastbound L2	Westbound L1	Westbound L2	Northbound L1	Northbound L2	Southbound L1	Southbound L2
Configuration	LTR		LTR		LTR		LTR	
PHF	1.00		1.00		1.00		1.00	
Flow Rate	265		400		205		3	
% Heavy Veh	0		0		0		0	
No. Lanes	1		1		1		1	
Opposing-Lanes	1		1		1		1	
Conflicting-lanes	1		1		1		1	
Geometry group	1		1		1		1	

Duration, T 0.25 hrs.

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound L1	Eastbound L2	Westbound L1	Westbound L2	Northbound L1	Northbound L2	Southbound L1	Southbound L2
Flow Rates:								
Total in Lane	265		400		205		3	
Left-Turn	10		45		5		1	
Right-Turn	25		270		125		1	
Prop. Left-Turns	0.0		0.1		0.0		0.3	
Prop. Right-Turns	0.1		0.7		0.6		0.3	
Prop. Heavy Vehicle	0.0		0.0		0.0		0.0	
Geometry Group	1		1		1		1	
Adjustments Exhibit 17-33:								
hLT-adj	0.2		0.2		0.2		0.2	
hRT-adj	-0.6		-0.6		-0.6		-0.6	
hHV-adj	1.7		1.7		1.7		1.7	
hadj, computed	-0.0		-0.4		-0.4		-0.1	

Worksheet 4 - Departure Headway and Service Time

	Eastbound L1	Eastbound L2	Westbound L1	Westbound L2	Northbound L1	Northbound L2	Southbound L1	Southbound L2
Flow rate	265		400		205		3	
hd, initial value	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20
x, initial	0.24		0.36		0.18		0.00	
hd, final value	4.89		4.43		5.07		5.70	
x, final value	0.36		0.49		0.29		0.00	
Move-up time, m	2.0		2.0		2.0		2.0	
Service Time	2.9		2.4		3.1		3.7	

Worksheet 5 - Capacity and Level of Service

	Eastbound L1	Eastbound L2	Westbound L1	Westbound L2	Northbound L1	Northbound L2	Southbound L1	Southbound L2
Flow Rate	265		400		205		3	
Service Time	2.9		2.4		3.1		3.7	
Utilization, x	0.36		0.49		0.29		0.00	
Dep. headway, hd	4.89		4.43		5.07		5.70	
Capacity	515		650		455		253	
Delay	10.61		11.63		10.12		8.72	
LOS	B		B		B		A	
Approach:								
Delay	10.61		11.63		10.12		8.72	
LOS	B		B		B		A	

Intersection Delay 10.96 Intersection LOS B

HCS2000: Unsignalized Intersections Release 4.1d

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Jurisdiction: kenosha county
Units: U. S. Customary
Analysis Year: 2007
Project ID: 2007 total traffic - with improvements
East/West Street: cth k
North/South Street: eastern frontage road

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	25	275	60	60	135	190	15	115	245	10	5	10
% Thrus Left Lane												

	Eastbound L1	Eastbound L2	Westbound L1	Westbound L2	Northbound L1	Northbound L2	Southbound L1	Southbound L2
Configuration	LTR		LTR		LTR		LTR	
PHF	1.00		1.00		1.00		1.00	
Flow Rate	360		385		375		25	
% Heavy Veh	0		0		0		0	
No. Lanes	1		1		1		1	
Opposing-Lanes	1		1		1		1	
Conflicting-lanes	1		1		1		1	
Geometry group	1		1		1		1	

Duration, T 0.25 hrs.

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound L1	Eastbound L2	Westbound L1	Westbound L2	Northbound L1	Northbound L2	Southbound L1	Southbound L2
Flow Rates:								
Total in Lane	360		385		375		25	
Left-Turn	25		60		15		10	
Right-Turn	60		190		245		10	
Prop. Left-Turns	0.1		0.2		0.0		0.4	
Prop. Right-Turns	0.2		0.5		0.7		0.4	
Prop. Heavy Vehicle	0.0		0.0		0.0		0.0	
Geometry Group	1		1		1		1	
Adjustments Exhibit 17-33:								
hLT-adj	0.2		0.2		0.2		0.2	
hRT-adj	-0.6		-0.6		-0.6		-0.6	
hHV-adj	1.7		1.7		1.7		1.7	
hadj, computed	-0.1		-0.3		-0.4		-0.2	

Worksheet 4 - Departure Headway and Service Time

	Eastbound L1	Eastbound L2	Westbound L1	Westbound L2	Northbound L1	Northbound L2	Southbound L1	Southbound L2
Flow rate	360		385		375		25	
hd, initial value	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20
x, initial	0.32		0.34		0.33		0.02	
hd, final value	5.68		5.48		5.60		6.73	
x, final value	0.57		0.59		0.58		0.05	
Move-up time, m		2.0		2.0		2.0		2.0
Service Time	3.7		3.5		3.6		4.7	

Worksheet 5 - Capacity and Level of Service

	Eastbound L1	Eastbound L2	Westbound L1	Westbound L2	Northbound L1	Northbound L2	Southbound L1	Southbound L2
Flow Rate	360		385		375		25	
Service Time	3.7		3.5		3.6		4.7	
Utilization, x	0.57		0.59		0.58		0.05	
Dep. headway, hd	5.68		5.48		5.60		6.73	
Capacity	603		626		603		275	
Delay	15.89		15.94		16.16		10.06	
LOS	C		C		C		B	
Approach:								
Delay		15.89		15.94		16.16		10.06
LOS		C		C		C		B

Intersection Delay 15.87 Intersection LOS C

HCS2000: Signalized Intersections Release 4.1e

Analyst: md
Agency:
Date: 1/3/2005
Period: am
Project ID: 2007 total traffic - with improvements
E/W St: Southern Access Drive

Inter.: 104th Ave/Southern Access Driv
Area Type: All other areas
Jurisd: Kenosha
Year : 2007
N/S St: 104th Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	2	0	0	0	0	0	1	1	0	0	1	1
LGConfig	L						L	T			T	R
Volume	500						1	355			190	1
Lane Width	12.0						12.0	12.0			12.0	12.0
RTOR Vol												0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A				NB Left	A	A		
Thru					Thru	A	A		
Right					Right				
Peds					Peds				
WB Left					SB Left				
Thru					Thru		A		
Right					Right		A		
Peds					Peds				
NB Right					EB Right				
SB Right	A				WB Right				
Green	30.0					5.0	40.0		
Yellow	4.5					3.0	4.5		
All Red	1.5					0.0	1.5		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	1168	3505	0.50	0.33	24.4	C		
							24.4	C
Westbound								
Northbound								
L	545	1805	0.00	0.53	10.1	B		
T	1046	1961	0.40	0.53	12.7	B	12.7	B
Southbound								
T	872	1961	0.26	0.44	15.8	B	15.8	B
R	1364	1615	0.00	0.84	1.1	A		

Intersection Delay = 18.8 (sec/veh) Intersection LOS = B

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/3/2005
Analysis Time Period: am
Intersection: 104th Ave/Southern Access Driv
Area Type: All other areas
Jurisdiction: Kenosha
Analysis Year: 2007
Project ID: 2007 total traffic - with improvements
East/West Street: Southern Access Drive
North/South Street: 104th Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	500						1	355			190	1
% Heavy Veh	0						0	2			2	0
PHF	0.85						0.85	0.85			0.85	0.85
PK 15 Vol	147						1	104			56	1
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat	1900						1900	2000			2000	1900
ParkExist												
NumPark												
No. Lanes	2	0	0	0	0	0	1	1	0	0	1	1
LGConfig	L						L	T			T	R
Lane Width	12.0						12.0	12.0			12.0	12.0
RTOR Vol												0
Adj Flow	588						1	418			224	1
%InSharedLn												
Prop LTs							1.000	0.000			0.000	
Prop RTs								0.000			0.000	1.000
Peds Bikes				0							0	
Buses	0						0	0			0	0
%InProtPhase							0.0					

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0						0.0	0.0			0.0	0.0
Arriv. Type	3						3	3			3	3
Unit Ext.	3.0						3.0	3.0			3.0	3.0
I Factor		1.000						1.000			1.000	
Lost Time	2.0						2.0	2.0			2.0	2.0
Ext of g	2.0						2.0	2.0			2.0	2.0
Ped Min g				3.2						3.2		

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A				NB Left	A	A		
Thru					Thru	A	A		
Right					Right				
Peds					Peds				
WB Left					SB Left				
Thru					Thru		A		
Right					Right		A		
Peds					Peds				
NB Right					EB Right				
SB Right	A				WB Right				
Green	30.0					5.0	40.0		
Yellow	4.5					3.0	4.5		
All Red	1.5					0.0	1.5		

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	500						1	355			190	1
PHF	0.85						0.85	0.85			0.85	0.85
Adj flow	588						1	418			224	1
No. Lanes	2	0	0	0	0	0	1	1	0	0	1	1
Lane group	L						L	T			T	R
Adj flow	588						1	418			224	1
Prop LTs							1.000	0.000			0.000	
Prop RTs								0.000			0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L						L	T			T	R
So	1900						1900	2000			2000	1900
Lanes	2	0	0	0	0	0	1	1	0	0	1	1
fW	1.000						1.000	1.000			1.000	1.000
fHV	1.000						1.000	0.980			0.980	1.000
fG	1.000						1.000	1.000			1.000	1.000
fP	1.000						1.000	1.000			1.000	1.000
fBB	1.000						1.000	1.000			1.000	1.000
fA	1.000						1.000	1.000			1.000	1.000
fLU	0.971						1.000	1.000			1.000	1.000
fRT								1.000			1.000	0.850
fLT	0.950						0.950	1.000			1.000	
Sec.							0.490					
fLpb	1.000						1.000	1.000			1.000	
fRpb								1.000			1.000	1.000
s	3505						1805	1961			1961	1615
Sec.							932					

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	588	3505	# 0.17	0.33	1168	0.50
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot		1	1805	0.00	0.056	100	0.01
Perm		0	932	0.00	0.478	445	0.00
Left	L	1			0.53	545	0.00
Prot							
Perm							
Thru	T	418	1961	# 0.21	0.53	1046	0.40
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	224	1961	0.11	0.44	872	0.26
Right	R	1	1615	0.00	0.84	1364	0.00

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.38
Total lost time per cycle, L = 12.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.44

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	0.50	0.33	24.0	1.000	1168	0.11	0.4	0.0	24.4	C		
											24.4	C
Westbound												
Northbound												
L	0.00	0.53	10.1	1.000	545	0.11	0.0	0.0	10.1	B		
T	0.40	0.53	12.5	1.000	1046	0.11	0.3	0.0	12.7	B	12.7	B
Southbound												

T	0.26	0.44	15.7	1.000	872	0.11	0.2	0.0	15.8	B	15.8	B
R	0.00	0.84	1.1	1.000	1364	0.11	0.0	0.0	1.1	A		

Intersection delay = 18.8 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach			M	
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)			48.0	
Effective permitted green time for LT lane group, g(s)			43.0	
Opposing effective green time, go (s)			40.0	
Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			1	
Adjusted LT flow rate, VLT (veh/h)			1	
Proportion of LT in LT lane group, PLT			1.000	
Proportion of LT in opposing flow, PLTo			0.00	
Adjusted opposing flow rate, Vo (veh/h)			224	
Lost time for LT lane group, tL			6.00	
Computation				
LT volume per cycle, LTC=VLTC/3600			0.03	
Opposing lane util. factor, fLUo			1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			5.60	
gf=G[exp(- a * (LTC ** b)]-tl, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.56	
gq, (see Exhibit C16-4,5,6,7,8)			7.11	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			35.89	
n=Max(gq-gf)/2,0)			3.55	
PTHo=1-PLTo			1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	
EL1 (refer to Exhibit C16-3)			1.70	
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g			0.09	
gdiff=max(gq-gf,0)			0.00	
fm=[gf/g)+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.49	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.190	

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT			0.000	0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo			1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b)]-tl, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g)+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 90.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v			1	
v/c ratio from Capacity Worksheet, X			0.00	
Protected phase effective green interval, g (s)			5.0	
Opposing queue effective green interval, gq			7.11	
Unopposed green interval, gu			35.89	
Red time r=(C-g-gq-gu)			42.0	
Arrival rate, qa=v/(3600(max[X,1.0]))			0.00	
Protected ph. departure rate, Sp=s/3600			0.501	
Permitted ph. departure rate, Sa=s(gq+gu)/(gu*3600)			0.31	
XPerm			0.00	
XProt			0.01	
Case			1	
Queue at beginning of green arrow, Qa			0.01	
Queue at beginning of unsaturated green, Qu			0.00	
Residual queue, Qr			0.00	
Uniform Delay, d1			10.1	

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 18.8 sec/veh Intersection LOS B

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L						L	T		T	R	
Init Queue	0.0						0.0	0.0		0.0	0.0	
Flow Rate	302						1	418		224	1	
So	1900						1900	2000		2000	1900	
No.Lanes	2	0	0	0	0	0	1	1	0	0	1	1
SL	1805						1023	1961		1961	1615	
LnCapacity	601						545	1046		872	1364	
Flow Ratio	0.17						0.00	0.21		0.11	0.00	
v/c Ratio	0.50						0.00	0.40		0.26	0.00	
Grn Ratio	0.33						0.53	0.53		0.44	0.84	
I Factor		1.000						1.000		1.000		
AT or PVG	3						3	3		3	3	
Pltn Ratio	1.00						1.00	1.00		1.00	1.00	
PF2	1.00						1.00	1.00		1.00	1.00	
Q1	6.0						0.0	6.2		3.5	0.0	
kB	0.5						0.5	0.7		0.6	0.8	
Q2	0.5						0.0	0.5		0.2	0.0	
Q Average	6.6						0.0	6.7		3.7	0.0	
Q Spacing	25.0						25.0	25.0		25.0	25.0	
Q Storage	0						0	0		0	0	
Q S Ratio												
70th Percentile Output:												
fB%	1.2						1.2	1.2		1.2	1.2	
BOQ	7.8						0.0	7.9		4.4	0.0	
QSRatio												
85th Percentile Output:												
fB%	1.5						1.6	1.5		1.6	1.6	
BOQ	10.1						0.0	10.3		5.8	0.0	
QSRatio												
90th Percentile Output:												
fB%	1.7						1.8	1.7		1.7	1.8	
BOQ	11.1						0.0	11.2		6.5	0.0	
QSRatio												
95th Percentile Output:												
fB%	1.9						2.1	1.9		2.0	2.1	
BOQ	12.6						0.0	12.8		7.4	0.0	
QSRatio												
98th Percentile Output:												
fB%	2.3						2.7	2.3		2.5	2.7	
BOQ	15.1						0.0	15.3		9.1	0.0	
QSRatio												

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: md
Agency:
Date: 1/3/2005
Period: pm
Project ID: 2007 total traffic - with improvements
E/W St: Southern Access Drive

Inter.: 104th Ave/Southern Access Driv
Area Type: All other areas
Jurisd: Kenosha
Year : 2007
N/S St: 104th Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound L	Eastbound T	Eastbound R	Westbound L	Westbound T	Westbound R	Northbound L	Northbound T	Northbound R	Southbound L	Southbound T	Southbound R
No. Lanes	2	0	0	0	0	0	1	1	0	0	1	1
LGConfig	L						L	T			T	R
Volume	785						1	415		265	1	
Lane Width	12.0						12.0	12.0		12.0	12.0	
RTOR Vol											0	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left		A			NB Left	A	A		
Thru					Thru	A	A		
Right					Right				
Peds					Peds				
WB Left					SB Left				
Thru					Thru		A		
Right					Right		A		
Peds					Peds				
NB Right					EB Right				
SB Right		A			WB Right				
Green		30.0				5.0	40.0		
Yellow		4.5				3.0	4.5		
All Red		1.5				0.0	1.5		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	1168	3505	0.79	0.33	30.9	C	30.9	C
Westbound								
Northbound								
L	472	1805	0.00	0.53	10.4	B	13.4	B
T	1046	1961	0.47	0.53	13.4	B		
Southbound								
T	872	1961	0.36	0.44	16.8	B	16.7	B
R	1364	1615	0.00	0.84	1.1	A		

Intersection Delay = 23.4 (sec/veh) Intersection LOS = C

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/3/2005
Analysis Time Period: pm
Intersection: 104th Ave/Southern Access Driv
Area Type: All other areas
Jurisdiction: Kenosha
Analysis Year: 2007
Project ID: 2007 total traffic - with improvements
East/West Street: Southern Access Drive
North/South Street: 104th Avenue

VOLUME DATA

	Eastbound L	Eastbound T	Eastbound R	Westbound L	Westbound T	Westbound R	Northbound L	Northbound T	Northbound R	Southbound L	Southbound T	Southbound R
Volume	785						1	415		265	1	
% Heavy Veh	0						0	2		2	0	
PHF	0.85						0.85	0.85		0.85	0.85	
PK 15 Vol	231						1	122		78	1	
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat	1900						1900	2000		2000	1900	
ParkExist												
NumPark												
No. Lanes	2	0	0	0	0	0	1	1	0	0	1	1
LGConfig	L						L	T			T	R
Lane Width	12.0						12.0	12.0		12.0	12.0	
RTOR Vol											0	
Adj Flow	924						1	488		312	1	
%InSharedLn							1.000	0.000			0.000	
Prop LTs							0.000			0.000	1.000	
Prop RTs										0		
Peds Bikes				0			0	0		0	0	
Buses	0						0.0					
%InProtPhase												

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound L	Eastbound T	Eastbound R	Westbound L	Westbound T	Westbound R	Northbound L	Northbound T	Northbound R	Southbound L	Southbound T	Southbound R
Init Unmet	0.0						0.0	0.0		0.0	0.0	
Arriv. Type	3						3	3		3	3	
Unit Ext.	3.0						3.0	3.0		3.0	3.0	
I Factor		1.000						1.000		1.000		
Lost Time	2.0						2.0	2.0		2.0	2.0	
Ext of g	2.0						2.0	2.0		2.0	2.0	

Ped Min g					3.2						3.2	

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left		A			NB Left	A	A		
Thru					Thru	A	A		
Right					Right				
Peds					Peds				
WB Left					SB Left				
Thru					Thru		A		
Right					Right		A		
Peds					Peds				
NB Right					EB Right				
SB Right		A			WB Right				
Green		30.0				5.0	40.0		
Yellow		4.5				3.0	4.5		
All Red		1.5				0.0	1.5		

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound L	Eastbound T	Eastbound R	Westbound L	Westbound T	Westbound R	Northbound L	Northbound T	Northbound R	Southbound L	Southbound T	Southbound R
Volume, V	785						1	415		265	1	
PHF	0.85						0.85	0.85		0.85	0.85	
Adj flow	924						1	488		312	1	
No. Lanes	2	0	0	0	0	0	1	1	0	0	1	1
Lane group	L						L	T			T	R
Adj flow	924						1	488		312	1	
Prop LTs							1.000	0.000			0.000	
Prop RTs								0.000		0.000	1.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound L	Eastbound T	Eastbound R	Westbound L	Westbound T	Westbound R	Northbound L	Northbound T	Northbound R	Southbound L	Southbound T	Southbound R
LG												
So	1900						1900	2000			2000	1900
Lanes	2	0	0	0	0	0	1	1	0	0	1	1
fW	1.000						1.000	1.000			1.000	1.000
fHV	1.000						1.000	0.980			0.980	1.000
fG	1.000						1.000	1.000			1.000	1.000
fP	1.000						1.000	1.000			1.000	1.000
fBB	1.000						1.000	1.000			1.000	1.000
fA	1.000						1.000	1.000			1.000	1.000
fLU	0.971						1.000	1.000			1.000	1.000
fRT								1.000			1.000	0.850
fLT	0.950						0.950	1.000			1.000	
Sec.							0.410					
fLpb	1.000						1.000	1.000			1.000	
fRpb								1.000			1.000	1.000
S	3505						1805	1961			1961	1615
Sec.							779					

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	924	3505	# 0.26	0.33	1168	0.79
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot		1	1805	0.00	0.056	100	0.01
Perm		0	779	0.00	0.478	372	0.00
Left	L	1			0.53	472	0.00
Prot							
Perm							
Thru	T	488	1961	# 0.25	0.53	1046	0.47
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	312	1961	0.16	0.44	872	0.36
Right	R	1	1615	0.00	0.84	1364	0.00

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.51
Total lost time per cycle, L = 12.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.59

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	0.79	0.33	27.2	1.000	1168	0.34	3.8	0.0	30.9	C	30.9	C
Westbound												
Northbound												
L	0.00	0.53	10.4	1.000	472	0.11	0.0	0.0	10.4	B		
T	0.47	0.53	13.0	1.000	1046	0.11	0.3	0.0	13.4	B	13.4	B
Southbound												

T	0.36	0.44	16.5	1.000	872	0.11	0.3	0.0	16.8	B	16.7	B
R	0.00	0.84	1.1	1.000	1364	0.11	0.0	0.0	1.1	A		

Intersection delay = 23.4 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach			M	
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)			48.0	
Effective permitted green time for LT lane group, g(s)			43.0	
Opposing effective green time, go (s)			40.0	
Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			1	
Adjusted LT flow rate, VLT (veh/h)			1	
Proportion of LT in LT lane group, PLT			1.000	
Proportion of LT in opposing flow, PLTo			0.00	
Adjusted opposing flow rate, Vo (veh/h)			312	
Lost time for LT lane group, tL			6.00	
Computation				
LT volume per cycle, LTC=VLTC/3600			0.03	
Opposing lane util. factor, fLUo			1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			7.80	
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.56	
gq, (see Exhibit C16-4,5,6,7,8)			10.48	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			32.52	
n=Max(gq-gf)/2,0)			5.24	
PTHo=1-PLTo			1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	
EL1 (refer to Exhibit C16-3)			1.84	
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g			0.09	
gdiff=max(gq-gf,0)			0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.41	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.410	

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT			0.000	0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo			1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 90.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v			1	
v/c ratio from Capacity Worksheet, X			0.00	
Protected phase effective green interval, g (s)			5.0	
Opposing queue effective green interval, gq			10.48	
Unopposed green interval, gu			32.52	
Red time r=(C-g-gq-gu)			42.0	
Arrival rate, qa=v/(3600(max[X,1.0]))			0.00	
Protected ph. departure rate, Sp=s/3600			0.501	
Permitted ph. departure rate, Sa=s(gq+gu)/(gu*3600)			0.29	
XPerm			0.00	
XProt			0.01	
Case			1	
Queue at beginning of green arrow, Qa			0.01	
Queue at beginning of unsaturated green, Qu			0.00	
Residual queue, Qr			0.00	
Uniform Delay, d1			10.4	

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Dur. Unmet Demand Q veh	Unmet Delay t hrs.	Uniform Delay Unadj. ds	Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 23.4 sec/veh Intersection LOS C

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L						L	T		T	R	
Init Queue	0.0						0.0	0.0		0.0	0.0	
Flow Rate	475						1	488		312	1	
So	1900						1900	2000		2000	1900	
No.Lanes	2	0	0	0	0	0	1	1	0	1	1	
SL	1805						886	1961		1961	1615	
LnCapacity	601						472	1046		872	1364	
Flow Ratio	0.26						0.00	0.25		0.16	0.00	
v/c Ratio	0.79						0.00	0.47		0.36	0.00	
Grn Ratio	0.33						0.53	0.53		0.44	0.84	
I Factor		1.000						1.000		1.000		
AT or PVG	3						3	3		3	3	
Pltn Ratio	1.00						1.00	1.00		1.00	1.00	
PF2	1.00						1.00	1.00		1.00	1.00	
Q1	10.7						0.0	7.6		5.2	0.0	
kB	0.5						0.4	0.7		0.6	0.8	
Q2	1.7						0.0	0.6		0.4	0.0	
Q Average	12.5						0.0	8.2		5.5	0.0	
Q Spacing	25.0						25.0	25.0		25.0	25.0	
Q Storage	0						0	0		0	0	
Q S Ratio												
70th Percentile Output:												
fB%	1.2						1.2	1.2		1.2	1.2	
BOQ	14.6						0.0	9.7		6.5	0.0	
QSRatio												
85th Percentile Output:												
fB%	1.5						1.6	1.5		1.5	1.6	
BOQ	18.7						0.0	12.5		8.5	0.0	
QSRatio												
90th Percentile Output:												
fB%	1.6						1.8	1.7		1.7	1.8	
BOQ	20.1						0.0	13.6		9.4	0.0	
QSRatio												
95th Percentile Output:												
fB%	1.8						2.1	1.9		1.9	2.1	
BOQ	22.5						0.0	15.4		10.7	0.0	
QSRatio												
98th Percentile Output:												
fB%	2.1						2.7	2.2		2.4	2.7	
BOQ	26.0						0.0	18.3		13.0	0.0	
QSRatio												

ERROR MESSAGES

No errors to report.

2007 TOTAL TRAFFIC CAPACITY ANALYSIS – WITHOUT IMPROVEMENTS

HCS2000: Signalized Intersections Release 4.1e

Analyst: md
Agency:
Date: 1/4/2005
Period: am
Project ID: 2007 total traffic - no improvements
E/W St: sth 158

Inter.: sth 158/cth h
Area Type: All other areas
Jurisd: wisdot
Year : 2007
N/S St: cth h

SIGNALIZED INTERSECTION SUMMARY

	Eastbound L	Eastbound T	Eastbound R	Westbound L	Westbound T	Westbound R	Northbound L	Northbound T	Northbound R	Southbound L	Southbound T	Southbound R
No. Lanes	1	1	0	1	1	0	0	1	0	0	1	0
LGConfig	L	TR		L	TR			LTR			LTR	
Volume	95	680	15	65	765	25	5	160	65	55	260	105
Lane Width	12.0	12.0		12.0	12.0			12.0			12.0	
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4			5	6	7	8
EB Left	A	A			NB	Left	A			
Thru		A				Thru	A			
Right		A				Right	A			
Peds						Peds				
WB Left	A	A			SB	Left	A			
Thru		A				Thru	A			
Right		A				Right	A			
Peds						Peds				
NB Right					EB	Right				
SB Right					WB	Right				
Green	6.0	40.0					29.0			
Yellow	3.0	4.5					4.5			
All Red	0.0	1.5					1.5			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	205	1805	0.52	0.54	21.2	C		
TR	842	1894	0.92	0.44	38.3	D	36.3	D
Westbound								
L	205	1805	0.35	0.54	19.1	B		
TR	840	1891	1.05	0.44	68.5	E	64.8	E
Northbound								
LTR	582	1806	0.44	0.32	24.6	C	24.6	C
Southbound								
LTR	541	1678	0.86	0.32	42.2	D	42.2	D

Intersection Delay = 46.8 (sec/veh) Intersection LOS = D

HCS2000: Signalized Intersections Release 4.1e

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Suite 202
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E-Mail: mdelavergne@landstrategiesinc.com

OPERATIONAL ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/4/2005
Analysis Time Period: am
Intersection: sth 158/cth h
Area Type: All other areas
Jurisdiction: wisdot
Analysis Year: 2007
Project ID: 2007 total traffic - no improvements
East/West Street: sth 158 North/South Street: cth h

VOLUME DATA

	Eastbound L	Eastbound T	Eastbound R	Westbound L	Westbound T	Westbound R	Northbound L	Northbound T	Northbound R	Southbound L	Southbound T	Southbound R
Volume	95	680	15	65	765	25	5	160	65	55	260	105
% Heavy Veh	0	0	0	0	0	0	0	0	0	0	0	0
PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
PK 15 Vol	26	189	4	18	213	7	2	44	18	15	72	29
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900		1900	1900			1900			1900	
ParkExist												
NumPark												
No. Lanes	1	1	0	1	1	0	0	1	0	0	1	0
LGConfig	L	TR		L	TR			LTR			LTR	
Lane Width	12.0	12.0		12.0	12.0			12.0			12.0	
RTOR Vol			0			0			0			0
Adj Flow	106	773		72	878			256			467	
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000			0.023			0.131	
Prop RTs		0.022			0.032		0.281			0.251		
Peds		0			0		0			0		
Bikes					0			0			0	
Buses	0	0		0	0							
%InProtPhase	0.0			0.0								

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound L	Eastbound T	Eastbound R	Westbound L	Westbound T	Westbound R	Northbound L	Northbound T	Northbound R	Southbound L	Southbound T	Southbound R
Init Unmet	0.0	0.0		0.0	0.0			0.0			0.0	
Arriv. Type	3	3		3	3			3			3	
Unit Ext.	3.0	3.0		3.0	3.0			3.0			3.0	
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0		2.0	2.0			2.0			2.0	
Ext of g	2.0	2.0		2.0	2.0			2.0			2.0	
Ped Min g	3.2			3.2			3.2			3.2		

PHASE DATA

Phase Combination	1	2	3	4			5	6	7	8
EB Left	A	A			NB	Left	A			
Thru		A				Thru	A			
Right		A				Right	A			
Peds						Peds				
WB Left	A	A			SB	Left	A			
Thru		A				Thru	A			
Right		A				Right	A			
Peds						Peds				
NB Right					EB	Right				
SB Right					WB	Right				
Green	6.0	40.0					29.0			
Yellow	3.0	4.5					4.5			
All Red	0.0	1.5					1.5			

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound L	Eastbound T	Eastbound R	Westbound L	Westbound T	Westbound R	Northbound L	Northbound T	Northbound R	Southbound L	Southbound T	Southbound R
Volume, V	95	680	15	65	765	25	5	160	65	55	260	105
PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj flow	106	756	17	72	850	28	6	178	72	61	289	117
No. Lanes	1	1	0	1	1	0	0	1	0	0	1	0
Lane group	L	TR		L	TR			LTR			LTR	
Adj flow	106	773		72	878			256			467	
Prop LTs	1.000	0.000		1.000	0.000			0.023			0.131	
Prop RTs		0.022			0.032		0.281			0.251		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound L	Eastbound TR		Westbound L	Westbound TR		Northbound LTR		Southbound LTR	
LG							1900		1900	
So	1900	1900		1900	1900					
Lanes	1	1	0	1	1	0	1	0	1	0
fW	1.000	1.000		1.000	1.000		1.000		1.000	
fHV	1.000	1.000		1.000	1.000		1.000		1.000	
fG	1.000	1.000		1.000	1.000		1.000		1.000	
fP	1.000	1.000		1.000	1.000		1.000		1.000	
fBB	1.000	1.000		1.000	1.000		1.000		1.000	
fA	1.000	1.000		1.000	1.000		1.000		1.000	
fLU	1.000	1.000		1.000	1.000		1.000		1.000	
fRT		0.997			0.995		0.962		0.966	
fLT	0.950	1.000		0.950	1.000		0.988		0.914	
Sec.	0.093			0.093						
fLpb	1.000	1.000		1.000	1.000		1.000		1.000	
fRpb		1.000			1.000		1.000		1.000	
S	1805	1894		1805	1891		1806		1678	
Sec.	177			177						

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		106	1805	# 0.06	0.067	120	0.88
Perm		0	177	0.00	0.478	85	0.00
Left	L	106			0.54	205	0.52
Prot							
Perm							
Thru	TR	773	1894	0.41	0.44	842	0.92
Right							
Westbound							
Prot		72	1805	0.04	0.067	120	0.60
Perm		0	177	0.00	0.478	85	0.00
Left	L	72			0.54	205	0.35
Prot							
Perm							
Thru	TR	878	1891	# 0.44	0.44	840	1.05
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	256	1806	0.14	0.32	582	0.44
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	467	1678	# 0.28	0.32	541	0.86
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.78
Total lost time per cycle, L = 18.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.98

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	0.52	0.54	18.9	1.000	205	0.12	2.3	0.0	21.2	C		
TR	0.92	0.44	23.5	1.000	842	0.44	14.9	0.0	38.3	D	36.3	D
Westbound												
L	0.35	0.54	18.0	1.000	205	0.11	1.0	0.0	19.1	B		
TR	1.05	0.44	25.0	1.000	840	0.50	43.5	0.0	68.5	E	64.8	E
Northbound												
LTR	0.44	0.32	24.1	1.000	582	0.11	0.5	0.0	24.6	C	24.6	C
Southbound												

LTR	0.86	0.32	28.6	1.000	541	0.39	13.5	0.0	42.2	D	42.2	D

Intersection delay = 46.8 (sec/veh) Intersection LOS = D

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M		
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	49.0	49.0		
Effective permitted green time for LT lane group, g(s)	43.0	43.0		
Opposing effective green time, go (s)	40.0	40.0		
Number of lanes in LT lane group, N	1	1		
Number of lanes in opposing approach, No	1	1		
Adjusted LT flow rate, VLT (veh/h)	106	72		
Proportion of LT in LT lane group, PLT	1.000	1.000		
Proportion of LT in opposing flow, PLTo	0.00	0.00		
Adjusted opposing flow rate, Vo (veh/h)	878	773		
Lost time for LT lane group, tL	6.00	6.00		
Computation				
LT volume per cycle, LTC=VLTC/3600	2.65	1.80		
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	21.95	19.33		
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g	0.0	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.56	0.56		
gq, (see Exhibit C16-4,5,6,7,8)	39.00	37.63		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	4.00	5.37		
n=Max(gq-gf)/2,0)	19.50	18.82		
PTHo=1-PLTo	1.00	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00		
EL1 (refer to Exhibit C16-3)	2.96	2.68		
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.09	0.09		
gdiff=max(gq-gf,0)	0.00	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.09	0.09		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.093	0.093		

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach			S	S
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)			29.0	29.0
Effective permitted green time for LT lane group, g(s)			29.0	29.0
Opposing effective green time, go (s)			29.0	29.0
Number of lanes in LT lane group, N			1	1
Number of lanes in opposing approach, No			1	1
Adjusted LT flow rate, VLT (veh/h)			6	61
Proportion of LT in LT lane group, PLT	0.000	0.000	0.023	0.131
Proportion of LT in opposing flow, PLTo			0.13	0.02
Adjusted opposing flow rate, Vo (veh/h)			467	256
Lost time for LT lane group, tL			6.00	6.00
Computation				
LT volume per cycle, LTC=VLTC/3600			0.15	1.53
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			11.68	6.40
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g			16.3	3.4
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.68	0.68
gq, (see Exhibit C16-4,5,6,7,8)			15.28	7.46
gu=g-gq if gq>=gf, or = g-gf if gq<gf			12.66	21.54
n=Max(gq-gf)/2,0)			0.00	2.01
PTHo=1-PLTo			0.87	0.98
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			0.02	0.13
EL1 (refer to Exhibit C16-3)			2.23	1.80
EL2=Max((1-Ptho**n)/Plto, 1.0)			1.00	1.98
fmin=2(1+PL)/g or fmin=2(1+Pl)/g			0.07	0.08
gdiff=max(gq-gf,0)			0.00	4.01
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.99	0.91
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.988	0.914

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 90.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v	106	72		
v/c ratio from Capacity Worksheet, X	0.52	0.35		
Protected phase effective green interval, g (s)	6.0	6.0		
Opposing queue effective green interval, gq	39.00	37.63		
Unopposed green interval, gu	4.00	5.37		
Red time r=(C-g-gq-gu)	41.0	41.0		
Arrival rate, qa=v/(3600(max[X,1.0]))	0.03	0.02		
Protected ph. departure rate, Sp=s/3600	0.501	0.501		
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.53	0.39		
XPerm	0.60	0.41		
XProt	0.46	0.31		
Case	1	1		
Queue at beginning of green arrow, Qa	1.21	0.82		
Queue at beginning of unsaturated green, Qu	1.15	0.75		
Residual queue, Qr	0.00	0.00		
Uniform Delay, d1	18.9	18.0		

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Dur. Unmet Demand Q veh	Initial Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 46.8 sec/veh Intersection LOS D

BACK OF QUEUE WORKSHEET

LaneGroup	Eastbound L	Eastbound TR	Westbound L	Westbound TR	Northbound LTR	Southbound LTR
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	106	773	72	878	256	467
So	1900	1900	1900	1900	1900	1900
No.Lanes	1	1 0	1	1 0	0 1 0	0 1 0
SL	376	1894	376	1891	1806	1678
LnCapacity	205	842	205	840	582	541
Flow Ratio	0.28	0.41	0.19	0.46	0.14	0.28
v/c Ratio	0.52	0.92	0.35	1.05	0.44	0.86
Grn Ratio	0.54	0.44	0.54	0.44	0.32	0.32
I Factor		1.000		1.000	1.000	1.000
AT or PVG	3	3	3	3	3	3
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00	1.00	1.00	1.00	1.00	1.00
Q1	1.3	18.1	0.8	22.0	5.1	11.0
kB	0.3	0.6	0.3	0.6	0.5	0.5
Q2	0.3	4.6	0.1	11.0	0.4	2.4
Q Average	1.5	22.7	1.0	32.9	5.4	13.4
Q Spacing	25.0	25.0	25.0	25.0	25.0	25.0
Q Storage	0	0	0	0	0	0
Q S Ratio						
70th Percentile Output:						
fB%	1.2	1.2	1.2	1.1	1.2	1.2
BOQ	1.8	26.3	1.2	37.7	6.5	15.6
QSRatio						
85th Percentile Output:						
fB%	1.6	1.4	1.6	1.4	1.6	1.5
BOQ	2.4	32.7	1.6	46.1	8.4	19.9
QSRatio						
90th Percentile Output:						
fB%	1.8	1.5	1.8	1.5	1.7	1.6
BOQ	2.7	34.7	1.7	48.6	9.3	21.4
QSRatio						
95th Percentile Output:						
fB%	2.1	1.7	2.1	1.6	1.9	1.8
BOQ	3.1	37.9	2.0	52.6	10.6	23.8
QSRatio						
98th Percentile Output:						
fB%	2.6	1.9	2.6	1.8	2.4	2.1
BOQ	4.0	42.5	2.6	58.6	12.8	27.5
QSRatio						

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: md
Agency:
Date: 1/4/2005
Period: pm
Project ID: 2007 total traffic - no improvements
E/W St: sth 158

Inter.: sth 158/cth h
Area Type: All other areas
Jurisd: wisdot
Year : 2007
N/S St: cth h

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	1	1	0	0	1	0	0	1	0
LGConfig	L	TR		L	TR			LTR			LTR	
Volume	160	930	20	40	665	60	10	310	50	55	280	75
Lane Width	12.0	12.0		12.0	12.0			12.0			12.0	
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4			5	6	7	8
EB Left	A	A			NB	Left	A			
Thru		A				Thru	A			
Right		A				Right	A			
Peds						Peds				
WB Left	A	A			SB	Left	A			
Thru		A				Thru	A			
Right		A				Right	A			
Peds						Peds				
NB Right					EB	Right				
SB Right					WB	Right				
Green	6.0	42.0					27.0			
Yellow	3.0	4.5					4.5			
All Red	0.0	1.5					1.5			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	205	1805	0.87	0.57	50.7	D		
TR	884	1894	1.19	0.47	122.2	F	111.9	F
Westbound								
L	205	1805	0.21	0.57	18.7	B		
TR	875	1876	0.92	0.47	37.3	D	36.3	D
Northbound								
LTR	551	1838	0.75	0.30	33.9	C	33.9	C
Southbound								
LTR	438	1459	1.04	0.30	84.9	F	84.9	F

Intersection Delay = 75.1 (sec/veh) Intersection LOS = E

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/4/2005
Analysis Time Period: pm
Intersection: sth 158/cth h
Area Type: All other areas
Jurisdiction: wisdot
Analysis Year: 2007
Project ID: 2007 total traffic - no improvements
East/West Street: sth 158 North/South Street: cth h

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	160	930	20	40	665	60	10	310	50	55	280	75
% Heavy Veh	0	0	0	0	0	0	0	0	0	0	0	0
PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
PK 15 Vol	44	258	6	11	185	17	3	86	14	15	78	21
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900		1900	1900			1900			1900	
ParkExist												
NumPark												
No. Lanes	1	1	0	1	1	0	0	1	0	0	1	0
LGConfig	L	TR		L	TR			LTR			LTR	
Lane Width	12.0	12.0		12.0	12.0			12.0			12.0	
RTOR Vol			0			0			0			0
Adj Flow	178	1055		44	806			411			455	
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000			0.027			0.134	
Prop RTs		0.021			0.083		0.136			0.182		
Peds			0		0		0			0		
Bikes	0			0					0			0
Buses			0			0						
%InProtPhase	0.0			0.0								

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0	0.0			0.0			0.0	
Arriv. Type	3	3		3	3			3			3	
Unit Ext.	3.0	3.0		3.0	3.0			3.0			3.0	
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0		2.0	2.0			2.0			2.0	
Ext of g	2.0	2.0		2.0	2.0			2.0			2.0	

Ped Min g	3.2	3.2	3.2	3.2

PHASE DATA

Phase Combination	1	2	3	4			5	6	7	8
EB Left	A	A			NB	Left	A			
Thru		A				Thru	A			
Right		A				Right	A			
Peds						Peds				
WB Left	A	A			SB	Left	A			
Thru		A				Thru	A			
Right		A				Right	A			
Peds						Peds				
NB Right					EB	Right				
SB Right					WB	Right				
Green	6.0	42.0					27.0			
Yellow	3.0	4.5					4.5			
All Red	0.0	1.5					1.5			

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	160	930	20	40	665	60	10	310	50	55	280	75
PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj flow	178	1033	22	44	739	67	11	344	56	61	311	83
No. Lanes	1	1	0	1	1	0	0	1	0	0	1	0
Lane group	L	TR		L	TR			LTR			LTR	
Adj flow	178	1055		44	806			411			455	
Prop LTs	1.000	0.000		1.000	0.000			0.027			0.134	
Prop RTs		0.021			0.083		0.136			0.182		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L	TR		L	TR			LTR			LTR	
So	1900	1900		1900	1900			1900			1900	
Lanes	1	1	0	1	1	0	0	1	0	0	1	0
fW	1.000	1.000		1.000	1.000			1.000			1.000	
fHV	1.000	1.000		1.000	1.000			1.000			1.000	
fG	1.000	1.000		1.000	1.000			1.000			1.000	
fP	1.000	1.000		1.000	1.000			1.000			1.000	
fBB	1.000	1.000		1.000	1.000			1.000			1.000	
fA	1.000	1.000		1.000	1.000			1.000			1.000	
fLU	1.000	1.000		1.000	1.000			1.000			1.000	
fRT		0.997			0.988			0.982			0.975	
fLT	0.950	1.000		0.950	1.000			0.985			0.787	
Sec.	0.089			0.089								
fLpb	1.000	1.000		1.000	1.000			1.000			1.000	
fRpb		1.000			1.000			1.000			1.000	
S	1805	1894		1805	1876			1838			1459	
Sec.	169			169								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		120	1805	# 0.07	0.067	120	1.00
Perm		58	169	0.34	0.500	85	0.68
Left	L	178			0.57	205	0.87
Prot							
Perm							
Thru	TR	1055	1894	# 0.47	0.47	884	1.19
Right							
Westbound							
Prot		44	1805	0.02	0.067	120	0.37
Perm		0	169	0.00	0.500	85	0.00
Left	L	44			0.57	205	0.21
Prot							
Perm							
Thru	TR	806	1876	0.43	0.47	875	0.92
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	411	1838	0.22	0.30	551	0.75
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	455	1459	# 0.31	0.30	438	1.04
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.85
Total lost time per cycle, L = 18.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.06

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	0.87	0.57	20.3	1.000	205	0.40	30.4	0.0	50.7	D		
TR	1.19	0.47	24.0	1.000	884	0.50	98.2	0.0	122.2	F	111.9	F
Westbound												
L	0.21	0.57	18.2	1.000	205	0.11	0.5	0.0	18.7	B		
TR	0.92	0.47	22.5	1.000	875	0.44	14.9	0.0	37.3	D	36.3	D
Northbound												
LTR	0.75	0.30	28.4	1.000	551	0.30	5.5	0.0	33.9	C	33.9	C
Southbound												

LTR	1.04	0.30	31.5	1.000	438	0.50	53.4	0.0	84.9	F	84.9	F

Intersection delay = 75.1 (sec/veh) Intersection LOS = E

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M		
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	51.0	51.0		
Effective permitted green time for LT lane group, g(s)	45.0	45.0		
Opposing effective green time, go (s)	42.0	42.0		
Number of lanes in LT lane group, N	1	1		
Number of lanes in opposing approach, No	1	1		
Adjusted LT flow rate, VLT (veh/h)	178	44		
Proportion of LT in LT lane group, PLT	1.000	1.000		
Proportion of LT in opposing flow, PLTo	0.00	0.00		
Adjusted opposing flow rate, Vo (veh/h)	806	1055		
Lost time for LT lane group, tL	6.00	6.00		
Computation				
LT volume per cycle, LTC=VLTC/3600	4.45	1.10		
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	20.15	26.38		
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g	0.0	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.53	0.53		
gq, (see Exhibit C16-4,5,6,7,8)	38.92	41.00		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	6.08	4.00		
n=Max(gq-gf)/2,0)	19.46	20.50		
PTHo=1-PLTo	1.00	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00		
EL1 (refer to Exhibit C16-3)	2.77	3.50		
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.09	0.09		
gdiff=max(gq-gf,0)	0.00	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.09	0.09		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.089	0.089		

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach			S	S
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)			27.0	27.0
Effective permitted green time for LT lane group, g(s)			27.0	27.0
Opposing effective green time, go (s)			27.0	27.0
Number of lanes in LT lane group, N			1	1
Number of lanes in opposing approach, No			1	1
Adjusted LT flow rate, VLT (veh/h)			11	61
Proportion of LT in LT lane group, PLT	0.000	0.000	0.027	0.134
Proportion of LT in opposing flow, PLTo			0.13	0.03
Adjusted opposing flow rate, Vo (veh/h)			455	411
Lost time for LT lane group, tL			6.00	6.00
Computation				
LT volume per cycle, LTC=VLTC/3600			0.28	1.53
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			11.38	10.27
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g			12.4	2.8
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.70	0.70
gq, (see Exhibit C16-4,5,6,7,8)			15.59	13.98
gu=g-gq if gq>=gf, or = g-gf if gq<gf			11.41	13.02
n=Max(gq-gf)/2,0)			1.58	5.59
PTHo=1-PLTo			0.87	0.97
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			0.03	0.13
EL1 (refer to Exhibit C16-3)			2.20	2.10
EL2=Max((1-Ptho**n)/Plto, 1.0)			1.52	5.26
fmin=2(1+PL)/g or fmin=2(1+Pl)/g			0.08	0.08
gdiff=max(gq-gf,0)			3.16	11.18
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.99	0.79
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.985	0.797

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 90.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v	178	44		
v/c ratio from Capacity Worksheet, X	0.87	0.21		
Protected phase effective green interval, g (s)	6.0	6.0		
Opposing queue effective green interval, gq	38.92	41.00		
Unopposed green interval, gu	6.08	4.00		
Red time r=(C-g-gq-gu)	39.0	39.0		
Arrival rate, qa=v/(3600(max[X,1.0]))	0.05	0.01		
Protected ph. departure rate, Sp=s/3600	0.501	0.501		
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.35	0.53		
XPerm	1.05	0.26		
XProt	0.74	0.18		
Case	3	1		
Queue at beginning of green arrow, Qa	2.04	0.48		
Queue at beginning of unsaturated green, Qu	1.92	0.50		
Residual queue, Qr	0.11	0.00		
Uniform Delay, d1	20.3	18.2		

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Dur. Unmet Demand Q veh	Unmet Demand t hrs.	Uniform Delay Unadj. ds	Adj. d1 sec	Initial Queue Param. u	Initial Final Unmet Demand Q veh	Initial Lane Queue Delay d3 sec	Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 75.1 sec/veh Intersection LOS E

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	TR		L	TR		LTR			LTR		
Init Queue	0.0	0.0		0.0	0.0		0.0			0.0		
Flow Rate	178	1055		44	806		411			455		
So	1900	1900		1900	1900		1900			1900		
No.Lanes	1	1	0	1	1	0	0	1	0	0	1	0
SL	361	1894		361	1876		1838			1459		
LnCapacity	205	884		205	875		551			438		
Flow Ratio	0.49	0.56		0.12	0.43		0.22			0.31		
v/c Ratio	0.87	1.19		0.21	0.92		0.75			1.04		
Grn Ratio	0.57	0.47		0.57	0.47		0.30			0.30		
I Factor		1.000			1.000		1.000			1.000		
AT or PVG	3	3		3	3		3			3		
Pltn Ratio	1.00	1.00		1.00	1.00		1.00			1.00		
PF2	1.00	1.00		1.00	1.00		1.00			1.00		
Q1	2.0	26.4		0.5	18.8		9.3			11.4		
kB	0.3	0.6		0.3	0.6		0.5			0.4		
Q2	1.3	24.8		0.1	4.8		1.3			6.1		
Q Average	3.3	51.2		0.6	23.6		10.6			17.4		
Q Spacing	25.0	25.0		25.0	25.0		25.0			25.0		
Q Storage	0	0		0	0		0			0		
Q S Ratio												
70th Percentile Output:												
fB%	1.2	1.1		1.2	1.2		1.2			1.2		
BOQ	4.0	57.7		0.7	27.3		12.5			20.3		
QSRatio												
85th Percentile Output:												
fB%	1.6	1.4		1.6	1.4		1.5			1.5		
BOQ	5.2	69.3		0.9	34.0		16.0			25.6		
QSRatio												
90th Percentile Output:												
fB%	1.7	1.4		1.8	1.5		1.6			1.6		
BOQ	5.8	73.2		1.0	36.0		17.3			27.3		
QSRatio												
95th Percentile Output:												
fB%	2.0	1.5		2.1	1.7		1.8			1.7		
BOQ	6.6	78.5		1.2	39.3		19.4			30.1		
QSRatio												
98th Percentile Output:												
fB%	2.5	1.7		2.7	1.9		2.1			2.0		
BOQ	8.2	88.0		1.5	44.0		22.7			34.2		
QSRatio												

ERROR MESSAGES

No errors to report.

HCS2000: Unsignalized Intersections Release 4.1d

TWO-WAY STOP CONTROL SUMMARY

Analyst: md
Agency/Co.:
Date Performed: 11/12/2004
Analysis Time Period: am
Intersection: sth 158/104th avenue
Jurisdiction: wisdot
Units: U. S. Customary
Analysis Year: 2004
Project ID: 2007 total traffic - no improvements
East/West Street: sth 158
North/South Street: 104th Avenue
Intersection Orientation: EW
Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1 L	2 T	3 R	4 L	5 T	6 R
Volume	5	715	235	185	635	5
Peak-Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate, HFR	5	715	235	185	635	5
Percent Heavy Vehicles	0	--	--	0	--	--
Median Type/Storage	Undivided			/		
RT Channelized?			No			No
Lanes	1 L	2 T	1 R	1 L	2 T	1 R
Configuration		No			No	
Upstream Signal?						

Minor Street: Approach	Northbound			Southbound		
Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume	490	5	275	5	10	5
Peak Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate, HFR	490	5	275	5	10	5
Percent Heavy Vehicles	0	0	0	0	0	0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No /			No /
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound		Southbound	
Movement	1	4	7	8	9	10	11	12
Lane Config	L	L		LTR			LTR	
v (vph)	5	185		770			20	
C(m) (vph)	954	731		99			62	
v/c	0.01	0.25		7.78			0.32	
95% queue length	0.02	1.00		87.19			1.17	
Control Delay	8.8	11.6		3133			88.6	
LOS	A	B		F			F	
Approach Delay				3133			88.6	
Approach LOS				F			F	

HCS2000: Unsignalized Intersections Release 4.1d

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TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 11/12/2004
Analysis Time Period: am
Intersection: sth 158/104th avenue
Jurisdiction: wisdot
Units: U. S. Customary
Analysis Year: 2004
Project ID: 2007 total traffic - no improvements
East/West Street: sth 158
North/South Street: 104th Avenue
Intersection Orientation: EW
Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume	5	715	235	185	635	5
Peak-Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Peak-15 Minute Volume	1	179	59	46	159	1
Hourly Flow Rate, HFR	5	715	235	185	635	5
Percent Heavy Vehicles	0	--	--	0	--	--
Median Type/Storage	Undivided			/		
RT Channelized?			No			No
Lanes	1 L	2 T	1 R	1 L	2 T	1 R
Configuration		No			No	
Upstream Signal?						

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume	490	5	275	5	10	5
Peak Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Peak-15 Minute Volume	122	1	69	1	2	1
Hourly Flow Rate, HFR	490	5	275	5	10	5
Percent Heavy Vehicles	0	0	0	0	0	0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No /			No /
RT Channelized?						
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

		Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2	Left-Turn							
	Through							
S5	Left-Turn							
	Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1	4.1	7.5	6.5	6.9	7.5	6.5	6.9
t(c,hv)		2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
P(hv)		0	0	0	0	0	0	0	0
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Grade/100				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage	4.1	4.1	7.5	6.5	6.9	7.5	6.5	6.9
	2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20	2.20	3.50	4.00	3.30	3.50	4.00	3.30
t(f,HV)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(HV)	0	0	0	0	0	0	0	0
t(f)	2.2	2.2	3.5	4.0	3.3	3.5	4.0	3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2 V(t)	Movement 2 V(1,prot)	Movement 5 V(t)	Movement 5 V(1,prot)
V prog				
Total Saturation Flow Rate, s (vph)				
Arrival Type				
Effective Green, g (sec)				
Cycle Length, C (sec)				
Rp (from Exhibit 16-11)				
Proportion vehicles arriving on green P				
g(q1)				
g(q2)				
g(q)				

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2 V(t)	Movement 2 V(1,prot)	Movement 5 V(t)	Movement 5 V(1,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p		0.000		0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5

Single-Stage Process Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x	640	950	1417	1735	358	1375	1965	318
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		3000		3000		3000		3000
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	358	318
Potential Capacity	644	684
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	644	684
Probability of Queue free St.	0.57	0.99
Step 2: LT from Major St.	4	1
Conflicting Flows	950	640
Potential Capacity	731	954
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	731	954
Probability of Queue free St.	0.75	0.99
Maj L-Shared Prob Q free St.		
Step 3: TH from Minor St.	8	11
Conflicting Flows	1735	1965
Potential Capacity	89	64
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.74	0.74
Movement Capacity	66	48
Probability of Queue free St.	0.92	0.79
Step 4: LT from Minor St.	7	10
Conflicting Flows	1417	1375
Potential Capacity	99	106
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.59	0.69
Maj. L, Min T Adj. Imp Factor.	0.68	0.76
Cap. Adj. factor due to Impeding mvmnt	0.67	0.43
Movement Capacity	67	46

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	1735	1965
Potential Capacity	89	64
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.74	0.74
Movement Capacity	66	48
Result for 2 stage process:		
a		
y		
C t	66	48
Probability of Queue free St.	0.92	0.79
Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	1417	1375
Potential Capacity	99	106
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.59	0.69
Maj. L, Min T Adj. Imp Factor.	0.68	0.76
Cap. Adj. factor due to Impeding mvmnt	0.67	0.43
Movement Capacity	67	46
Results for Two-stage process:		
a		
y		
C t	67	46

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	490	5	275	5	10	5
Movement Capacity (vph)	67	66	644	46	48	684
Shared Lane Capacity (vph)		99			62	

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	67	66	644	46	48	684
Volume	490	5	275	5	10	5
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh		99			62	
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	L	L		LTR			LTR	
v (vph)	5	185		770			20	
C(m) (vph)	954	731		99			62	
v/c	0.01	0.25		7.78			0.32	
95% queue length	0.02	1.00		87.19			1.17	
Control Delay	8.8	11.6		3133			88.6	
LOS	A	B		F			F	
Approach Delay				3133			88.6	
Approach LOS				F			F	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.99	0.75
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4	8.8	11.6
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS2000: Unsignalized Intersections Release 4.1d

TWO-WAY STOP CONTROL SUMMARY

Analyst: md
Agency/Co.:
Date Performed: 11/12/2004
Analysis Time Period: pm
Intersection: sth 158/104th avenue
Jurisdiction: wisdot
Units: U. S. Customary
Analysis Year: 2004
Project ID: 2007 total traffic - no improvements
East/West Street: sth 158
North/South Street: 104th Avenue
Intersection Orientation: EW
Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1 L	2 T	3 R	4 L	5 T	6 R
Volume	5	660	90	175	775	5
Peak-Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate, HFR	5	660	90	175	775	5
Percent Heavy Vehicles	0	--	--	0	--	--
Median Type/Storage	Undivided			/		
RT Channelized?			No			No
Lanes	1 L	2 T	1 R	1 L	2 T	1 R
Configuration		No			No	
Upstream Signal?						

Minor Street: Approach	Northbound			Southbound		
Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume	900	5	430	10	5	10
Peak Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate, HFR	900	5	430	10	5	10
Percent Heavy Vehicles	0	0	0	0	0	0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No /			No /
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	L	L		LTR			LTR	
v (vph)	5	175		1335			25	
C(m) (vph)	846	868		108			51	
v/c	0.01	0.20		12.36			0.49	
95% queue length	0.02	0.75		156.57			1.84	
Control Delay	9.3	10.2		5187			130.4	
LOS	A	B		F			F	
Approach Delay				5187			130.4	
Approach LOS				F			F	

HCS2000: Unsignalized Intersections Release 4.1d

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TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 11/12/2004
Analysis Time Period: pm
Intersection: sth 158/104th avenue
Jurisdiction: wisdot
Units: U. S. Customary
Analysis Year: 2004
Project ID: 2007 total traffic - no improvements
East/West Street: sth 158
North/South Street: 104th Avenue
Intersection Orientation: EW
Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume	5	660	90	175	775	5
Peak-Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Peak-15 Minute Volume	1	165	22	44	194	1
Hourly Flow Rate, HFR	5	660	90	175	775	5
Percent Heavy Vehicles	0	--	--	0	--	--
Median Type/Storage	Undivided			/		
RT Channelized?			No			No
Lanes	1 L	2 T	1 R	1 L	2 T	1 R
Configuration		No			No	
Upstream Signal?						

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume	900	5	430	10	5	10
Peak Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Peak-15 Minute Volume	225	1	108	2	1	2
Hourly Flow Rate, HFR	900	5	430	10	5	10
Percent Heavy Vehicles	0	0	0	0	0	0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No /			No /
RT Channelized?						
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn							
Through							
S5 Left-Turn							
Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1	4.1	7.5	6.5	6.9	7.5	6.5	6.9
t(c,hv)		2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
P(hv)		0	0	0	0	0	0	0	0
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Grade/100				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage	4.1	4.1	7.5	6.5	6.9	7.5	6.5	6.9
	2-stage								

Follow-Up Time Calculations Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20	2.20	3.50	4.00	3.30	3.50	4.00	3.30
t(f,HV)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(HV)	0	0	0	0	0	0	0	0
t(f)	2.2	2.2	3.5	4.0	3.3	3.5	4.0	3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2 V(t)	Movement 2 V(1,prot)	Movement 5 V(t)	Movement 5 V(1,prot)
V prog				
Total Saturation Flow Rate, s (vph)				
Arrival Type				
Effective Green, g (sec)				
Cycle Length, C (sec)				
Rp (from Exhibit 16-11)				
Proportion vehicles arriving on green P				
g(q1)				
g(q2)				
g(q)				

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2 V(t)	Movement 2 V(1,prot)	Movement 5 V(t)	Movement 5 V(1,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p		0.000		0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x	780	750	1410	1800	330	1467	1885	388
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		3000		3000		3000		3000
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	330	388
Potential Capacity	672	616
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	672	616
Probability of Queue free St.	0.36	0.98

Step 2: LT from Major St.	4	1
Conflicting Flows	750	780
Potential Capacity	868	846
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	868	846
Probability of Queue free St.	0.80	0.99
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows	1800	1885
Potential Capacity	81	71
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.79	0.79
Movement Capacity	64	56
Probability of Queue free St.	0.92	0.91

Step 4: LT from Minor St.	7	10
Conflicting Flows	1410	1467
Potential Capacity	100	91
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.72	0.73
Maj. L, Min T Adj. Imp Factor.	0.79	0.79
Cap. Adj. factor due to Impeding mvmnt	0.77	0.29
Movement Capacity	77	26

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	1800	1885
Potential Capacity	81	71
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.79	0.79
Movement Capacity	64	56
Result for 2 stage process:		
a		
y		
C t	64	56
Probability of Queue free St.	0.92	0.91

Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	1410	1467
Potential Capacity	100	91
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.72	0.73
Maj. L, Min T Adj. Imp Factor.	0.79	0.79
Cap. Adj. factor due to Impeding mvmnt	0.77	0.29
Movement Capacity	77	26
Results for Two-stage process:		
a		
y		
C t	77	26

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	900	5	430	10	5	10
Movement Capacity (vph)	77	64	672	26	56	616
Shared Lane Capacity (vph)		108			51	

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	77	64	672	26	56	616
Volume	900	5	430	10	5	10
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh		108			51	
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	L	L		LTR			LTR	
v (vph)	5	175		1335			25	
C(m) (vph)	846	868		108			51	
v/c	0.01	0.20		12.36			0.49	
95% queue length	0.02	0.75		156.57			1.04	
Control Delay	9.3	10.2		5187			130.4	
LOS	A	B		F			F	
Approach Delay				5187			130.4	
Approach LOS				F			F	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.99	0.80
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4	9.3	10.2
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS2000: Signalized Intersections Release 4.1e

Analyst: md
Agency:
Date: 1/3/2005
Period: am
Project ID: 2007 total traffic - no improvements
E/W St: sth 158

Inter.: sth 158/greyhound access
Area Type: All other areas
Jurisd: wisdot
Year : 2007
N/S St: greyhound access

SIGNALIZED INTERSECTION SUMMARY

	Eastbound L	Eastbound T	Eastbound R	Westbound L	Westbound T	Westbound R	Northbound L	Northbound T	Northbound R	Southbound L	Southbound T	Southbound R
No. Lanes	0	2	1	1	2	0	2	0	1	0	0	0
LGConfig		TR	R	L	T		L		R			
Volume		945	365	260	870		10		10			
Lane Width		12.0	12.0	12.0	12.0		12.0		12.0			
RTOR Vol			0						0			

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left					NB Left	A			
Thru		A			Thru				
Right		A			Right	A			
Peds					Peds				
WB Left	A	A			SB Left				
Thru	A	A			Thru				
Right					Right				
Peds					Peds				
NB Right	A				EB Right				
SB Right					WB Right				
Green	17.0	47.0				11.0			
Yellow	3.0	4.5				4.5			
All Red	0.0	1.5				1.5			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
TR	1889	3618	0.56	0.52	14.8	B	14.6	B
R	843	1615	0.48	0.52	14.2	B		
Westbound								
L	520	1805	0.56	0.74	9.3	A	5.3	A
T	2693	3618	0.36	0.74	4.1	A		
Northbound								
L	428	3505	0.03	0.12	34.8	C	26.2	C
R	610	1615	0.02	0.38	17.6	B		
Southbound								

Intersection Delay = 10.4 (sec/veh) Intersection LOS = B

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/3/2005
Analysis Time Period: am
Intersection: sth 158/greyhound access
Area Type: All other areas
Jurisdiction: wisdot
Analysis Year: 2007
Project ID: 2007 total traffic - no improvements
East/West Street: sth 158
North/South Street: greyhound access

VOLUME DATA

	Eastbound L	Eastbound T	Eastbound R	Westbound L	Westbound T	Westbound R	Northbound L	Northbound T	Northbound R	Southbound L	Southbound T	Southbound R
Volume		945	365	260	870		10		10			
% Heavy Veh		0	0	0	0		0		0			
PHF		0.90	0.90	0.90	0.90		0.90		0.90			
PK 15 Vol		263	101	72	242		3		3			
Hi Ln Vol								0				
% Grade		0			0							
Ideal Sat		1900	1900	1900	1900		1900		1900			
ParkExist												
NumPark												
No. Lanes	0	2	1	1	2	0	2	0	1	0	0	0
LGConfig		TR	R	L	T		L		R			
Lane Width		12.0	12.0	12.0	12.0		12.0		12.0			
RTOR Vol			0						0			
Adj Flow		1050	406	289	967		11		11			
%InSharedLn			0									
Prop LTs		0.000		1.000	0.000							
Prop RTs		0.000	1.000		0.000				1.000			
Peds		0					0			0		
Bikes												
Buses		0	0	0	0		0		0			
%InProtPhase				0.0								

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound L	Eastbound T	Eastbound R	Westbound L	Westbound T	Westbound R	Northbound L	Northbound T	Northbound R	Southbound L	Southbound T	Southbound R
Init Unmet		0.0	0.0	0.0	0.0		0.0		0.0			
Arriv. Type		3	3	3	3		3		3			
Unit Ext.		3.0	3.0	3.0	3.0		3.0		3.0			
I Factor		1.000			1.000			1.000				
Lost Time		2.0	2.0	2.0	2.0		2.0		2.0			
Ext of g		2.0	2.0	2.0	2.0		2.0		2.0			

Ped Min g	3.2				3.2		3.2		

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left					NB Left	A			
Thru		A			Thru				
Right		A			Right	A			
Peds					Peds				
WB Left	A	A			SB Left				
Thru	A	A			Thru				
Right					Right				
Peds					Peds				
NB Right	A				EB Right				
SB Right					WB Right				
Green	17.0	47.0				11.0			
Yellow	3.0	4.5				4.5			
All Red	0.0	1.5				1.5			

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound L	Eastbound T	Eastbound R	Westbound L	Westbound T	Westbound R	Northbound L	Northbound T	Northbound R	Southbound L	Southbound T	Southbound R
Volume, V		945	365	260	870		10		10			
PHF		0.90	0.90	0.90	0.90		0.90		0.90			
Adj flow		1050	406	289	967		11		11			
No. Lanes	0	2	1	1	2	0	2	0	1	0	0	0
Lane group		TR	R	L	T		L		R			
Adj flow		1050	406	289	967		11		11			
Prop LTs		0.000		1.000	0.000							
Prop RTs		0.000	1.000		0.000				1.000			

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound TR	Eastbound R	Westbound L	Westbound T		Northbound L	Northbound R		Southbound	
So	1900	1900	1900	1900		1900	1900			
Lanes	2	1	1	2	0	2 0	1	0	0	0
fW	1.000	1.000	1.000	1.000		1.000	1.000			
fHV	1.000	1.000	1.000	1.000		1.000	1.000			
fG	1.000	1.000	1.000	1.000		1.000	1.000			
fP	1.000	1.000	1.000	1.000		1.000	1.000			
fBB	1.000	1.000	1.000	1.000		1.000	1.000			
fA	1.000	1.000	1.000	1.000		1.000	1.000			
fLU	0.952	1.000	1.000	0.952		0.971	1.000			
fRT	1.000	0.850		1.000			0.850			
fLT	1.000		0.950	1.000		0.950				
Sec.			0.169							
fLpb	1.000		1.000	1.000		1.000				
fRpb	1.000	1.000		1.000			1.000			
S	3618	1615	1805	3618		3505	1615			
Sec.			322							

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	1050	3618	# 0.29	0.52	1889	0.56
Right	R	406	1615	0.25	0.52	843	0.48
Westbound							
Prot		289	1805	# 0.16	0.189	341	0.85
Perm		0	322	0.00	0.556	179	0.00
Left	L	289			0.74	520	0.56
Prot							
Perm							
Thru	T	967	3618	0.27	0.74	2693	0.36
Right							
Northbound							
Prot							
Perm							
Left	L	11	3505	# 0.00	0.12	428	0.03
Prot							
Perm							
Thru							
Right	R	11	1615	0.01	0.38	610	0.02
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.45
Total lost time per cycle, L = 18.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.57

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
TR	0.56	0.52	14.5	1.000	1889	0.15	0.4	0.0	14.8	B	14.6	B
R	0.48	0.52	13.7	1.000	843	0.11	0.4	0.0	14.2	B		
Westbound												
L	0.56	0.74	8.0	1.000	520	0.15	1.3	0.0	9.3	A	5.3	A
T	0.36	0.74	4.0	1.000	2693	0.11	0.1	0.0	4.1	A		
Northbound												
L	0.03	0.12	34.8	1.000	428	0.11	0.0	0.0	34.8	C	26.2	C
R	0.02	0.38	17.5	1.000	610	0.11	0.0	0.0	17.6	B		
Southbound												

Intersection delay = 10.4 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach		M		
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)		67.0		
Effective permitted green time for LT lane group, g(s)		50.0		
Opposing effective green time, go (s)		47.0		
Number of lanes in LT lane group, N		1		
Number of lanes in opposing approach, No		2		
Adjusted LT flow rate, VLT (veh/h)		289		
Proportion of LT in LT lane group, PLT		1.000		
Proportion of LT in opposing flow, PLTo		0.00		
Adjusted opposing flow rate, Vo (veh/h)		1050		
Lost time for LT lane group, tL		6.00		
Computation				
LT volume per cycle, LTC=VLTC/3600		7.23		
Opposing lane util. factor, fLUo	0.952	0.952		
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		13.79		
gf=G[exp(- a * (LTC ** b)]-tl, gf<=g		0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.48		
gq, (see Exhibit C16-4,5,6,7,8)		18.99		
gu=g-gq if gq>=gf, or = g-gf if gq<gf		31.01		
n=Max(gq-gf)/2,0)		9.50		
PTHo=1-PLTo		1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00		
EL1 (refer to Exhibit C16-3)		3.66		
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.08		
gdiff=max(gq-gf,0)		0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.17		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.169		

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT		0.000	0.000	
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo		0.952	0.952	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b)]-tl, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpadg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 90.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v		289		
v/c ratio from Capacity Worksheet, X		0.56		
Protected phase effective green interval, g (s)		17.0		
Opposing queue effective green interval, gq		18.99		
Unopposed green interval, gu		31.01		
Red time r=(C-g-gq-gu)		23.0		
Arrival rate, qa=v/(3600(max[X,1.0]))		0.08		
Protected ph. departure rate, Sp=s/3600		0.501		
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)		0.14		
XPerm		0.90		
XProt		0.38		
Case		1		
Queue at beginning of green arrow, Qa		1.85		
Queue at beginning of unsaturated green, Qu		1.52		
Residual queue, Qr		0.00		
Uniform Delay, d1		8.0		

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 10.4 sec/veh Intersection LOS B

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	TR	R	L	T	L	R		
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0		
Flow Rate	551	406	289	507	5	11		
So	1900	1900	1900	1900	1900	1900		
No.Lanes	2	1	1	2	2	1	0	0
SL	1900	1615	698	1900	1805	1615		
LnCapacity	992	843	520	1414	220	610		
Flow Ratio	0.29	0.25	0.41	0.27	0.00	0.01		
v/c Ratio	0.56	0.48	0.56	0.36	0.02	0.02		
Grn Ratio	0.52	0.52	0.74	0.74	0.12	0.38		
I Factor	1.000			1.000	1.000			
AT or PVG	3	3	3	3	3	3		
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00		
PF2	1.00	1.00	1.00	1.00	1.00	1.00		
Q1	9.3	6.5	2.1	4.4	0.1	0.2		
kB	0.7	0.6	0.5	0.8	0.3	0.5		
Q2	0.8	0.6	0.6	0.5	0.0	0.0		
Q Average	10.1	7.1	2.6	4.9	0.1	0.2		
Q Spacing	25.0	25.0	25.0	25.0	25.0	25.0		
Q Storage	0	0	0	0	0	0		
Q S Ratio								
70th Percentile Output:								
fB%	1.2	1.2	1.2	1.2	1.2	1.2		
BOQ	11.9	8.3	3.1	5.8	0.1	0.2		
QSRatio								
85th Percentile Output:								
fB%	1.5	1.5	1.6	1.6	1.6	1.6		
BOQ	15.3	10.8	4.1	7.6	0.2	0.3		
QSRatio								
90th Percentile Output:								
fB%	1.6	1.7	1.8	1.7	1.8	1.8		
BOQ	16.6	11.9	4.6	8.4	0.2	0.3		
QSRatio								
95th Percentile Output:								
fB%	1.8	1.9	2.0	2.0	2.1	2.1		
BOQ	18.6	13.4	5.3	9.6	0.2	0.4		
QSRatio								
98th Percentile Output:								
fB%	2.2	2.3	2.5	2.4	2.7	2.7		
BOQ	21.8	16.1	6.6	11.7	0.3	0.5		
QSRatio								

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: md
Agency:
Date: 1/3/2005
Period: pm
Project ID: 2007 total traffic - no improvements
E/W St: sth 158

Inter.: sth 158/greyhound access
Area Type: All other areas
Jurisd: wisdot
Year : 2007
N/S St: greyhound access

SIGNALIZED INTERSECTION SUMMARY

	Eastbound L	Eastbound T	Eastbound R	Westbound L	Westbound T	Westbound R	Northbound L	Northbound T	Northbound R	Southbound L	Southbound T	Southbound R
No. Lanes	0	2	1	1	2	0	2	0	1	0	0	0
LGConfig		TR	R	L	T		L		R			
Volume		745	605	465	1220		20		10			
Lane Width		12.0	12.0	12.0	12.0		12.0		12.0			
RTOR Vol			0						0			

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left					NB Left	A			
Thru		A			Thru				
Right		A			Right	A			
Peds					Peds				
WB Left	A	A			SB Left				
Thru	A	A			Thru				
Right					Right				
Peds					Peds				
NB Right	A				EB Right				
SB Right					WB Right				
Green	22.0	42.0				11.0			
Yellow	3.0	4.5				4.5			
All Red	0.0	1.5				1.5			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
TR	1688	3618	0.49	0.47	16.8	B	24.9	C
R	754	1615	0.89	0.47	34.8	C		
Westbound								
L	655	1805	0.79	0.74	18.6	B		
T	2693	3618	0.50	0.74	4.9	A	8.7	A
Northbound								
L	428	3505	0.05	0.12	34.9	C	28.1	C
R	700	1615	0.02	0.43	14.6	B		
Southbound								

Intersection Delay = 16.0 (sec/veh) Intersection LOS = B

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/3/2005
Analysis Time Period: pm
Intersection: sth 158/greyhound access
Area Type: All other areas
Jurisdiction: wisdot
Analysis Year: 2007
Project ID: 2007 total traffic - no improvements
East/West Street: sth 158
North/South Street: greyhound access

VOLUME DATA

	Eastbound L	Eastbound T	Eastbound R	Westbound L	Westbound T	Westbound R	Northbound L	Northbound T	Northbound R	Southbound L	Southbound T	Southbound R
Volume		745	605	465	1220		20		10			
% Heavy Veh		0	0	0	0		0		0			
PHF		0.90	0.90	0.90	0.90		0.90		0.90			
PK 15 Vol		207	168	129	339		6		3			
Hi Ln Vol												
% Grade		0			0			0				
Ideal Sat		1900	1900	1900	1900		1900		1900			
ParkExist												
NumPark												
No. Lanes	0	2	1	1	2	0	2	0	1	0	0	0
LGConfig		TR	R	L	T		L		R			
Lane Width		12.0	12.0	12.0	12.0		12.0		12.0			
RTOR Vol			0						0			
Adj Flow		828	672	517	1356		22		11			
%InSharedLn			0									
Prop LTs		0.000		1.000	0.000							
Prop RTs		0.000	1.000		0.000				1.000			
Peds	Bikes 0											
Buses		0	0	0	0		0		0			
%InProtPhase				0.0								

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound L	Eastbound T	Eastbound R	Westbound L	Westbound T	Westbound R	Northbound L	Northbound T	Northbound R	Southbound L	Southbound T	Southbound R
Init Unmet		0.0	0.0	0.0	0.0		0.0		0.0			
Arriv. Type		3	3	3	3		3		3			
Unit Ext.		3.0	3.0	3.0	3.0		3.0		3.0			
I Factor		1.000			1.000			1.000				
Lost Time		2.0	2.0	2.0	2.0		2.0		2.0			
Ext of g		2.0	2.0	2.0	2.0		2.0		2.0			

Ped Min g	3.2				3.2		3.2		

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left					NB Left	A			
Thru		A			Thru				
Right		A			Right	A			
Peds					Peds				
WB Left	A	A			SB Left				
Thru	A	A			Thru				
Right					Right				
Peds					Peds				
NB Right	A				EB Right				
SB Right					WB Right				
Green	22.0	42.0				11.0			
Yellow	3.0	4.5				4.5			
All Red	0.0	1.5				1.5			

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound L	Eastbound T	Eastbound R	Westbound L	Westbound T	Westbound R	Northbound L	Northbound T	Northbound R	Southbound L	Southbound T	Southbound R
Volume, V		745	605	465	1220		20		10			
PHF		0.90	0.90	0.90	0.90		0.90		0.90			
Adj flow		828	672	517	1356		22		11			
No. Lanes	0	2	1	1	2	0	2	0	1	0	0	0
Lane group		TR	R	L	T		L		R			
Adj flow		828	672	517	1356		22		11			
Prop LTs		0.000		1.000	0.000							
Prop RTs		0.000	1.000		0.000				1.000			

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	TR	R	L	T		L		R				
So	1900	1900	1900	1900		1900		1900				
Lanes 0	2	1	1	2	0	2	0	1	0	0	0	
fW	1.000	1.000	1.000	1.000		1.000		1.000				
fHV	1.000	1.000	1.000	1.000		1.000		1.000				
fG	1.000	1.000	1.000	1.000		1.000		1.000				
fP	1.000	1.000	1.000	1.000		1.000		1.000				
fBB	1.000	1.000	1.000	1.000		1.000		1.000				
fA	1.000	1.000	1.000	1.000		1.000		1.000				
fLU	0.952	1.000	1.000	0.952		0.971		1.000				
fRT	1.000	0.850		1.000				0.850				
fLT	1.000		0.950	1.000		0.950						
Sec.			0.225									
fLpb	1.000		1.000	1.000		1.000						
fRpb	1.000	1.000		1.000				1.000				
S	3618	1615	1805	3618		3505		1615				
Sec.			427									

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	Lane Group Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	828	3618	0.23	0.47	1688	0.49
Right	R	672	1615	# 0.42	0.47	754	0.89
Westbound							
Prot		441	1805	# 0.24	0.244	441	1.00
Perm		76	427	0.18	0.500	214	0.36
Left	L	517			0.74	655	0.79
Prot							
Perm							
Thru	T	1356	3618	0.37	0.74	2693	0.50
Right							
Northbound							
Prot							
Perm							
Left	L	22	3505	# 0.01	0.12	428	0.05
Prot							
Perm							
Thru							
Right	R	11	1615	0.01	0.43	700	0.02
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.67
Total lost time per cycle, L = 18.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.83

Control Delay and LOS Determination

Appr/ Lane Grp	v/c	g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
TR	0.49	0.47	16.6	1.000	1688	0.11	0.2	0.0	16.8	B	24.9	C
R	0.89	0.47	21.9	1.000	754	0.42	12.9	0.0	34.8	C		
Westbound												
L	0.79	0.74	12.2	1.000	655	0.34	6.5	0.0	18.6	B		
T	0.50	0.74	4.7	1.000	2693	0.11	0.2	0.0	4.9	A	8.7	A
Northbound												
L	0.05	0.12	34.9	1.000	428	0.11	0.1	0.0	34.9	C		
R	0.02	0.43	14.5	1.000	700	0.11	0.0	0.0	14.6	B	28.1	C
Southbound												

Intersection delay = 16.0 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach		M		
Cycle length, C	90.0 sec			
Total actual green time for LT lane group, G (s)		67.0		
Effective permitted green time for LT lane group, g(s)		45.0		
Opposing effective green time, go (s)		42.0		
Number of lanes in LT lane group, N		1		
Number of lanes in opposing approach, No		2		
Adjusted LT flow rate, VLT (veh/h)		517		
Proportion of LT in LT lane group, PLT		1.000		
Proportion of LT in opposing flow, PLTo		0.00		
Adjusted opposing flow rate, Vo (veh/h)		828		
Lost time for LT lane group, tL		6.00		
Computation				
LT volume per cycle, LTC=VLTC/3600		12.93		
Opposing lane util. factor, fLUo	0.952	0.952		
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		10.87		
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g		0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.53		
gq, (see Exhibit C16-4,5,6,7,8)		15.29		
gu=g-gq if gq>=gf, or = g-gf if gq<gf		29.71		
n=Max(gq-gf)/2,0)		7.65		
PTHo=1-PLTo		1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00		
EL1 (refer to Exhibit C16-3)		2.94		
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.09		
gdiff=max(gq-gf,0)		0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.22		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.225		

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0 sec			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT		0.000	0.000	
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo		0.952	0.952	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0 sec			
Adj. LT vol from Vol Adjustment Worksheet, v		517		
v/c ratio from Capacity Worksheet, X		0.79		
Protected phase effective green interval, g (s)		22.0		
Opposing queue effective green interval, gq		15.29		
Unopposed green interval, gu		29.71		
Red time r=(C-g-gq-gu)		23.0		
Arrival rate, qa=v/(3600(max[X,1.0]))		0.14		
Protected ph. departure rate, Sp=s/3600		0.501		
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)		0.18		
XPerm		1.21		
XProt		0.59		
Case		3		
Queue at beginning of green arrow, Qa		4.43		
Queue at beginning of unsaturated green, Qu		2.20		
Residual queue, Qr		1.13		
Uniform Delay, d1		12.2		

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 16.0 sec/veh Intersection LOS B

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	TR	R	L	T	L	R		
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0		
Flow Rate	434	672	517	712	11	11		
So	1900	1900	1900	1900	1900	1900		
No.Lanes	2	1	1	2	0	2	0	1	0	0	0
SL	1900	1615	879	1900	1805	1615		
LnCapacity	886	754	655	1414	220	700		
Flow Ratio	0.23	0.42	0.59	0.37	0.01	0.01		
v/c Ratio	0.49	0.89	0.79	0.50	0.05	0.02		
Grn Ratio	0.47	0.47	0.74	0.74	0.12	0.43		
I Factor	1.000		1.000		1.000			
AT or PVG	3	3	3	3	3			
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00		
PF2	1.00	1.00	1.00	1.00	1.00	1.00		
Q1	7.5	15.3	4.1	7.3	0.2	0.2		
kB	0.6	0.6	0.5	0.8	0.3	0.6		
Q2	0.6	3.5	1.8	0.9	0.0	0.0		
Q Average	8.1	18.9	5.9	8.1	0.3	0.2		
Q Spacing	25.0	25.0	25.0	25.0	25.0	25.0		
Q Storage	0	0	0	0	0	0		
Q S Ratio								
70th Percentile Output:								
fB%	1.2	1.2	1.2	1.2	1.2	1.2		
BOQ	9.6	22.0	7.0	9.6	0.3	0.2		
QSRatio								
85th Percentile Output:								
fB%	1.5	1.5	1.5	1.5	1.6	1.6		
BOQ	12.4	27.6	9.1	12.4	0.4	0.3		
QSRatio								
90th Percentile Output:								
fB%	1.7	1.6	1.7	1.7	1.8	1.8		
BOQ	13.5	29.4	10.0	13.5	0.5	0.3		
QSRatio								
95th Percentile Output:								
fB%	1.9	1.7	1.9	1.9	2.1	2.1		
BOQ	15.3	32.3	11.4	15.3	0.5	0.3		
QSRatio								
98th Percentile Output:								
fB%	2.2	1.9	2.3	2.2	2.7	2.7		
BOQ	18.1	36.5	13.8	18.2	0.7	0.4		
QSRatio								

ERROR MESSAGES

No errors to report.

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ALL-WAY STOP CONTROL(AWSC) ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 11/15/2004
Analysis Time Period: am
Intersection: STH 158/Eastern Frontage
Jurisdiction: WisDOT
Units: U. S. Customary
Analysis Year: 2004
Project ID: 2007 total traffic - no improvements
East/West Street: sth 158
North/South Street: Eastern Frontage Road

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	20	795	55	125	495	1	135	170	35	5	0	10
% Thrus Left Lane												

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	LT		TR		LT		LR	
PHF	1.00		1.00		1.00		1.00	
Flow Rate	815		496		305		15	
% Heavy Veh	0		0		0		0	
No. Lanes	1		1		1		1	
Opposing-Lanes	1		1		1		1	
Conflicting-lanes	1		1		1		1	
Geometry group	1		1		1		1	

Duration, T 0.25 hrs.

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	815		496		305		15	
Left-Turn	20		0		135		5	
Right-Turn	0		1		0		10	
Prop. Left-Turns	0.0		0.0		0.4		0.3	
Prop. Right-Turns	0.0		0.0		0.0		0.7	
Prop. Heavy Vehicle	0.0		0.0		0.0		0.0	
Geometry Group	1		1		1		1	
Adjustments Exhibit 17-33:								
hLT-adj	0.2		0.2		0.2		0.2	
hRT-adj	-0.6		-0.6		-0.6		-0.6	
hHV-adj	1.7		1.7		1.7		1.7	
hadj, computed	0.0		-0.0		0.1		-0.3	

Worksheet 4 - Departure Headway and Service Time

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow rate	815		496		305		15	
hd, initial value	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20
x, initial	0.72		0.44		0.27		0.01	
hd, final value	6.10		6.25		7.12		8.10	
x, final value	1.38		0.86		0.60		0.03	
Move-up time, m	2.0		2.0		2.0		2.0	
Service Time	4.1		4.3		5.1		6.1	

Worksheet 5 - Capacity and Level of Service

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rate	815		496		305		15	
Service Time	4.1		4.3		5.1		6.1	
Utilization, x	1.38		0.86		0.60		0.03	
Dep. headway, hd	6.10		6.25		7.12		8.10	
Capacity	815		572		493		265	
Delay	200.70		36.40		20.35		11.38	
LOS	F		E		C		B	
Approach:								
Delay	200.70		36.40		20.35		11.38	
LOS	F		E		C		B	

Intersection Delay 115.27 Intersection LOS F

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ALL-WAY STOP CONTROL(AWSC) ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 11/15/2004
Analysis Time Period: pm
Intersection: STH 158/Eastern Frontage
Jurisdiction: WisDOT
Units: U. S. Customary
Analysis Year: 2004
Project ID: 2007 total traffic - no improvements
East/West Street: sth 158
North/South Street: Eastern Frontage Road

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	15	715	55	125	600	1	115	150	35	5	0	5
% Thrus Left Lane												

	Eastbound L1	Eastbound L2	Westbound L1	Westbound L2	Northbound L1	Northbound L2	Southbound L1	Southbound L2
Configuration	LT		TR		LT		LR	
PHF	1.00		1.00		1.00		1.00	
Flow Rate	730		601		265		10	
% Heavy Veh	0		0		0		0	
No. Lanes	1		1		1		1	
Opposing-Lanes	1		1		1		1	
Conflicting-lanes	1		1		1		1	
Geometry group	1		1		1		1	

Duration, T 0.25 hrs.

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound L1	Eastbound L2	Westbound L1	Westbound L2	Northbound L1	Northbound L2	Southbound L1	Southbound L2
Flow Rates:								
Total in Lane	730		601		265		10	
Left-Turn	15		0		115		5	
Right-Turn	0		1		0		5	
Prop. Left-Turns	0.0		0.0		0.4		0.5	
Prop. Right-Turns	0.0		0.0		0.0		0.5	
Prop. Heavy Vehicle	0.0		0.0		0.0		0.0	
Geometry Group	1		1		1		1	
Adjustments Exhibit 17-33:								
hLT-adj	0.2		0.2		0.2		0.2	
hRT-adj	-0.6		-0.6		-0.6		-0.6	
hHV-adj	1.7		1.7		1.7		1.7	
hadj, computed	0.0		-0.0		0.1		-0.2	

Worksheet 4 - Departure Headway and Service Time

	Eastbound L1	Eastbound L2	Westbound L1	Westbound L2	Northbound L1	Northbound L2	Southbound L1	Southbound L2
Flow rate	730		601		265		10	
hd, initial value	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20
x, initial	0.65		0.53		0.24		0.01	
hd, final value	6.07		6.07		7.27		8.35	
x, final value	1.23		1.01		0.54		0.02	
Move-up time, m	2.0		2.0		2.0		2.0	
Service Time	4.1		4.1		5.3		6.4	

Worksheet 5 - Capacity and Level of Service

	Eastbound L1	Eastbound L2	Westbound L1	Westbound L2	Northbound L1	Northbound L2	Southbound L1	Southbound L2
Flow Rate	730		601		265		10	
Service Time	4.1		4.1		5.3		6.4	
Utilization, x	1.23		1.01		0.54		0.02	
Dep. headway, hd	6.07		6.07		7.27		8.35	
Capacity	730		601		495		260	
Delay	138.89		64.53		18.34		11.55	
LOS	F		F		C		B	
Approach:								
Delay	138.89		64.53		18.34		11.55	
LOS	F		F		C		B	

Intersection Delay 90.38 Intersection LOS F

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ALL-WAY STOP CONTROL(AWSC) ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 11/15/2004
Analysis Time Period: am
Intersection: STH 158/Western Frontage
Jurisdiction: WisDOT
Units: U. S. Customary
Analysis Year: 2004
Project ID: 2007 total traffic - no improvements
East/West Street: sth 158
North/South Street: Western Frontage Road

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	0	745	75	70	570	0	10	0	70	0	0	0
% Thrus Left Lane												

	Eastbound L1	Eastbound L2	Westbound L1	Westbound L2	Northbound L1	Northbound L2	Southbound L1	Southbound L2
Configuration	T	R	LT		LR			
PHF	1.00	1.00	1.00		1.00			
Flow Rate	745	75	640		80			
% Heavy Veh	0	0	0		0			
No. Lanes	2		1		1			
Opposing-Lanes	1		2		0			
Conflicting-lanes	1		1		2			
Geometry group	5		3a		1			

Duration, T 0.25 hrs.

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound L1	Eastbound L2	Westbound L1	Westbound L2	Northbound L1	Northbound L2	Southbound L1	Southbound L2
Flow Rates:								
Total in Lane	745	75	640		80			
Left-Turn	0	0	70		10			
Right-Turn	0	75	0		70			
Prop. Left-Turns	0.0	0.0	0.1		0.1			
Prop. Right-Turns	0.0	1.0	0.0		0.9			
Prop. Heavy Vehicle	0.0	0.0	0.0		0.0			
Geometry Group	5		3a		1			
Adjustments Exhibit 17-33:								
hLT-adj	0.5		0.2		0.2			
hRT-adj	-0.7		-0.6		-0.6			
hHV-adj	1.7		1.7		1.7			
hadj, computed	0.0	-0.7	0.0		-0.5			

Worksheet 4 - Departure Headway and Service Time

	Eastbound L1	Eastbound L2	Westbound L1	Westbound L2	Northbound L1	Northbound L2	Southbound L1	Southbound L2
Flow rate	745	75	640		80			
hd, initial value	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20
x, initial	0.66	0.07	0.57		0.07			
hd, final value	5.37	4.66	5.17		6.49			
x, final value	1.11	0.10	0.92		0.14			
Move-up time, m	2.3		2.0		2.0			
Service Time	3.1	2.4	3.2		4.5			

Worksheet 5 - Capacity and Level of Service

	Eastbound L1	Eastbound L2	Westbound L1	Westbound L2	Northbound L1	Northbound L2	Southbound L1	Southbound L2
Flow Rate	745	75	640		80			
Service Time	3.1	2.4	3.2		4.5			
Utilization, x	1.11	0.10	0.92		0.14			
Dep. headway, hd	5.37	4.66	5.17		6.49			
Capacity	745	325	696		330			
Delay	90.74	7.87	39.75		10.58			
LOS	F	A	E		B			
Approach:								
Delay	83.16		39.75		10.58			
LOS	F		E		B			

Intersection Delay 61.35 Intersection LOS F

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ALL-WAY STOP CONTROL(AWSC) ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 11/15/2004
Analysis Time Period: pm
Intersection: STH 158/Western Frontage
Jurisdiction: WisDOT
Units: U. S. Customary
Analysis Year: 2004
Project ID: 2007 total traffic - no improvements
East/West Street: sth 158
North/South Street: Western Frontage Road

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	0	675	210	120	600	0	10	0	55	0	0	0
% Thrus Left Lane												

	Eastbound L1	Eastbound L2	Westbound L1	Westbound L2	Northbound L1	Northbound L2	Southbound L1	Southbound L2
Configuration	T	R	LT		LR			
PHF	1.00	1.00	1.00		1.00			
Flow Rate	675	210	720		65			
% Heavy Veh	0	0	0		0			
No. Lanes	2		1		1			
Opposing-Lanes	1		2		0			
Conflicting-lanes	1		1		2			
Geometry group	5		3a		1			

Duration, T 0.25 hrs.

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound L1	Eastbound L2	Westbound L1	Westbound L2	Northbound L1	Northbound L2	Southbound L1	Southbound L2
Flow Rates:								
Total in Lane	675	210	720		65			
Left-Turn	0	0	120		10			
Right-Turn	0	210	0		55			
Prop. Left-Turns	0.0	0.0	0.2		0.2			
Prop. Right-Turns	0.0	1.0	0.0		0.8			
Prop. Heavy Vehicle	0.0	0.0	0.0		0.0			
Geometry Group	5		3a		1			
Adjustments Exhibit 17-33:								
hLT-adj	0.5		0.2		0.2			
hRT-adj	-0.7		-0.6		-0.6			
hHV-adj	1.7		1.7		1.7			
hadj, computed	0.0	-0.7	0.0		-0.5			

Worksheet 4 - Departure Headway and Service Time

	Eastbound L1	Eastbound L2	Westbound L1	Westbound L2	Northbound L1	Northbound L2	Southbound L1	Southbound L2
Flow rate	675	210	720		65			
hd, initial value	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20
x, initial	0.60	0.19	0.64		0.06			
hd, final value	5.35	4.65	5.12		6.62			
x, final value	1.00	0.27	1.02		0.12			
Move-up time, m	2.3		2.0		2.0			
Service Time	3.1	2.3	3.1		4.6			

Worksheet 5 - Capacity and Level of Service

	Eastbound L1	Eastbound L2	Westbound L1	Westbound L2	Northbound L1	Northbound L2	Southbound L1	Southbound L2
Flow Rate	675	210	720		65			
Service Time	3.1	2.3	3.1		4.6			
Utilization, x	1.00	0.27	1.02		0.12			
Dep. headway, hd	5.35	4.65	5.12		6.62			
Capacity	675	460	720		315			
Delay	58.17	9.07	62.55		10.51			
LOS	F	A	F		B			
Approach:								
Delay	46.52		62.55		10.51			
LOS	E		F		B			

Intersection Delay 52.03 Intersection LOS F

HCS2000: Unsignalized Intersections Release 4.1d

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ALL-WAY STOP CONTROL(AWSC) ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 11/15/2004
Analysis Time Period: am
Intersection: CTH K/104th
Jurisdiction: Kenosha County
Units: U. S. Customary
Analysis Year: 2004
Project ID: 2007 total traffic - no improvements
East/West Street: CTH K
North/South Street: 104th

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	25	225	30	85	260	145	5	185	80	75	185	30

% Thrus Left Lane

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	LT	R	LTR		L	TR	LT	R
PHF	1.00	1.00	1.00		1.00	1.00	1.00	1.00
Flow Rate	250	30	490		5	265	260	30
% Heavy Veh	0	0	0		0	0	0	0
No. Lanes	2		1		2		2	
Opposing-Lanes	1		2		2		2	
Conflicting-lanes	2		2		2		2	
Geometry group	5		4b		5		5	

Duration, T 0.25 hrs.

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	250	30	490		5	265	260	30
Left-Turn	25	0	85		5	0	75	0
Right-Turn	0	30	145		0	80	0	30
Prop. Left-Turns	0.1	0.0	0.2		1.0	0.0	0.3	0.0
Prop. Right-Turns	0.0	1.0	0.3		0.0	0.3	0.0	1.0
Prop. Heavy Vehicle	0.0	0.0	0.0		0.0	0.0	0.0	0.0
Geometry Group	5		4b		5		5	
Adjustments Exhibit 17-33:								
hLT-adj	0.5		0.2		0.5		0.5	
hRT-adj	-0.7		-0.6		-0.7		-0.7	
hHV-adj	1.7		1.7		1.7		1.7	
hadj, computed	0.1	-0.7	-0.1		0.5	-0.2	0.1	-0.7

Worksheet 4 - Departure Headway and Service Time

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow rate	250	30	490		5	265	260	30
hd, initial value	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20
x, initial	0.22	0.03	0.44		0.00	0.24	0.23	0.03
hd, final value	8.03	7.26	7.20		8.73	7.99	8.30	7.43
x, final value	0.56	0.06	0.98		0.01	0.59	0.60	0.06
Move-up time, m	2.3		2.3		2.3		2.3	
Service Time	5.7	5.0	4.9		6.4	5.7	6.0	5.1

Worksheet 5 - Capacity and Level of Service

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rate	250	30	490		5	265	260	30
Service Time	5.7	5.0	4.9		6.4	5.7	6.0	5.1
Utilization, x	0.56	0.06	0.98		0.01	0.59	0.60	0.06
Dep. headway, hd	8.03	7.26	7.20		8.73	7.99	8.30	7.43
Capacity	430	280	499		255	434	419	280
Delay	20.36	10.42	61.85		11.53	21.48	22.67	10.62
LOS	C	B	F		B	C	C	B
Approach:								
Delay	19.30		61.85		21.30		21.42	
LOS	C		F		C		C	

Intersection Delay 35.84 Intersection LOS E

HCS2000: Unsignalized Intersections Release 4.1d

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ALL-WAY STOP CONTROL(AWSC) ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 11/15/2004
Analysis Time Period: pm
Intersection: CTH K/104th
Jurisdiction: Kenosha County
Units: U. S. Customary
Analysis Year: 2004
Project ID: 2007 total traffic - no improvements
East/West Street: CTH K
North/South Street: 104th

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	20	285	20	75	280	150	15	245	90	170	215	40

% Thrus Left Lane

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	LT	R	LTR		L	TR	LT	R
PHF	1.00	1.00	1.00		1.00	1.00	1.00	1.00
Flow Rate	305	20	505		15	335	385	40
% Heavy Veh	0	0	0		0	0	0	0
No. Lanes	2		1		2		2	
Opposing-Lanes	1		2		2		2	
Conflicting-lanes	2		2		2		2	
Geometry group	5		4b		5		5	

Duration, T 0.25 hrs.

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	305	20	505		15	335	385	40
Left-Turn	20	0	75		15	0	170	0
Right-Turn	0	20	150		0	90	0	40
Prop. Left-Turns	0.1	0.0	0.1		1.0	0.0	0.4	0.0
Prop. Right-Turns	0.0	1.0	0.3		0.0	0.3	0.0	1.0
Prop. Heavy Vehicle	0.0	0.0	0.0		0.0	0.0	0.0	0.0
Geometry Group	5		4b		5		5	
Adjustments Exhibit 17-33:								
hLT-adj	0.5		0.2		0.5		0.5	
hRT-adj	-0.7		-0.6		-0.7		-0.7	
hHV-adj	1.7		1.7		1.7		1.7	
hadj, computed	0.0	-0.7	-0.1		0.5	-0.2	0.2	-0.7

Worksheet 4 - Departure Headway and Service Time

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow rate	305	20	505		15	335	385	40
hd, initial value	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20
x, initial	0.27	0.02	0.45		0.01	0.30	0.34	0.04
hd, final value	9.52	8.76	8.88		9.97	9.25	9.40	8.44
x, final value	0.81	0.05	1.25		0.04	0.86	1.01	0.09
Move-up time, m	2.3		2.3		2.3		2.3	
Service Time	7.2	6.5	6.6		7.7	6.9	7.1	6.1

Worksheet 5 - Capacity and Level of Service

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rate	305	20	505		15	335	385	40
Service Time	7.2	6.5	6.6		7.7	6.9	7.1	6.1
Utilization, x	0.81	0.05	1.25		0.04	0.86	1.01	0.09
Dep. headway, hd	9.52	8.76	8.88		9.97	9.25	9.40	8.44
Capacity	375	270	505		265	388	385	290
Delay	41.89	11.91	156.52		13.10	48.14	78.55	12.01
LOS	E	B	F		B	E	F	B
Approach:								
Delay	40.05		156.52		46.63		72.29	
LOS	E		F		E		F	

Intersection Delay 86.67 Intersection LOS F

2017 BACKGROUND TRAFFIC CAPACITY ANALYSIS – WITH IMPROVEMENTS

HCS2000: Signalized Intersections Release 4.1e

Analyst: md
Agency:
Date: 1/4/2005
Period: am
Project ID: 2017 background traffic - with improvements
E/W St: sth 158

Inter.: sth 158/cth h
Area Type: All other areas
Jurisd: wisdot
Year : 2017
N/S St: cth h

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes		1	2	1	1	2	0	0	1	0	0	1	1
LGConfig		L	T	R	L	TR			LTR			LT	R
Volume		75	600	20	75	655	30	5	185	75	65	305	90
Lane Width		12.0	12.0	12.0	12.0	12.0			12.0			12.0	12.0
RTOR Vol				0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A	A			NB Left		A		
Thru		A			Thru		A		
Right		A			Right		A		
Peds					Peds				
WB Left	A	A			SB Left	A	A		
Thru		A			Thru	A	A		
Right		A			Right	A	A		
Peds					Peds				
NB Right					EB Right				
SB Right	A				WB Right				
Green	5.0	39.0				10.0	28.0		
Yellow	3.0	4.5				3.0	4.5		
All Red	0.0	1.5				0.0	1.5		

Cycle Length: 100.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	239	1752	0.36	0.47	17.5	B		
T	1314	3370	0.52	0.39	23.7	C	22.9	C
R	630	1615	0.04	0.39	18.9	B		
Westbound								
L	282	1752	0.30	0.47	16.7	B		
TR	1312	3363	0.59	0.39	24.9	C	24.1	C
Northbound								
LTR	497	1776	0.61	0.28	33.3	C	33.3	C
Southbound								
LT	527	1783	0.80	0.41	34.4	C	30.1	C
R	808	1553	0.13	0.52	12.4	B		

Intersection Delay = 26.1 (sec/veh) Intersection LOS = C

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/4/2005
Analysis Time Period: am
Intersection: sth 158/cth h
Area Type: All other areas
Jurisdiction: wisdot
Analysis Year: 2017
Project ID: 2017 background traffic - with improvements
East/West Street: sth 158 North/South Street: cth h

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	75	600	20	75	655	30	5	185	75	65	305	90
% Heavy Veh	3	13	0	3	7	4	20	1	3	4	6	4
PHF	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
PK 15 Vol	21	170	6	21	186	9	2	53	21	18	87	26
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	2000	1900	1900	1900			1900			1900	1900
ParkExist												
NumPark												
No. Lanes		1	2	1	1	2	0	0	1	0	0	1	1
LGConfig		L	T	R	L	TR			LTR			LT	R
Lane Width		12.0	12.0	12.0	12.0	12.0			12.0			12.0	12.0
RTOR Vol				0			0			0			0
Adj Flow		85	682	23	85	778			301			421	102
%InSharedLn													
Prop LTs		1.000	0.000		1.000	0.000			0.020			0.176	
Prop RTs			0.000	1.000		0.044		0.282			0.000	1.000	
Peds	Bikes	0			0			0			0		
Buses		0	0	0	0	0			0			0	0
%InProtPhase		0.0			0.0						0.0		

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0	0.0	0.0	0.0			0.0			0.0	0.0
Arriv. Type	3	3	3	3	3			3			3	3
Unit Ext.	3.0	3.0	3.0	3.0	3.0			3.0			3.0	3.0
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0	2.0	2.0	2.0			2.0			2.0	2.0
Ext of g	2.0	2.0	2.0	2.0	2.0			2.0			2.0	2.0
Ped Min g	3.2			3.2			3.2			3.2		

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A	A			NB Left		A		
Thru		A			Thru		A		
Right		A			Right		A		
Peds					Peds				
WB Left	A	A			SB Left	A	A		
Thru		A			Thru	A	A		
Right		A			Right	A	A		
Peds					Peds				
NB Right					EB Right				
SB Right	A				WB Right				
Green	5.0	39.0				10.0	28.0		
Yellow	3.0	4.5				3.0	4.5		
All Red	0.0	1.5				0.0	1.5		

Cycle Length: 100.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	75	600	20	75	655	30	5	185	75	65	305	90
PHF	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Adj flow	85	682	23	85	744	34	6	210	85	74	347	102
No. Lanes		1	2	1	1	2	0	0	1	0	0	1	1
Lane group		L	T	R	L	TR			LTR			LT	R
Adj flow		85	682	23	85	778			301			421	102
Prop LTs		1.000	0.000		1.000	0.000			0.020			0.176	
Prop RTs			0.000	1.000		0.044		0.282			0.000	1.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L	T	R	L	TR		LTR			LT	R	
So	1900	2000	1900	1900	1900		1900			1900	1900	
Lanes	1	2	1	1	2	0	0	1	0	0	1	1
fW	1.000	1.000	1.000	1.000	1.000			1.000			1.000	1.000
fHV	0.971	0.885	1.000	0.971	0.936			0.981			0.947	0.962
fG	1.000	1.000	1.000	1.000	1.000			1.000			1.000	1.000
fP	1.000	1.000	1.000	1.000	1.000			1.000			1.000	1.000
fBB	1.000	1.000	1.000	1.000	1.000			1.000			1.000	1.000
fA	1.000	1.000	1.000	1.000	1.000			1.000			1.000	1.000
fLU	1.000	0.952	1.000	1.000	0.952			0.962			1.000	0.850
fRT		1.000	0.850		0.993			0.991			0.991	
fLT	0.950	1.000		0.950	1.000						0.626	
Sec.	0.195			0.251				1.000			1.000	
fLpb	1.000	1.000		1.000	1.000			1.000			1.000	1.000
fRpb		1.000	1.000		1.000			1776			1783	1553
S	1752	3370	1615	1752	3363						1126	
Sec.	359			463								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		85	1752	0.05	0.050	88	0.97
Perm		0	359	0.00	0.420	151	0.00
Left	L	85			0.47	239	0.36
Prot							
Perm							
Thru	T	682	3370	0.20	0.39	1314	0.52
Right	R	23	1615	0.01	0.39	630	0.04
Westbound							
Prot		85	1752	# 0.05	0.050	88	0.97
Perm		0	463	0.00	0.420	194	0.00
Left	L	85			0.47	282	0.30
Prot							
Perm							
Thru	TR	778	3363	# 0.23	0.39	1312	0.59
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	301	1776	0.17	0.28	497	0.61
Right							
Southbound							
Prot							
Perm							
Left							
Prot		178	1783	# 0.10	0.100	178	1.00
Perm		243	1126	# 0.22	0.310	349	0.70
Thru	LT	421			0.41	527	0.80
Right	R	102	1553	0.07	0.52	808	0.13

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.60
Total lost time per cycle, L = 18.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.73

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	0.36	0.47	16.6	1.000	239	0.11	0.9	0.0	17.5	B		
T	0.52	0.39	23.3	1.000	1314	0.12	0.4	0.0	23.7	C	22.9	C
R	0.04	0.39	18.9	1.000	630	0.11	0.0	0.0	18.9	B		
Westbound												
L	0.30	0.47	16.1	1.000	282	0.11	0.6	0.0	16.7	B		
TR	0.59	0.39	24.2	1.000	1312	0.18	0.7	0.0	24.9	C	24.1	C
Northbound												
LTR	0.61	0.28	31.2	1.000	497	0.19	2.1	0.0	33.3	C	33.3	C
Southbound												

LT	0.80	0.41	25.9	1.000	527	0.34	8.5	0.0	34.4	C	30.1	C
R	0.13	0.52	12.3	1.000	808	0.11	0.1	0.0	12.4	B		

Intersection delay = 26.1 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M		
Cycle length, C 100.0 sec				
Total actual green time for LT lane group, G (s)	47.0	47.0		
Effective permitted green time for LT lane group, g(s)	42.0	42.0		
Opposing effective green time, go (s)	39.0	39.0		
Number of lanes in LT lane group, N	1	1		
Number of lanes in opposing approach, No	2	2		
Adjusted LT flow rate, VLT (veh/h)	85	85		
Proportion of LT in LT lane group, PLT	1.000	1.000		
Proportion of LT in opposing flow, PLTo	0.00	0.00		
Adjusted opposing flow rate, Vo (veh/h)	778	682		
Lost time for LT lane group, tL	6.00	6.00		
Computation				
LT volume per cycle, LTC=VLTC/3600	2.36	2.36		
Opposing lane util. factor, fLUo	0.952	0.952	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	11.35	9.95		
gf=G[exp(- a * (LTC ** b)]-tl, gf<=g	0.0	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.61	0.61		
gq, (see Exhibit C16-4,5,6,7,8)	17.91	15.15		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	24.09	26.85		
n=Max(gq-gf)/2,0)	8.96	7.58		
PTHo=1-PLTo	1.00	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00		
EL1 (refer to Exhibit C16-3)	2.94	2.55		
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.10	0.10		
gdiff=max(gq-gf,0)	0.00	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.19	0.25		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.195	0.251		

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach			M	S
Cycle length, C 100.0 sec				
Total actual green time for LT lane group, G (s)			28.0	41.0
Effective permitted green time for LT lane group, g(s)			28.0	31.0
Opposing effective green time, go (s)			41.0	28.0
Number of lanes in LT lane group, N			1	1
Number of lanes in opposing approach, No			1	1
Adjusted LT flow rate, VLT (veh/h)			6	74
Proportion of LT in LT lane group, PLT	0.000	0.000	0.020	0.176
Proportion of LT in opposing flow, PLTo			0.18	0.02
Adjusted opposing flow rate, Vo (veh/h)			421	301
Lost time for LT lane group, tL			6.00	6.00
Computation				
LT volume per cycle, LTC=VLTC/3600			0.17	2.06
Opposing lane util. factor, fLUo	0.952	0.952	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			11.69	8.36
gf=G[exp(- a * (LTC ** b)]-tl, gf<=g			15.9	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.59	0.72
gq, (see Exhibit C16-4,5,6,7,8)			0.00	17.59
gu=g-gq if gq>=gf, or = g-gf if gq<gf			12.06	13.41
n=Max(gq-gf)/2,0)			0.00	8.80
PTHo=1-PLTo			0.82	0.98
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			0.02	0.18
EL1 (refer to Exhibit C16-3)			2.13	1.88
EL2=Max((1-Ptho**n)/Plto, 1.0)			1.00	8.14
fmin=2(1+PL)/g or fmin=2(1+Pl)/g			0.07	0.08
gdiff=max(gq-gf,0)			0.00	17.59
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.99	0.63
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.991	0.626

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 100.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v	85	85		
v/c ratio from Capacity Worksheet, X	0.36	0.30		
Protected phase effective green interval, g (s)	5.0	5.0		
Opposing queue effective green interval, gq	17.91	15.15		
Unopposed green interval, gu	24.09	26.85		
Red time r=(C-g-gq-gu)	53.0	53.0		
Arrival rate, qa=v/(3600[max(X,1.0)])	0.02	0.02		
Protected ph. departure rate, Sp=s/3600	0.487	0.487		
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.17	0.20		
XPerm	0.24	0.18		
XProt	0.56	0.56		
Case	1	1		
Queue at beginning of green arrow, Qa	1.25	1.25		
Queue at beginning of unsaturated green, Qu	0.42	0.36		
Residual queue, Qr	0.00	0.00		
Uniform Delay, dl	16.6	16.1		

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Dur. Unmet Demand Q veh	Unmet Demand t hrs.	Uniform Delay Unadj. ds	Adj. dl sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 26.1 sec/veh Intersection LOS C

BACK OF QUEUE WORKSHEET

LaneGroup	Eastbound L	T	R	Westbound L	TR	Northbound LTR	Southbound LT	R
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	85	358	23	85	408	301	421	102
So	1900	2000	1900	1900	1900	1900	1900	1900
No.Lanes	1	2	1	1	2 0	0 1 0	0 1	1
SL	507	1769	1615	600	1766	1776	1286	1553
LnCapacity	239	690	630	282	689	497	527	808
Flow Ratio	0.17	0.20	0.01	0.14	0.23	0.17	0.33	0.07
v/c Ratio	0.36	0.52	0.04	0.30	0.59	0.61	0.80	0.13
Grn Ratio	0.47	0.39	0.39	0.47	0.39	0.28	0.41	0.52
I Factor		1.000			1.000	1.000	1.000	
AT or PVG	3	3	3	3	3	3	3	3
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Q1	1.3	7.6	0.4	1.3	9.0	7.2	7.5	1.5
kB	0.3	0.6	0.6	0.3	0.6	0.5	0.5	0.6
Q2	0.2	0.6	0.0	0.1	0.8	0.7	1.8	0.1
Q Average	1.4	8.2	0.4	1.4	9.8	8.0	9.3	1.5
Q Spacing	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0
Q Storage	0	0	0	0	0	0	0	0
Q S Ratio								
70th Percentile Output:								
fB%	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
BOQ	1.7	9.7	0.5	1.7	11.6	9.4	10.9	1.9
QSRatio								
85th Percentile Output:								
fB%	1.6	1.5	1.6	1.6	1.5	1.5	1.5	1.6
BOQ	2.3	12.6	0.7	2.2	14.9	12.2	14.1	2.5
QSRatio								
90th Percentile Output:								
fB%	1.8	1.7	1.8	1.8	1.6	1.7	1.7	1.8
BOQ	2.6	13.7	0.7	2.5	16.2	13.3	15.3	2.7
QSRatio								
95th Percentile Output:								
fB%	2.1	1.9	2.1	2.1	1.8	1.9	1.9	2.1
BOQ	3.0	15.5	0.9	2.9	18.1	15.0	17.2	3.2
QSRatio								
98th Percentile Output:								
fB%	2.6	2.2	2.7	2.6	2.2	2.2	2.2	2.6
BOQ	3.7	18.4	1.1	3.7	21.3	17.9	20.3	4.0
QSRatio								

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: md
Agency:
Date: 1/4/2005
Period: pm
Project ID: 2017 background traffic - with improvements
E/W St: sth 158

Inter.: sth 158/cth h
Area Type: All other areas
Jurisd: wisdot
Year : 2017
N/S St: cth h

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	2	1	1	2	0	0	1	0	0	1	1
LGConfig	L	T	R	L	TR			LTR			LT	R
Volume	14	765	25	45	450	70	10	365	60	65	325	45
Lane Width	12.0	12.0	12.0	12.0	12.0			12.0			12.0	12.0
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	3
EB Left	A	A	A		NB Left		A		
Thru		A	A		Thru		A		
Right		A	A		Right		A		
Peds					Peds				
WB Left	A		A		SB Left	A	A		
Thru			A		Thru	A	A		
Right			A		Right	A	A		
Peds					Peds				
NB Right					EB Right				
SB Right	A	A			WB Right				
Green	5.0	6.0	32.0			9.0	37.0		
Yellow	3.0	3.0	4.5			3.0	4.5		
All Red	0.0	0.0	1.5			0.0	1.5		

Cycle Length: 110.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	362	1805	0.04	0.45	18.3	B		
T	1352	3627	0.64	0.37	29.5	C	29.1	C
R	602	1615	0.05	0.37	22.1	C		
Westbound								
L	232	1805	0.22	0.34	25.6	C		
TR	1005	3455	0.59	0.29	34.3	C	33.6	C
Northbound								
LTR	604	1797	0.82	0.34	42.1	D	42.1	D
Southbound								
LT	515	1847	0.86	0.45	41.2	D	37.8	D
R	913	1455	0.06	0.63	7.9	A		

Intersection Delay = 34.4 (sec/veh) Intersection LOS = C

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/4/2005
Analysis Time Period: pm
Intersection: sth 158/cth h
Area Type: All other areas
Jurisdiction: wisdot
Analysis Year: 2017
Project ID: 2017 background traffic - with improvements
East/West Street: sth 158 North/South Street: cth h

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	14	765	25	45	450	70	10	365	60	65	325	45
% Heavy Veh	0	5	0	0	3	0	10	2	4	2	2	11
PHF	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
PK 15 Vol	4	217	7	13	128	20	3	104	17	18	92	13
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	2000	1900	1900	1900			1900			1900	1900
ParkExist												
NumPark												
No. Lanes	1	2	1	1	2	0	0	1	0	0	1	1
LGConfig	L	T	R	L	TR			LTR			LT	R
Lane Width	12.0	12.0	12.0	12.0	12.0			12.0			12.0	12.0
RTOR Vol			0			0			0			0
Adj Flow	16	869	28	51	591			494			443	51
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000			0.022			0.167	
Prop RTs		0.000	1.000		0.135		0.138			0.000	1.000	
Peds Bikes		0			0			0			0	
Buses	0	0	0	0	0						0	0
%InProtPhase	0.0			0.0						0.0		

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0	0.0	0.0	0.0			0.0			0.0	0.0
Arriv. Type	3	3	3	3	3			3			3	3
Unit Ext.	3.0	3.0	3.0	3.0	3.0			3.0			3.0	3.0
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0	2.0	2.0	2.0			2.0			2.0	2.0
Ext of g	2.0	2.0	2.0	2.0	2.0			2.0			2.0	2.0
Ped Min g	3.2			3.2				3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A	A	A		NB Left		A		
Thru		A	A		Thru		A		
Right		A	A		Right		A		
Peds					Peds				
WB Left	A		A		SB Left	A	A		
Thru			A		Thru	A	A		
Right			A		Right	A	A		
Peds					Peds				
NB Right					EB Right				
SB Right	A	A			WB Right				
Green	5.0	6.0	32.0			9.0	37.0		
Yellow	3.0	3.0	4.5			3.0	4.5		
All Red	0.0	0.0	1.5			0.0	1.5		

Cycle Length: 110.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	14	765	25	45	450	70	10	365	60	65	325	45
PHF	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Adj flow	16	869	28	51	511	80	11	415	68	74	369	51
No. Lanes	1	2	1	1	2	0	0	1	0	0	1	1
Lane group	L	T	R	L	TR			LTR			LT	R
Adj flow	16	869	28	51	591			494			443	51
Prop LTs	1.000	0.000		1.000	0.000			0.022			0.167	
Prop RTs		0.000	1.000		0.135		0.138			0.000	1.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L	T	R	L	TR			LTR			LT	R
So	1900	2000	1900	1900	1900			1900			1900	1900
Lanes	1	2	1	1	2	0	0	1	0	0	1	1
fW	1.000	1.000	1.000	1.000	1.000			1.000			1.000	1.000
fHV	1.000	0.952	1.000	1.000	0.975			0.976			0.980	0.901
fG	1.000	1.000	1.000	1.000	1.000			1.000			1.000	1.000
fP	1.000	1.000	1.000	1.000	1.000			1.000			1.000	1.000
fBB	1.000	1.000	1.000	1.000	1.000			1.000			1.000	1.000
fA	1.000	1.000	1.000	1.000	1.000			1.000			1.000	1.000
fLU	1.000	0.952	1.000	1.000	0.952			0.981			1.000	0.850
fRT		1.000	0.850		0.980			0.987			0.992	
fLT	0.950	1.000		0.950	1.000						0.537	
Sec.	0.218			0.271				1.000			1.000	
fLpb	1.000	1.000		1.000	1.000			1.000			1.000	1.000
fRpb		1.000	1.000		1.000			1797			1847	1455
S	1805	3627	1615	1805	3455						1001	
Sec.	415			516								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		16	1805	0.01	0.127	230	0.07
Perm		0	415	0.00	0.318	132	0.00
Left	L	16			0.45	362	0.04
Prot							
Perm							
Thru	T	869	3627	# 0.24	0.37	1352	0.64
Right	R	28	1615	0.02	0.37	602	0.05
Westbound							
Prot		51	1805	# 0.03	0.045	82	0.62
Perm		0	516	0.00	0.291	150	0.00
Left	L	51			0.34	232	0.22
Prot							
Perm							
Thru	TR	591	3455	0.17	0.29	1005	0.59
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	494	1797	0.27	0.34	604	0.82
Right							
Southbound							
Prot							
Perm							
Left							
Prot		151	1847	# 0.08	0.082	151	1.00
Perm		292	1001	# 0.29	0.364	364	0.80
Thru	LT	443			0.45	515	0.86
Right	R	51	1455	0.04	0.63	913	0.06

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.64
Total lost time per cycle, L = 21.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.79

Control Delay and LOS Determination

Appr/ Lane Grp	v/c	g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	0.04	0.45	18.3	1.000	362	0.11	0.1	0.0	18.3	B		
T	0.64	0.37	28.5	1.000	1352	0.22	1.1	0.0	29.5	C	29.1	C
R	0.05	0.37	22.0	1.000	602	0.11	0.0	0.0	22.1	C		
Westbound												
L	0.22	0.34	25.1	1.000	232	0.11	0.5	0.0	25.6	C		
TR	0.59	0.29	33.4	1.000	1005	0.18	0.9	0.0	34.3	C	33.6	C
Northbound												
LTR	0.82	0.34	33.4	1.000	604	0.36	8.7	0.0	42.1	D	42.1	D
Southbound												

LT	0.86	0.45	27.4	1.000	515	0.39	13.8	0.0	41.2	D	37.8	D
R	0.06	0.63	7.9	1.000	913	0.11	0.0	0.0	7.9	A		

Intersection delay = 34.4 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M		
Cycle length, C 110.0 sec				
Total actual green time for LT lane group, G (s)	49.0	37.0		
Effective permitted green time for LT lane group, g(s)	35.0	32.0		
Opposing effective green time, go (s)	32.0	41.0		
Number of lanes in LT lane group, N	1	1		
Number of lanes in opposing approach, No	2	2		
Adjusted LT flow rate, VLT (veh/h)	16	51		
Proportion of LT in LT lane group, PLT	1.000	1.000		
Proportion of LT in opposing flow, PLTo	0.00	0.00		
Adjusted opposing flow rate, Vo (veh/h)	591	869		
Lost time for LT lane group, tL	6.00	9.00		
Computation				
LT volume per cycle, LTC=VLTC/3600	0.49	1.56		
Opposing lane util. factor, fLUo	0.952	0.952	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	9.48	13.95		
gf=G[exp(- a * (LTC ** b)]-tl, gf<=g	0.0	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.71	0.63		
gq, (see Exhibit C16-4,5,6,7,8)	16.25	5.44		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	18.75	26.56		
n=Max(gq-gf)/2,0)	8.13	2.72		
PTHo=1-PLTo	1.00	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00		
EL1 (refer to Exhibit C16-3)	2.45	3.06		
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.11	0.13		
gdiff=max(gq-gf,0)	0.00	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.22	0.27		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.218	0.271		

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach			M	S
Cycle length, C 110.0 sec				
Total actual green time for LT lane group, G (s)			37.0	49.0
Effective permitted green time for LT lane group, g(s)			37.0	40.0
Opposing effective green time, go (s)			49.0	37.0
Number of lanes in LT lane group, N			1	1
Number of lanes in opposing approach, No			1	1
Adjusted LT flow rate, VLT (veh/h)			11	74
Proportion of LT in LT lane group, PLT	0.000	0.000	0.022	0.167
Proportion of LT in opposing flow, PLTo			0.17	0.02
Adjusted opposing flow rate, Vo (veh/h)			443	494
Lost time for LT lane group, tL			6.00	6.00
Computation				
LT volume per cycle, LTC=VLTC/3600			0.34	2.26
Opposing lane util. factor, fLUo	0.952	0.952	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			13.54	15.09
gf=G[exp(- a * (LTC ** b)]-tl, gf<=g			18.7	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.55	0.66
gq, (see Exhibit C16-4,5,6,7,8)			1.25	25.31
gu=g-gq if gq>=gf, or = g-gf if gq<gf			18.29	14.69
n=Max(gq-gf)/2,0)			0.00	12.66
PTHo=1-PLTo			0.83	0.98
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			0.02	0.17
EL1 (refer to Exhibit C16-3)			2.17	2.29
EL2=Max((1-Ptho**n)/Plto, 1.0)			1.00	11.14
fmin=2(1+PL)/g or fmin=2(1+Pl)/g			0.06	0.06
gdiff=max(gq-gf,0)			0.00	25.31
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.99	0.54
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.987	0.537

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 110.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v	16	51		
v/c ratio from Capacity Worksheet, X	0.04	0.22		
Protected phase effective green interval, g (s)	14.0	5.0		
Opposing queue effective green interval, gq	16.25	5.44		
Unopposed green interval, gu	18.75	26.56		
Red time r=(C-g-gq-gu)	61.0	73.0		
Arrival rate, qa=v/(3600(max[X,1.0]))	0.00	0.01		
Protected ph. departure rate, Sp=s/3600	0.501	0.501		
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.22	0.17		
XPerm	0.04	0.10		
XProt	0.05	0.44		
Case	1	1		
Queue at beginning of green arrow, Qa	0.27	1.03		
Queue at beginning of unsaturated green, Qu	0.07	0.08		
Residual queue, Qr	0.00	0.00		
Uniform Delay, d1	18.3	25.1		

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Dur. Unmet Demand Q veh	Unmet Demand t hrs.	Uniform Delay Unadj. ds	Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 34.4 sec/veh Intersection LOS C

BACK OF QUEUE WORKSHEET

LaneGroup	Eastbound L	T	R	Westbound L	TR	Northbound LTR	Southbound LT	R
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	16	456	28	51	310	494	443	51
So	1900	2000	1900	1900	1900	1900	1900	1900
No.Lanes	1	2	1	1	2 0	0 1 0	0 1	1
SL	812	1904	1615	690	1814	1797	1156	1455
LnCapacity	362	710	602	232	527	604	515	913
Flow Ratio	0.02	0.24	0.02	0.07	0.17	0.27	0.38	0.04
v/c Ratio	0.04	0.64	0.05	0.22	0.59	0.82	0.86	0.06
Grn Ratio	0.45	0.37	0.37	0.34	0.29	0.34	0.45	0.63
I Factor		1.000			1.000	1.000	1.000	
AT or PVG	3	3	3	3	3	3	3	3
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Q1	0.3	11.5	0.5	1.0	8.1	13.8	8.1	0.6
kB	0.4	0.6	0.6	0.3	0.5	0.6	0.5	0.7
Q2	0.0	1.1	0.0	0.1	0.7	2.2	2.5	0.0
Q Average	0.3	12.6	0.6	1.1	8.8	16.0	10.6	0.6
Q Spacing	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0
Q Storage	0	0	0	0	0	0	0	0
Q S Ratio								
70th Percentile Output:								
fB%	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
BOQ	0.4	14.8	0.7	1.4	10.4	18.7	12.5	0.8
QSRatio								
85th Percentile Output:								
fB%	1.6	1.5	1.6	1.6	1.5	1.5	1.5	1.6
BOQ	0.5	18.8	0.9	1.8	13.5	23.7	16.0	1.0
QSRatio								
90th Percentile Output:								
fB%	1.8	1.6	1.8	1.8	1.7	1.6	1.6	1.8
BOQ	0.5	20.3	1.0	2.0	14.6	25.3	17.3	1.2
QSRatio								
95th Percentile Output:								
fB%	2.1	1.8	2.1	2.1	1.9	1.7	1.8	2.1
BOQ	0.6	22.6	1.2	2.3	16.5	28.0	19.4	1.3
QSRatio								
98th Percentile Output:								
fB%	2.7	2.1	2.7	2.6	2.2	2.0	2.1	2.7
BOQ	0.8	26.2	1.5	3.0	19.5	31.9	22.7	1.7
QSRatio								

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: md
Agency:
Date: 1/10/2005
Period: am
Project ID: 2017 background traffic - with improvements
E/W St: STH 158

Inter.: STH 158/104th
Area Type: All other areas
Jurisd: WisDOT
Year : 2017
N/S St: 104th Ave

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	2	1	1	2	1	1	1	1	1	1	0
LGConfig	L	T	R	L	T	R	L	LT	R	L	TR	
Volume	5	620	25	145	540	5	40	5	120	5	10	5
Lane Width	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A		A		NB Left	A			
Thru			A		Thru	A			
Right			A		Right	A			
Peds					Peds				
WB Left	A	A	A		SB Left		A		
Thru		A	A		Thru		A		
Right		A	A		Right		A		
Peds					Peds				
NB Right		A			EB Right				
SB Right					WB Right				
Green	5.0	4.0	30.0			29.0	8.0		
Yellow	3.0	3.0	4.5			4.5	4.5		
All Red	0.0	0.0	1.5			1.5	1.5		

Cycle Length: 100.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	304	1770	0.02	0.35	21.2	C		
T	993	3311	0.75	0.30	34.9	C	34.4	C
R	475	1583	0.06	0.30	25.0	C		
Westbound								
L	300	1770	0.58	0.45	22.3	C		
T	1305	3526	0.50	0.37	24.6	C	24.1	C
R	586	1583	0.01	0.37	19.9	B		
Northbound								
L	523	1805	0.05	0.29	25.6	C		
LT	530	1827	0.06	0.29	25.7	C	25.1	C
R	528	1599	0.27	0.33	25.0	C		
Southbound								
L	142	1770	0.04	0.08	42.6	D		
TR	141	1758	0.13	0.08	43.2	D	43.0	D

Intersection Delay = 28.9 (sec/veh) Intersection LOS = C

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/10/2005
Analysis Time Period: am
Intersection: STH 158/104th
Area Type: All other areas
Jurisdiction: WisDOT
Analysis Year: 2017
Project ID: 2017 background traffic - with improvements
East/West Street: STH 158
North/South Street: 104th Ave

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	5	620	25	145	540	5	40	5	120	5	10	5
% Heavy Veh	2	15	2	2	8	2	0	0	1	2	3	2
PHF	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83
PK 15 Vol	2	187	8	44	163	2	12	2	36	2	3	2
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	2000	1900	1900	2000	1900	1900	1900	1900	1900	1900	
ParkExist												
NumPark												
No. Lanes	1	2	1	1	2	1	1	1	1	1	1	0
LGConfig	L	T	R	L	T	R	L	LT	R	L	TR	
Lane Width	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	
RTOR Vol			0			0			0			0
Adj Flow	6	747	30	175	651	6	24	30	145	6	18	
%InSharedLn							50					
Prop LTs	1.000	0.000		1.000	0.000			0.800			0.000	
Prop RTs		0.000	1.000		0.000	1.000		0.000	1.000		0.333	
Peds Bikes	0			0			0			0		
Buses	0	0	0	0	0	0	0	0	0	0	0	
%InProtPhase	0.0			0.0								

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Arriv. Type	3	3	3	3	3	3	3	3	3	3	3	
Unit Ext.	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	
Ext of g	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	

Ped Min g	3.2	3.2	3.2	3.2

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A		A		NB Left	A			
Thru			A		Thru	A			
Right			A		Right	A			
Peds					Peds				
WB Left	A	A	A		SB Left		A		
Thru		A	A		Thru		A		
Right		A	A		Right		A		
Peds					Peds				
NB Right		A			EB Right				
SB Right					WB Right				
Green	5.0	4.0	30.0			29.0	8.0		
Yellow	3.0	3.0	4.5			4.5	4.5		
All Red	0.0	0.0	1.5			1.5	1.5		

Cycle Length: 100.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	5	620	25	145	540	5	40	5	120	5	10	5
PHF	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83
Adj flow	6	747	30	175	651	6	48	6	145	6	12	6
No. Lanes	1	2	1	1	2	1	1	1	1	1	1	0
Lane group	L	T	R	L	T	R	L	LT	R	L	TR	
Adj flow	6	747	30	175	651	6	24	30	145	6	18	
Prop LTs	1.000	0.000		1.000	0.000			0.800			0.000	
Prop RTs		0.000	1.000		0.000	1.000		0.000	1.000		0.333	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L	T	R	L	T	R	L	LT	R	L	TR	
So	1900	2000	1900	1900	2000	1900	1900	1900	1900	1900	1900	0
Lanes	1	2	1	1	2	1	1	1	1	1	1	
fW	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
fHV	0.980	0.870	0.980	0.980	0.926	0.980	1.000	1.000	0.990	0.980	0.974	
fG	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
fP	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
fBB	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
fA	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
fLU	1.000	0.952	1.000	1.000	0.952	1.000	1.000	1.000	1.000	1.000	1.000	
fRT		1.000	0.850		1.000	0.850		1.000	0.850		0.950	
fLT	0.950	1.000		0.950	1.000		0.950	0.962		0.950	1.000	
Sec.	0.385			0.143								
fLpb	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fRpb		1.000	1.000		1.000	1.000		1.000	1.000		1.000	
S	1770	3311	1583	1770	3526	1583	1805	1827	1599	1770	1758	
Sec.	717			267								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		6	1770	0.00	0.050	89	0.07
Perm		0	717	0.00	0.300	215	0.00
Left	L	6			0.35	304	0.02
Prot							
Perm							
Thru	T	747	3311	# 0.23	0.30	993	0.75
Right	R	30	1583	0.02	0.30	475	0.06
Westbound							
Prot		175	1770	# 0.10	0.120	212	0.83
Perm		0	267	0.00	0.330	88	0.00
Left	L	175			0.45	300	0.58
Prot							
Perm							
Thru	T	651	3526	0.18	0.37	1305	0.50
Right	R	6	1583	0.00	0.37	586	0.01
Northbound							
Prot							
Perm							
Left	L	24	1805	0.01	0.29	523	0.05
Prot							
Perm							
Thru	LT	30	1827	# 0.02	0.29	530	0.06
Right	R	145	1599	0.09	0.33	528	0.27
Southbound							
Prot							
Perm							
Left	L	6	1770	0.00	0.08	142	0.04
Prot							
Perm							
Thru	TR	18	1758	# 0.01	0.08	141	0.13
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.35
Total lost time per cycle, L = 24.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.46

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	0.02	0.35	21.2	1.000	304	0.11	0.0	0.0	21.2	C		
T	0.75	0.30	31.6	1.000	993	0.31	3.3	0.0	34.9	C	34.4	C
R	0.06	0.30	25.0	1.000	475	0.11	0.1	0.0	25.0	C		
Westbound												
L	0.58	0.45	19.4	1.000	300	0.17	2.9	0.0	22.3	C		
T	0.50	0.37	24.3	1.000	1305	0.11	0.3	0.0	24.6	C	24.1	C
R	0.01	0.37	19.9	1.000	586	0.11	0.0	0.0	19.9	B		
Northbound												
L	0.05	0.29	25.5	1.000	523	0.11	0.0	0.0	25.6	C		
LT	0.06	0.29	25.6	1.000	530	0.11	0.0	0.0	25.7	C	25.1	C
R	0.27	0.33	24.7	1.000	528	0.11	0.3	0.0	25.0	C		
Southbound												
L	0.04	0.08	42.5	1.000	142	0.11	0.1	0.0	42.6	D		

TR	0.13	0.08	42.8	1.000	141	0.11	0.4	0.0	43.2	D	43.0	D

Intersection delay = 28.9 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M		
Cycle length, C 100.0 sec				
Total actual green time for LT lane group, G (s)	35.0	45.0		
Effective permitted green time for LT lane group, g(s)	30.0	33.0		
Opposing effective green time, go (s)	37.0	30.0		
Number of lanes in LT lane group, N	1	1		
Number of lanes in opposing approach, No	2	2		
Adjusted LT flow rate, VLT (veh/h)	6	175		
Proportion of LT in LT lane group, PLT	1.000	1.000		
Proportion of LT in opposing flow, PLTo	0.00	0.00		
Adjusted opposing flow rate, Vo (veh/h)	651	747		
Lost time for LT lane group, tL	9.00	6.00		
Computation				
LT volume per cycle, LTC=VLTC/3600	0.17	4.86		
Opposing lane util. factor, fLUo	0.952	0.952	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	9.50	10.90		
gf=G[exp(- a * (LTC ** b)]-tl, gf<=g	0.0	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.63	0.70		
gq, (see Exhibit C16-4,5,6,7,8)	0.00	19.51		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	30.00	13.49		
n=Max(gq-gf)/2,0)	0.00	9.75		
PTHo=1-PLTo	1.00	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00		
EL1 (refer to Exhibit C16-3)	2.60	2.86		
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.13	0.12		
gdiff=max(gq-gf,0)	0.00	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.38	0.14		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.385	0.143		

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 100.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000	0.800	0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	0.952	0.952	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b)]-tl, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 100.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v	6	175		
v/c ratio from Capacity Worksheet, X	0.02	0.58		
Protected phase effective green interval, g (s)	5.0	12.0		
Opposing queue effective green interval, gq	0.00	19.51		
Unopposed green interval, gu	30.00	13.49		
Red time r=(C-g-gq-gu)	65.0	55.0		
Arrival rate, qa=v/(3600(max[X,1.0]))	0.00	0.05		
Protected ph. departure rate, Sp=s/3600	0.492	0.492		
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.20	0.18		
XPerm	0.01	0.66		
XProt	0.05	0.55		
Case	1	1		
Queue at beginning of green arrow, Qa	0.11	2.67		
Queue at beginning of unsaturated green, Qu	0.00	0.95		
Residual queue, Qr	0.00	0.00		
Uniform Delay, d1	21.2	19.4		

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Dur. Unmet Demand Q veh	Initial Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Initial Final Unmet Demand Q veh	Initial Lane Queue Delay d3 sec	Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 28.9 sec/veh Intersection LOS C

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound	
LaneGroup	L	T	R	L	T	R	L	LT	R	L	TR
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	6	392	30	175	341	6	24	30	145	6	18
So	1900	2000	1900	1900	2000	1900	1900	1900	1900	1900	1900
No.Lanes	1	2	1	1	2	1	1	1	1	1	1 0
SL	867	1738	1583	668	1851	1583	1805	1827	1599	1770	1758
LnCapacity	304	521	475	300	685	586	523	530	528	142	141
Flow Ratio	0.01	0.23	0.02	0.26	0.18	0.00	0.01	0.02	0.09	0.00	0.01
v/c Ratio	0.02	0.75	0.06	0.58	0.50	0.01	0.05	0.06	0.27	0.04	0.13
Grn Ratio	0.35	0.30	0.30	0.45	0.37	0.37	0.29	0.29	0.33	0.08	0.08
I Factor		1.000			1.000			1.000			1.000
AT or PVG	3	3	3	3	3	3	3	3	3	3	3
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Q1	0.1	9.8	0.6	2.9	7.3	0.1	0.5	0.6	3.0	0.2	0.5
kB	0.4	0.5	0.5	0.4	0.6	0.5	0.5	0.5	0.5	0.2	0.2
Q2	0.0	1.4	0.0	0.5	0.6	0.0	0.0	0.0	0.2	0.0	0.0
Q Average	0.1	11.2	0.6	3.4	7.9	0.1	0.5	0.6	3.2	0.2	0.5
Q Spacing	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0
Q Storage	0	0	0	0	0	0	0	0	0	0	0
Q S Ratio											
70th Percentile Output:											
fB%	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
BOQ	0.1	13.2	0.8	4.0	9.3	0.1	0.6	0.8	3.8	0.2	0.6
QSRatio											
85th Percentile Output:											
fB%	1.6	1.5	1.6	1.6	1.5	1.6	1.6	1.6	1.6	1.6	1.6
BOQ	0.2	16.9	1.0	5.3	12.1	0.2	0.8	1.0	5.0	0.3	0.8
QSRatio											
90th Percentile Output:											
fB%	1.8	1.6	1.8	1.7	1.7	1.8	1.8	1.8	1.7	1.8	1.8
BOQ	0.2	18.3	1.1	5.8	13.2	0.2	0.9	1.1	5.5	0.3	0.9
QSRatio											
95th Percentile Output:											
fB%	2.1	1.8	2.1	2.0	1.9	2.1	2.1	2.1	2.0	2.1	2.1
BOQ	0.2	20.5	1.3	6.7	14.9	0.2	1.0	1.3	6.3	0.3	1.0
QSRatio											
98th Percentile Output:											
fB%	2.7	2.1	2.7	2.5	2.2	2.7	2.7	2.7	2.5	2.7	2.7
BOQ	0.3	23.8	1.7	8.3	17.7	0.3	1.3	1.7	7.8	0.4	1.3
QSRatio											

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: md
Agency:
Date: 12/10/2004
Period: pm
Project ID: 2017 background traffic - with improvements
E/W St: STH 158

Inter.: STH 158/104th
Area Type: All other areas
Jurisd: WisDOT
Year : 2017
N/S St: 104th Ave

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	2	1	1	2	1	1	1	1	1	1	0
LGConfig	L	T	R	L	T	R	L	LT	R	L	TR	
Volume	5	710	25	140	415	5	25	5	185	15	5	15
Lane Width	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A		A		NB Left	A			
Thru			A		Thru	A			
Right			A		Right	A			
Peds									
WB Left	A	A	A		SB Left		A		
Thru		A	A		Thru		A		
Right		A	A		Right		A		
Peds									
NB Right	A	A			EB Right				
SB Right					WB Right				
Green	5.0	4.0	32.0			40.0	5.0		
Yellow	3.0	3.0	4.5			4.5	4.5		
All Red	0.0	0.0	1.5			1.5	1.5		

Cycle Length: 110.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	324	1770	0.02	0.34	24.3	C		
T	1075	3697	0.78	0.29	39.4	D	38.9	D
R	470	1615	0.06	0.29	28.2	C		
Westbound								
L	266	1805	0.62	0.43	27.9	C		
T	1274	3592	0.38	0.35	26.7	C	27.0	C
R	561	1583	0.01	0.35	23.0	C		
Northbound								
L	656	1805	0.02	0.36	22.5	C		
LT	667	1834	0.03	0.36	22.5	C	18.6	B
R	756	1599	0.29	0.47	17.9	B		
Southbound								
L	80	1770	0.22	0.05	52.1	D		
TR	75	1653	0.32	0.05	53.3	D	52.8	D

Intersection Delay = 32.1 (sec/veh) Intersection LOS = C

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 12/10/2004
Analysis Time Period: pm
Intersection: STH 158/104th
Area Type: All other areas
Jurisdiction: WisDOT
Analysis Year: 2017
Project ID: 2017 background traffic - with improvements
East/West Street: STH 158 North/South Street: 104th Ave

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	5	710	25	140	415	5	25	5	185	15	5	15
% Heavy Veh	2	3	0	0	6	2	0	0	1	2	2	2
PHF	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
PK 15 Vol	2	209	7	41	122	2	7	2	54	4	2	4
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	2000	1900	1900	2000	1900	1900	1900	1900	1900	1900	
ParkExist												
NumPark												
No. Lanes	1	2	1	1	2	1	1	1	1	1	1	0
LGConfig	L	T	R	L	T	R	L	LT	R	L	TR	
Lane Width	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	
RTOR Vol			0			0			0			0
Adj Flow	6	835	29	165	488	6	15	20	218	18	24	
%InSharedLn							50					
Prop LTs	1.000	0.000		1.000	0.000			0.725			0.000	
Prop RTs		0.000	1.000		0.000	1.000		0.000	1.000		0.750	
Peds Bikes	0			0			0			0		
Buses	0	0	0	0	0	0	0	0	0	0	0	
%InProtPhase	0.0			0.0								

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Arriv. Type	3	3	3	3	3	3	3	3	3	3	3	
Unit Ext.	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	
Ext of g	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	

Ped Min g	3.2		3.2		3.2		3.2	

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A		A		NB Left	A			
Thru			A		Thru	A			
Right			A		Right	A			
Peds									
WB Left	A	A	A		SB Left		A		
Thru		A	A		Thru		A		
Right		A	A		Right		A		
Peds									
NB Right	A	A			EB Right				
SB Right					WB Right				
Green	5.0	4.0	32.0			40.0	5.0		
Yellow	3.0	3.0	4.5			4.5	4.5		
All Red	0.0	0.0	1.5			1.5	1.5		

Cycle Length: 110.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	5	710	25	140	415	5	25	5	185	15	5	15
PHF	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Adj flow	6	835	29	165	488	6	29	6	218	18	6	18
No. Lanes	1	2	1	1	2	1	1	1	1	1	1	0
Lane group	L	T	R	L	T	R	L	LT	R	L	TR	
Adj flow	6	835	29	165	488	6	15	20	218	18	24	
Prop LTs	1.000	0.000		1.000	0.000			0.725			0.000	
Prop RTs		0.000	1.000		0.000	1.000		0.000	1.000		0.750	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L	T	R	L	T	R	L	LT	R	L	TR	
So	1900	2000	1900	1900	2000	1900	1900	1900	1900	1900	1900	
Lanes	1	2	1	1	2	1	1	1	1	1	1	0
fW	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
fHV	0.980	0.971	1.000	1.000	0.943	0.980	1.000	1.000	0.990	0.980	0.980	
fG	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
fP	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
fBB	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
fA	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
fLU	1.000	0.952	1.000	1.000	0.952	1.000	1.000	1.000	1.000	1.000	1.000	
fRT		1.000	0.850		1.000	0.850		1.000	0.850		0.887	
fLT	0.950	1.000		0.950	1.000		0.950	0.965		0.950	1.000	
Sec.	0.451			0.114								
fLpb	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fRpb		1.000	1.000		1.000	1.000		1.000	1.000		1.000	
S	1770	3697	1615	1805	3592	1583	1805	1834	1599	1770	1653	
Sec.	840			217								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		6	1770	0.00	0.045	80	0.08
Perm		0	840	0.00	0.291	244	0.00
Left	L	6			0.34	324	0.02
Prot							
Perm							
Thru	T	835	3697	# 0.23	0.29	1075	0.78
Right	R	29	1615	0.02	0.29	470	0.06
Westbound							
Prot		165	1805	0.09	0.109	197	0.84
Perm		0	217	0.00	0.318	69	0.00
Left	L	165			0.43	266	0.62
Prot							
Perm							
Thru	T	488	3592	0.14	0.35	1274	0.38
Right	R	6	1583	0.00	0.35	561	0.01
Northbound							
Prot							
Perm							
Left	L	15	1805	0.01	0.36	656	0.02
Prot							
Perm							
Thru	LT	20	1834	0.01	0.36	667	0.03
Right	R	218	1599	# 0.14	0.47	756	0.29
Southbound							
Prot							
Perm							
Left	L	18	1770	0.01	0.05	80	0.22
Prot							
Perm							
Thru	TR	24	1653	# 0.01	0.05	75	0.32
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.38
Total lost time per cycle, L = 21.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.47

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	0.02	0.34	24.3	1.000	324	0.11	0.0	0.0	24.3	C		
T	0.78	0.29	35.7	1.000	1075	0.33	3.7	0.0	39.4	D	38.9	D
R	0.06	0.29	28.2	1.000	470	0.11	0.1	0.0	28.2	C		
Westbound												
L	0.62	0.43	23.5	1.000	266	0.20	4.4	0.0	27.9	C		
T	0.38	0.35	26.5	1.000	1274	0.11	0.2	0.0	26.7	C	27.0	C
R	0.01	0.35	23.0	1.000	561	0.11	0.0	0.0	23.0	C		
Northbound												
L	0.02	0.36	22.5	1.000	656	0.11	0.0	0.0	22.5	C		
LT	0.03	0.36	22.5	1.000	667	0.11	0.0	0.0	22.5	C	18.6	B
R	0.29	0.47	17.7	1.000	756	0.11	0.2	0.0	17.9	B		
Southbound												
L	0.22	0.05	50.6	1.000	80	0.11	1.4	0.0	52.1	D		

TR	0.32	0.05	50.9	1.000	75	0.11	2.5	0.0	53.3	D	52.8	D

Intersection delay = 32.1 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M		
Cycle length, C 110.0 sec				
Total actual green time for LT lane group, G (s)	37.0	47.0		
Effective permitted green time for LT lane group, g(s)	32.0	35.0		
Opposing effective green time, go (s)	39.0	32.0		
Number of lanes in LT lane group, N	1	1		
Number of lanes in opposing approach, No	2	2		
Adjusted LT flow rate, VLT (veh/h)	6	165		
Proportion of LT in LT lane group, PLT	1.000	1.000		
Proportion of LT in opposing flow, PLTo	0.00	0.00		
Adjusted opposing flow rate, Vo (veh/h)	488	835		
Lost time for LT lane group, tL	9.00	6.00		
Computation				
LT volume per cycle, LTC=VLTC/3600	0.18	5.04		
Opposing lane util. factor, fLUo	0.952	0.952	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	7.83	13.40		
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g	0.0	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.65	0.71		
gq, (see Exhibit C16-4,5,6,7,8)	0.00	25.13		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	32.00	9.87		
n=Max(gq-gf)/2,0)	0.00	12.56		
PTHo=1-PLTo	1.00	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00		
EL1 (refer to Exhibit C16-3)	2.22	3.11		
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.13	0.11		
gdiff=max(gq-gf,0)	0.00	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.45	0.11		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.451	0.114		

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 110.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000	0.725	0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	0.952	0.952	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
Apb7				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 110.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v	6	165		
v/c ratio from Capacity Worksheet, X	0.02	0.62		
Protected phase effective green interval, g (s)	5.0	12.0		
Opposing queue effective green interval, gq	0.00	25.13		
Unopposed green interval, gu	32.00	9.87		
Red time r=(C-g-gq-gu)	73.0	63.0		
Arrival rate, qa=v/(3600(max[X,1.0]))	0.00	0.05		
Protected ph. departure rate, Sp=s/3600	0.492	0.501		
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.23	0.21		
XPerm	0.01	0.76		
XProt	0.05	0.57		
Case	1	1		
Queue at beginning of green arrow, Qa	0.12	2.89		
Queue at beginning of unsaturated green, Qu	0.00	1.15		
Residual queue, Qr	0.00	0.00		
Uniform Delay, d1	24.3	23.5		

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 32.1 sec/veh Intersection LOS C

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	T	R	L	T	R	L	LT	R	L	TR	
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Flow Rate	6	438	29	165	256	6	15	20	218	18	24	
So	1900	2000	1900	1900	2000	1900	1900	1900	1900	1900	1900	
No.Lanes	1	2	1	1	2	1	1	1	1	1	1	0
SL	966	1941	1615	622	1886	1583	1805	1834	1599	1770	1653	
LnCapacity	324	564	470	266	669	561	656	667	756	80	75	
Flow Ratio	0.01	0.23	0.02	0.27	0.14	0.00	0.01	0.01	0.14	0.01	0.01	
v/c Ratio	0.02	0.78	0.06	0.62	0.38	0.01	0.02	0.03	0.29	0.22	0.32	
Grn Ratio	0.34	0.29	0.29	0.43	0.35	0.35	0.36	0.36	0.47	0.05	0.05	
I Factor		1.000			1.000			1.000			1.000	
AT or PVG	3	3	3	3	3	3	3	3	3	3	3	
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
PF2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Q1	0.1	12.3	0.6	3.1	5.8	0.1	0.3	0.4	4.1	0.5	0.7	
kB	0.4	0.6	0.5	0.4	0.6	0.6	0.6	0.6	0.7	0.2	0.2	
Q2	0.0	1.7	0.0	0.6	0.4	0.0	0.0	0.0	0.3	0.0	0.1	
Q Average	0.1	14.0	0.7	3.6	6.2	0.1	0.3	0.4	4.3	0.6	0.8	
Q Spacing	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	
Q Storage	0	0	0	0	0	0	0	0	0	0	0	
Q S Ratio												
70th Percentile Output:												
fB%	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	
BOQ	0.2	16.4	0.8	4.3	7.4	0.1	0.4	0.5	5.2	0.7	0.9	
QSRatio												
85th Percentile Output:												
fB%	1.6	1.5	1.6	1.6	1.5	1.6	1.6	1.6	1.6	1.6	1.6	
BOQ	0.2	20.8	1.1	5.7	9.6	0.2	0.6	0.7	6.8	0.9	1.3	
QSRatio												
90th Percentile Output:												
fB%	1.8	1.6	1.8	1.7	1.7	1.8	1.8	1.8	1.7	1.8	1.8	
BOQ	0.2	22.4	1.2	6.3	10.5	0.2	0.6	0.7	7.5	1.0	1.4	
QSRatio												
95th Percentile Output:												
fB%	2.1	1.8	2.1	2.0	1.9	2.1	2.1	2.1	2.0	2.1	2.1	
BOQ	0.3	24.8	1.4	7.3	12.0	0.3	0.6	0.9	8.5	1.2	1.6	
QSRatio												
98th Percentile Output:												
fB%	2.7	2.0	2.6	2.5	2.3	2.7	2.7	2.7	2.4	2.7	2.6	
BOQ	0.3	28.6	1.8	9.0	14.4	0.3	0.8	1.1	10.5	1.5	2.1	
QSRatio												

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: md
Agency:
Date: 1/3/2005
Period: am
Project ID: 2017 background traffic - with improvements
E/W St: sth 158

Inter.: sth 158/greyhound access
Area Type: All other areas
Jurisd: wisdot
Year : 2017
N/S St: greyhound access

SIGNALIZED INTERSECTION SUMMARY

	Eastbound L	T	R	Westbound L	T	R	Northbound L	T	R	Southbound L	T	R
No. Lanes	0	2	0	1	2	0	2	0	1	0	0	0
LGConfig		T		L	T		L		R			
Volume		645		5	585		5		5			
Lane Width		12.0		12.0	12.0		12.0		12.0			
RTOR Vol									0			

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left								
Thru		A						
Right								
Peds								
WB Left	A	A						
Thru	A	A						
Right								
Peds								
NB Right	A							
SB Right								
Green	15.0	52.0			18.0			
Yellow	3.0	4.5			4.5			
All Red	0.0	1.5			1.5			

NB	Left	A				
	Thru					
	Right	A				
	Peds					
SB	Left					
	Thru					
	Right					
	Peds					
EB	Right					
WB	Right					

Cycle Length: 100.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	g/C	Lane Group Delay	LOS	Approach Delay	LOS
Eastbound								
T	1722	3311	0.39	0.52	14.6	B	14.6	B
Westbound								
L	585	1805	0.01	0.70	5.2	A		
T	2468	3526	0.24	0.70	5.5	A	5.5	A
Northbound								
L	631	3505	0.01	0.18	33.7	C	26.2	C
R	630	1615	0.01	0.39	18.7	B		
Southbound								

Intersection Delay = 10.3 (sec/veh) Intersection LOS = B

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/3/2005
Analysis Time Period: am
Intersection: sth 158/greyhound access
Area Type: All other areas
Jurisdiction: wisdot
Analysis Year: 2017
Project ID: 2017 background traffic - with improvements
East/West Street: sth 158 North/South Street: greyhound access

VOLUME DATA

	Eastbound L	T	R	Westbound L	T	R	Northbound L	T	R	Southbound L	T	R
Volume		645		5	585		5		5			
% Heavy Veh		15		0	8		0		0			
PHF		0.97		0.97	0.97		0.97		0.97			
PK 15 Vol		166		2	151		2		2			
Hi Ln Vol												
% Grade		0			0			0				
Ideal Sat		2000		1900	2000		1900		1900			
ParkExist												
NumPark												
No. Lanes	0	2	0	1	2	0	2	0	1	0	0	0
LGConfig		T		L	T		L		R			
Lane Width		12.0		12.0	12.0		12.0		12.0			
RTOR Vol									0			
Adj Flow		665		5	603		5		5			
%InSharedLn												
Prop LTs		0.000		1.000	0.000							
Prop RTs		0.000			0.000				1.000			
Peds		0						0			0	
Bikes												
Buses		0		0	0		0		0			
%InProtPhase				0.0								

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound L	T	R	Westbound L	T	R	Northbound L	T	R	Southbound L	T	R
Init Unmet		0.0		0.0	0.0		0.0		0.0			
Arriv. Type		3		3	3		3		3			
Unit Ext.		3.0		3.0	3.0		3.0		3.0			
I Factor		1.000			1.000			1.000				
Lost Time		2.0		2.0	2.0		2.0		2.0			
Ext of g		2.0		2.0	2.0		2.0		2.0			

Ped Min g	3.2			3.2		3.2		

PHASE DATA

Phase Combination	1	2	3	4	5	6	7	8
EB Left								
Thru		A						
Right								
Peds								
WB Left	A	A						
Thru	A	A						
Right								
Peds								
NB Right	A							
SB Right								
Green	15.0	52.0			18.0			
Yellow	3.0	4.5			4.5			
All Red	0.0	1.5			1.5			

NB	Left	A		
	Thru			
	Right	A		
	Peds			
SB	Left			
	Thru			
	Right			
	Peds			
EB	Right			
WB	Right			

Cycle Length: 100.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound L	T	R	Westbound L	T	R	Northbound L	T	R	Southbound L	T	R
Volume, V		645		5	585		5		5			
PHF		0.97		0.97	0.97		0.97		0.97			
Adj flow		665		5	603		5		5			
No Lanes	0	2	0	1	2	0	2	0	1	0	0	0
Lane group		T		L	T		L		R			
Adj flow		665		5	603		5		5			
Prop LTs		0.000		1.000	0.000							
Prop RTs		0.000			0.000				1.000			

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound T			Westbound L	T		Northbound L		R	Southbound		
LG												
So	2000			1900	2000		1900		1900			
Lanes	0	2	0	1	2	0	2	0	1	0	0	0
fW		1.000		1.000	1.000		1.000		1.000			
fHV		0.870		1.000	0.926		1.000		1.000			
fG		1.000		1.000	1.000		1.000		1.000			
fP		1.000		1.000	1.000		1.000		1.000			
fBB		1.000		1.000	1.000		1.000		1.000			
fA		1.000		1.000	1.000		1.000		1.000			
fLU		0.952		1.000	0.952		0.971		1.000			
fRT		1.000			1.000				0.850			
fLT		1.000		0.950	1.000		0.950					
Sec.				0.300								
fLpb		1.000		1.000	1.000		1.000					
fRpb		1.000			1.000				1.000			
S		3311		1805	3526		3505		1615			
Sec.				570								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	665	3311	# 0.20	0.52	1722	0.39
Right							
Westbound							
Prot		5	1805	# 0.00	0.150	271	0.02
Perm		0	570	0.00	0.550	314	0.00
Left	L	5			0.70	585	0.01
Prot							
Perm							
Thru	T	603	3526	0.17	0.70	2468	0.24
Right							
Northbound							
Prot							
Perm							
Left	L	5	3505	# 0.00	0.18	631	0.01
Prot							
Perm							
Thru							
Right	R	5	1615	0.00	0.39	630	0.01
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.21
Total lost time per cycle, L = 18.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.25

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group Delay	LOS	Approach Delay	LOS
Eastbound												
T	0.39	0.52	14.4	1.000	1722	0.11	0.1	0.0	14.6	B	14.6	B
Westbound												
L	0.01	0.70	5.2	1.000	585	0.11	0.0	0.0	5.2	A		
T	0.24	0.70	5.4	1.000	2468	0.11	0.1	0.0	5.5	A	5.5	A
Northbound												
L	0.01	0.18	33.7	1.000	631	0.11	0.0	0.0	33.7	C	26.2	C
R	0.01	0.39	18.7	1.000	630	0.11	0.0	0.0	18.7	B		
Southbound												

Intersection delay = 10.3 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach		M		
Cycle length, C 100.0 sec				
Total actual green time for LT lane group, G (s)		70.0		
Effective permitted green time for LT lane group, g(s)		55.0		
Opposing effective green time, go (s)		52.0		
Number of lanes in LT lane group, N		1		
Number of lanes in opposing approach, No		2		
Adjusted LT flow rate, VLT (veh/h)		5		
Proportion of LT in LT lane group, PLT		1.000		
Proportion of LT in opposing flow, PLTo		0.00		
Adjusted opposing flow rate, Vo (veh/h)		665		
Lost time for LT lane group, tL		6.00		
Computation				
LT volume per cycle, LTC=VLTC/3600		0.14		
Opposing lane util. factor, fLUo	0.952	0.952		
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		9.70		
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g		0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.48		
gq, (see Exhibit C16-4,5,6,7,8)		11.56		
gu=g-gq if gq>=gf, or = g-gf if gq<gf		43.44		
n=Max(gq-gf)/2,0)		5.78		
PTHo=1-PLTo		1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00		
EL1 (refer to Exhibit C16-3)		2.64		
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.07		
gdiff=max(gq-gf,0)		0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.30		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.300		

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 100.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT		0.000	0.000	
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo		0.952	0.952	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 100.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v		5		
v/c ratio from Capacity Worksheet, X		0.01		
Protected phase effective green interval, g (s)		15.0		
Opposing queue effective green interval, gq		11.56		
Unopposed green interval, gu		43.44		
Red time r=(C-g-gq-gu)		30.0		
Arrival rate, qa=v/(3600(max(X,1.0)))		0.00		
Protected ph. departure rate, Sp=s/3600		0.501		
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)		0.20		
XPerm		0.01		
XProt		0.01		
Case		1		
Queue at beginning of green arrow, Qa		0.04		
Queue at beginning of unsaturated green, Qu		0.02		
Residual queue, Qr		0.00		
Uniform Delay, d1		5.2		

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 10.3 sec/veh Intersection LOS B

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	T			L	T		L		R			
Init Queue	0.0			0.0	0.0		0.0		0.0			
Flow Rate	349			5	316		2		5			
So	2000			1900	2000		1900		1900			
No.Lanes	0	2	0	1	2	0	2	0	1	0	0	0
SL	1738			835	1851		1805		1615			
LnCapacity	904			585	1296		324		630			
Flow Ratio	0.20			0.01	0.17		0.00		0.00			
v/c Ratio	0.39			0.01	0.24		0.01		0.01			
Grn Ratio	0.52			0.70	0.70		0.18		0.39			
I Factor	1.000				1.000			1.000				
AT or PVG	3			3	3		3		3			
Pltn Ratio	1.00			1.00	1.00		1.00		1.00			
PF2	1.00			1.00	1.00		1.00		1.00			
Q1	5.8			0.0	3.2		0.0		0.1			
kB	0.7			0.5	0.9		0.4		0.6			
Q2	0.4			0.0	0.3		0.0		0.0			
Q Average	6.3			0.0	3.5		0.0		0.1			
Q Spacing	25.0			25.0	25.0		25.0		25.0			
Q Storage	0			0	0		0		0			
Q S Ratio												
70th Percentile Output:												
fB%	1.2			1.2	1.2		1.2		1.2			
BOQ	7.4			0.1	4.1		0.1		0.1			
QSRatio												
85th Percentile Output:												
fB%	1.5			1.6	1.6		1.6		1.6			
BOQ	9.7			0.1	5.4		0.1		0.1			
QSRatio												
90th Percentile Output:												
fB%	1.7			1.8	1.7		1.8		1.8			
BOQ	10.6			0.1	6.0		0.1		0.2			
QSRatio												
95th Percentile Output:												
fB%	1.9			2.1	2.0		2.1		2.1			
BOQ	12.0			0.1	6.9		0.1		0.2			
QSRatio												
98th Percentile Output:												
fB%	2.3			2.7	2.5		2.7		2.7			
BOQ	14.5			0.1	8.5		0.1		0.2			
QSRatio												

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: md
Agency:
Date: 1/3/2005
Period: pm
Project ID: 2017 background traffic - with improvements
E/W St: sth 158

Inter.: sth 158/greyhound access
Area Type: All other areas
Jurisd: wisdot
Year : 2017
N/S St: greyhound access

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	1	2	0	2	0	1	0	0	0
LGConfig		T		L	T		L		R			
Volume		435		30	425		15		5			
Lane Width		12.0		12.0	12.0		12.0		12.0			
RTOR Vol									0			

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left					NB Left	A			
Thru		A			Thru				
Right					Right	A			
Peds					Peds				
WB Left	A	A			SB Left				
Thru	A	A			Thru				
Right					Right				
Peds					Peds				
NB Right	A				EB Right				
SB Right					WB Right				
Green	40.0	39.0				16.0			
Yellow	3.0	4.5				4.5			
All Red	0.0	1.5				1.5			

Cycle Length: 110.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
T	1286	3627	0.36	0.35	26.5	C	26.5	C
Westbound								
L	900	1805	0.04	0.75	4.2	A		
T	2678	3592	0.17	0.75	4.1	A	4.1	A
Northbound								
L	510	3505	0.03	0.15	40.4	D		
R	910	1615	0.01	0.56	10.5	B	33.3	C
Southbound								

Intersection Delay = 15.4 (sec/veh) Intersection LOS = B

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/3/2005
Analysis Time Period: pm
Intersection: sth 158/greyhound access
Area Type: All other areas
Jurisdiction: wisdot
Analysis Year: 2017
Project ID: 2017 background traffic - with improvements
East/West Street: sth 158 North/South Street: greyhound access

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume		435		30	425		15		5			
% Heavy Veh		5		0	6		0		0			
PHF		0.93		0.93	0.93		0.93		0.93			
PK 15 Vol		117		8	114		4		2			
Hi Ln Vol												
% Grade		0			0			0				
Ideal Sat		2000		1900	2000		1900		1900			
ParkExist												
NumPark												
No. Lanes	0	2	0	1	2	0	2	0	1	0	0	0
LGConfig		T		L	T		L		R			
Lane Width		12.0		12.0	12.0		12.0		12.0			
RTOR Vol									0			
Adj Flow		468		32	457		16		5			
%InSharedLn												
Prop LTs		0.000		1.000	0.000							
Prop RTs		0.000			0.000				1.000			
Peds Bikes	0							0			0	
Buses		0		0	0		0		0			
%InProtPhase				0.0								

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0		0.0	0.0		0.0		0.0			
Arriv. Type		3		3	3		3		3			
Unit Ext.		3.0		3.0	3.0		3.0		3.0			
I Factor		1.000			1.000			1.000				
Lost Time		2.0		2.0	2.0		2.0		2.0			
Ext of g		2.0		2.0	2.0		2.0		2.0			
Ped Min g		3.2						3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left					NB Left	A			
Thru		A			Thru				
Right					Right	A			
Peds					Peds				
WB Left	A	A			SB Left				
Thru	A	A			Thru				
Right					Right				
Peds					Peds				
NB Right	A				EB Right				
SB Right					WB Right				
Green	40.0	39.0				16.0			
Yellow	3.0	4.5				4.5			
All Red	0.0	1.5				1.5			

Cycle Length: 110.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V		435		30	425		15		5			
PHF		0.93		0.93	0.93		0.93		0.93			
Adj flow		468		32	457		16		5			
No. Lanes	0	2	0	1	2	0	2	0	1	0	0	0
Lane group		T		L	T		L		R			
Adj flow		468		32	457		16		5			
Prop LTs		0.000		1.000	0.000							
Prop RTs		0.000			0.000				1.000			

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	T			L	T		L		R			
So	2000			1900	2000		1900		1900			
Lanes	2	0		1	2	0	2	0	1	0	0	0
fW	1.000			1.000	1.000		1.000		1.000			
fHV	0.952			1.000	0.943		1.000		1.000			
fG	1.000			1.000	1.000		1.000		1.000			
fP	1.000			1.000	1.000		1.000		1.000			
fBB	1.000			1.000	1.000		1.000		1.000			
fA	1.000			1.000	1.000		1.000		1.000			
fLU	0.952			1.000	0.952		0.971		1.000			
fRT	1.000				1.000				0.850			
fLT	1.000			0.950	1.000		0.950					
Sec.				0.337								
fLpb	1.000			1.000	1.000		1.000					
fRpb	1.000				1.000				1.000			
S	3627			1805	3592		3505		1615			
Sec.				640								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	Lane Group Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	468	3627	# 0.13	0.35	1286	0.36
Right							
Westbound							
Prot		32	1805	# 0.02	0.364	656	0.05
Perm		0	640	0.00	0.382	244	0.00
Left	L	32			0.75	900	0.04
Prot							
Perm							
Thru	T	457	3592	0.13	0.75	2678	0.17
Right							
Northbound							
Prot							
Perm							
Left	L	16	3505	# 0.00	0.15	510	0.03
Prot							
Perm							
Thru							
Right	R	5	1615	0.00	0.56	910	0.01
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.15
Total lost time per cycle, L = 18.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.18

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
T	0.36	0.35	26.3	1.000	1286	0.11	0.2	0.0	26.5	C	26.5	C
Westbound												
L	0.04	0.75	4.2	1.000	900	0.11	0.0	0.0	4.2	A		
T	0.17	0.75	4.1	1.000	2678	0.11	0.0	0.0	4.1	A	4.1	A
Northbound												
L	0.03	0.15	40.3	1.000	510	0.11	0.0	0.0	40.4	D		
R	0.01	0.56	10.5	1.000	910	0.11	0.0	0.0	10.5	B	33.3	C
Southbound												

Intersection delay = 15.4 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach		M		
Cycle length, C 110.0 sec				
Total actual green time for LT lane group, G (s)		82.0		
Effective permitted green time for LT lane group, g(s)		42.0		
Opposing effective green time, go (s)		39.0		
Number of lanes in LT lane group, N		1		
Number of lanes in opposing approach, No		2		
Adjusted LT flow rate, VLT (veh/h)		32		
Proportion of LT in LT lane group, PLT		1.000		
Proportion of LT in opposing flow, PLTo		0.00		
Adjusted opposing flow rate, Vo (veh/h)		468		
Lost time for LT lane group, tL		6.00		
Computation				
LT volume per cycle, LTC=VLTC/3600		0.98		
Opposing lane util. factor, fLUo	0.952	0.952		
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		7.51		
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g		0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.65		
gq, (see Exhibit C16-4,5,6,7,8)		11.23		
gu=g-gq if gq>=gf, or = g-gf if gq<gf		30.77		
n=Max(gq-gf)/2,0)		5.61		
PTHo=1-PLTo		1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00		
EL1 (refer to Exhibit C16-3)		2.18		
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.10		
gdiff=max(gq-gf,0)		0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.34		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.337		

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 110.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT		0.000	0.000	
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo		0.952	0.952	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 110.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v		32		
v/c ratio from Capacity Worksheet, X		0.04		
Protected phase effective green interval, g (s)		40.0		
Opposing queue effective green interval, gq		11.23		
Unopposed green interval, gu		30.77		
Red time r=(C-g-gq-gu)		28.0		
Arrival rate, qa=v/(3600(max[X,1.0]))		0.01		
Protected ph. departure rate, Sp=s/3600		0.501		
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)		0.24		
XPerm		0.05		
XProt		0.03		
Case		1		
Queue at beginning of green arrow, Qa		0.25		
Queue at beginning of unsaturated green, Qu		0.10		
Residual queue, Qr		0.00		
Uniform Delay, d1		4.2		

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Dur. Unmet Demand Q veh	Unmet Demand t hrs.	Uniform Delay Unadj. ds	Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 15.4 sec/veh Intersection LOS B

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	T		L	T	L	R		
Init Queue	0.0		0.0	0.0	0.0	0.0		
Flow Rate	245		32	240	8	5		
So	2000		1900	2000	1900	1900		
No.Lanes	2	0	1	2 0	2 0	1	0 0	0
SL	1904		1208	1886	1805	1615		
LnCapacity	675		900	1406	262	910		
Flow Ratio	0.13		0.03	0.13	0.00	0.00		
v/c Ratio	0.36		0.04	0.17	0.03	0.01		
Grn Ratio	0.35		0.75	0.75	0.15	0.56		
I Factor	1.000			1.000	1.000			
AT or PVG	3		3	3	3	3		
Pltn Ratio	1.00		1.00	1.00	1.00	1.00		
PF2	1.00		1.00	1.00	1.00	1.00		
Q1	5.5		0.3	2.1	0.2	0.1		
kB	0.6		0.7	1.0	0.3	0.7		
Q2	0.3		0.0	0.2	0.0	0.0		
Q Average	5.9		0.3	2.3	0.2	0.1		
Q Spacing	25.0		25.0	25.0	25.0	25.0		
Q Storage	0		0	0	0	0		
Q S Ratio								
70th Percentile Output:								
fB%	1.2		1.2	1.2	1.2	1.2		
BOQ	7.0		0.3	2.8	0.3	0.1		
QSRatio								
85th Percentile Output:								
fB%	1.5		1.6	1.6	1.6	1.6		
BOQ	9.1		0.4	3.7	0.4	0.1		
QSRatio								
90th Percentile Output:								
fB%	1.7		1.8	1.8	1.8	1.8		
BOQ	10.0		0.5	4.1	0.4	0.1		
QSRatio								
95th Percentile Output:								
fB%	1.9		2.1	2.0	2.1	2.1		
BOQ	11.4		0.6	4.7	0.5	0.1		
QSRatio								
98th Percentile Output:								
fB%	2.3		2.7	2.5	2.7	2.7		
BOQ	13.8		0.7	5.9	0.6	0.2		
QSRatio								

ERROR MESSAGES

No errors to report.

HCS2000: Unsignalized Intersections Release 4.1d

TWO-WAY STOP CONTROL SUMMARY

Analyst: md
Agency/Co.:
Date Performed: 12/15/2004
Analysis Time Period: am
Intersection: STH 158/Eastern Frontage Road
Jurisdiction: WisDOT
Units: U. S. Customary
Analysis Year: 2017
Project ID: 2017 Background Traffic - With Improvements
East/West Street: STH 158
North/South Street: Frontage Road
Intersection Orientation: EW
Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1 L	2 T	3 R	4 L	5 T	6 R
Volume	1	730	1	1	705	10
Peak-Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate, HFR	1	730	1	1	705	10
Percent Heavy Vehicles	0	--	--	0	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						No
Lanes	1 L	2 T	0 TR	1 L	2 T	1 R
Configuration					No	
Upstream Signal?		No				

Minor Street: Approach	Northbound			Southbound		
Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume	50	10	55	10	1	10
Peak Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate, HFR	50	10	55	10	1	10
Percent Heavy Vehicles	0	0	0	0	0	0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No /			No /
Lanes	1 L	1	0 TR	1 L	1	0 TR
Configuration						

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound		Southbound	
Movement	1	4	7	8	9	10	11	12
Lane Config	L	L	L		TR	L		TR
v (vph)	1	1	50		65	10		11
C(m) (vph)	895	883	169		401	150		481
v/c	0.00	0.00	0.30		0.16	0.07		0.02
95% queue length	0.00	0.00	1.17		0.57	0.21		0.07
Control Delay	9.0	9.1	35.0+		15.7	30.7		12.7
LOS	A	A	E		C	D		B
Approach Delay				24.1			21.3	
Approach LOS				C			C	

HCS2000: Unsignalized Intersections Release 4.1d

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TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 12/15/2004
Analysis Time Period: am
Intersection: STH 158/Eastern Frontage Road
Jurisdiction: WisDOT
Units: U. S. Customary
Analysis Year: 2017
Project ID: 2017 Background Traffic - With Improvements
East/West Street: STH 158
North/South Street: Frontage Road
Intersection Orientation: EW
Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume	1	730	1	1	705	10
Peak-Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Peak-15 Minute Volume	0	182	0	0	176	2
Hourly Flow Rate, HFR	1	730	1	1	705	10
Percent Heavy Vehicles	0	--	--	0	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						No
Lanes	1 L	2 T	0 TR	1 L	2 T	1 R
Configuration		No			No	
Upstream Signal?						

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume	50	10	55	10	1	10
Peak Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Peak-15 Minute Volume	12	2	14	2	0	2
Hourly Flow Rate, HFR	50	10	55	10	1	10
Percent Heavy Vehicles	0	0	0	0	0	0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No /			No /
RT Channelized?						
Lanes	1 L	1	0 TR	1 L	1	0 TR
Configuration						

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn							
Through							
S5 Left-Turn							
Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1	4.1	7.5	6.5	6.9	7.5	6.5	6.9
t(c,hv)		2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
P(hv)		0	0	0	0	0	0	0	0
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Grade/100				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage	4.1	4.1	7.5	6.5	6.9	7.5	6.5	6.9
	2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20	2.20	3.50	4.00	3.30	3.50	4.00	3.30
t(f,HV)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(HV)	0	0	0	0	0	0	0	0
t(f)	2.2	2.2	3.5	4.0	3.3	3.5	4.0	3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2 V(t)	Movement 2 V(l,prot)	Movement 5 V(t)	Movement 5 V(l,prot)
V prog				
Total Saturation Flow Rate, s (vph)				
Arrival Type				
Effective Green, g (sec)				
Cycle Length, C (sec)				
Rp (from Exhibit 16-11)				
Proportion vehicles arriving on green P				
g(q1)				
g(q2)				
g(q)				

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2 V(t)	Movement 2 V(l,prot)	Movement 5 V(t)	Movement 5 V(l,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p		0.000		0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x	715	731	1086	1449	366	1079	1440	352
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
a		3000		3000		3000		3000
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	366	352
Potential Capacity	637	650
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	637	650
Probability of Queue free St.	0.91	0.98

Step 2: LT from Major St.	4	1
Conflicting Flows	731	715
Potential Capacity	883	895
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	883	895
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows	1449	1440
Potential Capacity	132	134
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	132	134
Probability of Queue free St.	0.92	0.99

Step 4: LT from Minor St.	7	10
Conflicting Flows	1086	1079
Potential Capacity	173	175
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.99	0.92
Maj. L, Min T Adj. Imp Factor.	0.99	0.94
Cap. Adj. factor due to Impeding mvmnt	0.98	0.86
Movement Capacity	169	150

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	1449	1440
Potential Capacity	132	134
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	132	134
Result for 2 stage process:		
a		
y		
C t	132	134
Probability of Queue free St.	0.92	0.99

Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	1086	1079
Potential Capacity	173	175
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.99	0.92
Maj. L, Min T Adj. Imp Factor.	0.99	0.94
Cap. Adj. factor due to Impeding mvmnt	0.98	0.86
Movement Capacity	169	150
Results for Two-stage process:		
a		
y		
C t	169	150

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	50	10	55	10	1	10
Movement Capacity (vph)	169	132	637	150	134	650
Shared Lane Capacity (vph)			401			481

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	169	132	637	150	134	650
Volume	50	10	55	10	1	10
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh			401			481
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	L	L	L		TR	L		TR
v (vph)	1	1	50		65	10		11
C(m) (vph)	895	883	169		401	150		481
v/c	0.00	0.00	0.30		0.16	0.07		0.02
95% queue length	0.00	0.00	1.17		0.57	0.21		0.07
Control Delay	9.0	9.1	35.0+		15.7	30.7		12.7
LOS	A	A	E		C	D		B
Approach Delay				24.1			21.3	
Approach LOS				C			C	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4	9.0	9.1
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS2000: Unsignalized Intersections Release 4.1d

TWO-WAY STOP CONTROL SUMMARY

Analyst: md
Agency/Co.:
Date Performed: 12/15/2004
Analysis Time Period: pm
Intersection: STH 158/Eastern Frontage Road
Jurisdiction: WisDOT
Units: U. S. Customary
Analysis Year: 2017
Project ID: 2017 Background Traffic - With Improvements
East/West Street: STH 158
North/South Street: Frontage Road
Intersection Orientation: EW
Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1 L	2 T	3 R	4 L	5 T	6 R
Volume	1	870	1	1	505	25
Peak-Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate, HFR	1	870	1	1	505	25
Percent Heavy Vehicles	0	--	--	0	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						No
Lanes	1 L	2 T	0 TR	1 L	2 T	1 R
Configuration						
Upstream Signal?		No			No	

Minor Street: Approach	Northbound			Southbound		
Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume	105	25	65	10	1	10
Peak Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate, HFR	105	25	65	10	1	10
Percent Heavy Vehicles	0	0	0	0	0	0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No /			No /
Lanes	1 L	1	0 TR	1 L	1	0 TR
Configuration						

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	L	L	L		TR	L		TR
v (vph)	1	1	105		90	10		11
C(m) (vph)	1048	783	159		310	164		547
v/c	0.00	0.00	0.66		0.29	0.06		0.02
95% queue length	0.00	0.00	3.75		1.18	0.19		0.06
Control Delay	8.4	9.6	63.3		21.3	28.4		11.7
LOS	A	A	F		C	D		B
Approach Delay				43.9			19.6	
Approach LOS				E			C	

HCS2000: Unsignalized Intersections Release 4.1d

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TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 12/15/2004
Analysis Time Period: pm
Intersection: STH 158/Eastern Frontage Road
Jurisdiction: WisDOT
Units: U. S. Customary
Analysis Year: 2017
Project ID: 2017 Background Traffic - With Improvements
East/West Street: STH 158
North/South Street: Frontage Road
Intersection Orientation: EW
Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume	1	870	1	1	505	25
Peak-Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Peak-15 Minute Volume	0	218	0	0	126	6
Hourly Flow Rate, HFR	1	870	1	1	505	25
Percent Heavy Vehicles	0	--	--	0	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						No
Lanes	1 L	2 T	0 TR	1 L	2 T	1 R
Configuration		No			No	
Upstream Signal?						

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume	105	25	65	10	1	10
Peak Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Peak-15 Minute Volume	26	6	16	2	0	2
Hourly Flow Rate, HFR	105	25	65	10	1	10
Percent Heavy Vehicles	0	0	0	0	0	0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No /			No /
RT Channelized?						
Lanes	1 L	1	0 TR	1 L	1	0 TR
Configuration						

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn							
Through							
S5 Left-Turn							
Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1	4.1	7.5	6.5	6.9	7.5	6.5	6.9
t(c,hv)		2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
P(hv)		0	0	0	0	0	0	0	0
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Grade/100				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage	4.1	4.1	7.5	6.5	6.9	7.5	6.5	6.9
	2-stage								

Follow-Up Time Calculations Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20	2.20	3.50	4.00	3.30	3.50	4.00	3.30
t(f,HV)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(HV)	0	0	0	0	0	0	0	0
t(f)	2.2	2.2	3.5	4.0	3.3	3.5	4.0	3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal	Movement 2 V(t)	Movement 2 V(1,prot)	Movement 5 V(t)	Movement 5 V(1,prot)
V prog				
Total Saturation Flow Rate, s (vph)				
Arrival Type				
Effective Green, g (sec)				
Cycle Length, C (sec)				
Rp (from Exhibit 16-11)				
Proportion vehicles arriving on green P				
g(q1)				
g(q2)				
g(q)				

Computation 2-Proportion of TWSC Intersection Time blocked	Movement 2 V(t)	Movement 2 V(1,prot)	Movement 5 V(t)	Movement 5 V(1,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p		0.000		0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x	530	871	1126	1404	436	957	1380	252
s								
Px								
V c,u,x								

C r,x				
C plat,x				

Two-Stage Process	7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		3000		3000		3000		3000
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	436	252
Potential Capacity	574	754
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	574	754
Probability of Queue free St.	0.89	0.99

Step 2: LT from Major St.	4	1
Conflicting Flows	871	530
Potential Capacity	783	1048
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	783	1048
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows	1404	1380
Potential Capacity	141	146
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	141	146
Probability of Queue free St.	0.82	0.99

Step 4: LT from Minor St.	7	10
Conflicting Flows	1126	957
Potential Capacity	162	215
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.99	0.82
Maj. L, Min T Adj. Imp Factor.	0.99	0.86
Cap. Adj. factor due to Impeding mvmnt	0.98	0.76
Movement Capacity	159	164

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		

Part 3 - Single Stage		
Conflicting Flows	1404	1380
Potential Capacity	141	146
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	141	146

Result for 2 stage process:		
a		
y		
C t	141	146
Probability of Queue free St.	0.82	0.99

Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		

Part 3 - Single Stage		
Conflicting Flows	1126	957
Potential Capacity	162	215
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.99	0.82
Maj. L, Min T Adj. Imp Factor.	0.99	0.86
Cap. Adj. factor due to Impeding mvmnt	0.98	0.76
Movement Capacity	159	164

Results for Two-stage process:		
a		
y		
C t	159	164

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	105	25	65	10	1	10
Movement Capacity (vph)	159	141	574	164	146	754
Shared Lane Capacity (vph)			310			547

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	159	141	574	164	146	754
Volume	105	25	65	10	1	10
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh			310			547
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	L	L	L		TR	L		TR
v (vph)	1	1	105		90	10		11
C(m) (vph)	1048	783	159		310	164		547
v/c	0.00	0.00	0.66		0.29	0.06		0.02
95% queue length	0.00	0.00	3.75		1.18	0.19		0.06
Control Delay	8.4	9.6	63.3		21.3	28.4		11.7
LOS	A	A	F		C	D		B
Approach Delay				43.9			19.6	
Approach LOS				E			C	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4	8.4	9.6
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS2000: Unsignalized Intersections Release 4.1d

TWO-WAY STOP CONTROL SUMMARY

Analyst: md
Agency/Co.:
Date Performed: 12/15/2004
Analysis Time Period: am
Intersection: sth 158/i-94 nb interchange
Jurisdiction: wisdot
Units: U. S. Customary
Analysis Year: 2017
Project ID: 2017 Background Traffic - With Improvements
East/West Street: sth 158
North/South Street: i-94 nb interchange
Intersection Orientation: EW
Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1 L	2 T	3 R	4 L	5 T	6 R
Volume	25	530			445	320
Peak-Hour Factor, PHF	1.00	1.00			1.00	1.00
Hourly Flow Rate, HFR	25	530			445	320
Percent Heavy Vehicles	0	--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?						No
Lanes	1 L	2 T			2 T	1 R
Configuration						
Upstream Signal?		No			No	

Minor Street: Approach	Northbound			Southbound		
Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume	1	1				
Peak Hour Factor, PHF	1.00	1.00				
Hourly Flow Rate, HFR	1	1				
Percent Heavy Vehicles	0	0			0	
Percent Grade (%)		0				
Flared Approach: Exists?/Storage				/		/
Lanes	0	1				
Configuration		LT				

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	L		LT					
v (vph)	25		2					
C(m) (vph)	857		203					
v/c	0.03		0.01					
95% queue length	0.09		0.03					
Control Delay	9.3		22.9					
LOS	A		C					
Approach Delay				22.9				
Approach LOS				C				

HCS2000: Unsignalized Intersections Release 4.1d

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TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 12/15/2004
Analysis Time Period: am
Intersection: sth 158/i-94 nb interchange
Jurisdiction: wisdot
Units: U. S. Customary
Analysis Year: 2017
Project ID: 2017 Background Traffic - With Improvements
East/West Street: sth 158
North/South Street: i-94 nb interchange
Intersection Orientation: EW
Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume	25	530			445	320
Peak-Hour Factor, PHF	1.00	1.00			1.00	1.00
Peak-15 Minute Volume	6	132			111	80
Hourly Flow Rate, HFR	25	530			445	320
Percent Heavy Vehicles	0	--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?						No
Lanes	1 L	2 T			2 T	1 R
Configuration						
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume	1	1				
Peak Hour Factor, PHF	1.00	1.00				
Peak-15 Minute Volume	0	0				
Hourly Flow Rate, HFR	1	1				
Percent Heavy Vehicles	0	0			0	
Percent Grade (%)		0				
Flared Approach: Exists?/Storage				/		/
RT Channelized?						
Lanes	0	1				
Configuration		LT				

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn							
Through							
S5 Left-Turn							
Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1		7.5	6.5				
t(c,hv)		2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
P(hv)		0		0	0				
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Grade/100				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00		0.70	0.00				
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage	4.1		6.8	6.5				
	2-stage								

Follow-Up Time Calculations Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20		3.50	4.00				
t(f,HV)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(HV)	0		0	0				
t(f)	2.2		3.5	4.0				

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2 V(t)	Movement 2 V(1,prot)	Movement 5 V(t)	Movement 5 V(1,prot)
V prog				
Total Saturation Flow Rate, s (vph)				
Arrival Type				
Effective Green, g (sec)				
Cycle Length, C (sec)				
Rp (from Exhibit 16-11)				
Proportion vehicles arriving on green P				
g(q1)				
g(q2)				
g(q)				

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2 V(t)	Movement 2 V(1,prot)	Movement 5 V(t)	Movement 5 V(1,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p		0.000		0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x	765		802	1345				
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		3000		3000				
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 2: LT from Major St.	4	1
Conflicting Flows		765
Potential Capacity		857
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		857
Probability of Queue free St.	1.00	0.97
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows	1345	
Potential Capacity	153	
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.97	0.97
Movement Capacity	149	
Probability of Queue free St.	0.99	1.00

Step 4: LT from Minor St.	7	10
Conflicting Flows	802	
Potential Capacity	326	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.96
Maj. L, Min T Adj. Imp Factor.		0.97
Cap. Adj. factor due to Impeding mvmnt	0.97	0.97
Movement Capacity	316	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	1345	
Potential Capacity	153	
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.97	0.97
Movement Capacity	149	
Result for 2 stage process:		
a		
y		
C t	149	
Probability of Queue free St.	0.99	1.00

Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	802	
Potential Capacity	326	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.96
Maj. L, Min T Adj. Imp Factor.		0.97
Cap. Adj. factor due to Impeding mvmnt	0.97	0.97
Movement Capacity	316	
Results for Two-stage process:		
a		
y		
C t	316	

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	1	1				
Movement Capacity (vph)	316	149				
Shared Lane Capacity (vph)	203					

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	316	149				
Volume	1	1				
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh	203					
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	L		LT					
v (vph)	25		2					
C(m) (vph)	857		203					
v/c	0.03		0.01					
95% queue length	0.09		0.03					
Control Delay	9.3		22.9					
LOS	A		C					
Approach Delay				22.9				
Approach LOS				C				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.97	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4	9.3	
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS2000: Unsignalized Intersections Release 4.1d

TWO-WAY STOP CONTROL SUMMARY

Analyst: md
Agency/Co.:
Date Performed: 12/15/2004
Analysis Time Period: pm
Intersection: sth 158/i-94 nb interchange
Jurisdiction: wisdot
Units: U. S. Customary
Analysis Year: 2017
Project ID: 2017 Background Traffic - With Improvements455
East/West Street: sth 158
North/South Street: i-94 nb interchange
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound				Westbound	
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	15	455			295	325
Peak-Hour Factor, PHF	1.00	1.00			1.00	1.00
Hourly Flow Rate, HFR	15	455			295	325
Percent Heavy Vehicles	0	--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?					No	
Lanes	1	2			2	1
Configuration	L	T			T	R
Upstream Signal?		No			No	

Minor Street: Approach	Northbound				Southbound	
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	1	1				
Peak Hour Factor, PHF	1.00	1.00				
Hourly Flow Rate, HFR	1	1				
Percent Heavy Vehicles	0	0				
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		/
Lanes	0	1				
Configuration		LT				

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	L		LT					
v (vph)	15		2					
C(m) (vph)	970		278					
v/c	0.02		0.01					
95% queue length	0.05		0.02					
Control Delay	8.8		18.0					
LOS	A		C					
Approach Delay				18.0				
Approach LOS				C				

HCS2000: Unsignalized Intersections Release 4.1d

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TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 12/15/2004
Analysis Time Period: pm
Intersection: sth 158/i-94 nb interchange
Jurisdiction: wisdot
Units: U. S. Customary
Analysis Year: 2017
Project ID: 2017 Background Traffic - With Improvements455
East/West Street: sth 158
North/South Street: i-94 nb interchange
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	15	455			295	325
Peak-Hour Factor, PHF	1.00	1.00			1.00	1.00
Peak-15 Minute Volume	4	114			74	81
Hourly Flow Rate, HFR	15	455			295	325
Percent Heavy Vehicles	0	--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?					No	
Lanes	1	2			2	1
Configuration	L	T			T	R
Upstream Signal?		No			No	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	1	1				
Peak Hour Factor, PHF	1.00	1.00				
Peak-15 Minute Volume	0	0				
Hourly Flow Rate, HFR	1	1				
Percent Heavy Vehicles	0	0				
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		/
RT Channelized?						
Lanes	0	1				
Configuration		LT				

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

		Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2	Left-Turn							
	Through							
S5	Left-Turn							
	Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1	4	7	8	9	10	11	12
		L	L	L	T	R	L	T	R
t(c,base)		4.1		7.5	6.5				
t(c,hv)		2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
P(hv)		0		0	0				
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Grade/100				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00		0.70	0.00				
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage	4.1		6.8	6.5				
	2-stage								

Follow-Up Time Calculations

Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)	2.20		3.50	4.00				
t(f,HV)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(HV)	0		0	0				
t(f)	2.2		3.5	4.0				

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(1,prot)	V(t)	V(1,prot)
V prog				
Total Saturation Flow Rate, s (vph)				
Arrival Type				
Effective Green, g (sec)				
Cycle Length, C (sec)				
Rp (from Exhibit 16-11)				
Proportion vehicles arriving on green P				
g(q1)				
g(q2)				
g(q)				

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2		Movement 5	
	V(t)	V(1,prot)	V(t)	V(1,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p	0.000		0.000	

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5

Single-Stage Process

Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
V c,x	620		632	1105				
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process

	7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		3000		3000				
P(x)								
V(c,u,x)								
C(f,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 2: LT from Major St.	4	1
Conflicting Flows		620
Potential Capacity		970
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		970
Probability of Queue free St.	1.00	0.98
Maj L-Shared Prob Q free St.		
Step 3: TH from Minor St.	8	11
Conflicting Flows	1105	
Potential Capacity	213	
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.98	0.98
Movement Capacity	210	
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows	632	
Potential Capacity	417	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.98
Maj. L, Min T Adj. Imp Factor.		0.98
Cap. Adj. factor due to Impeding mvmnt	0.98	0.98
Movement Capacity	411	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	1105	
Potential Capacity	213	
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.98	0.98
Movement Capacity	210	
Result for 2 stage process:		
a		
y		
C t	210	
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	632	
Potential Capacity	417	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.98
Maj. L, Min T Adj. Imp Factor.		0.98
Cap. Adj. factor due to Impeding mvmnt	0.98	0.98
Movement Capacity	411	
Results for Two-stage process:		
a		
y		
C t	411	

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	1	1				
Movement Capacity (vph)	411	210				
Shared Lane Capacity (vph)	278					

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	411	210				
Volume	1	1				
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh	278					
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	L		LT					
v (vph)	15		2					
C(m) (vph)	970		278					
v/c	0.02		0.01					
95% queue length	0.05		0.02					
Control Delay	8.8		18.0					
LOS	A		C					
Approach Delay				18.0				
Approach LOS				C				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.98	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4	8.8	
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS2000: Signalized Intersections Release 4.1e

Analyst: md
Agency:
Date: 12/15/2004
Period: am
Project ID: 2017 background traffic - with improvements
E/W St: sth 158

Inter.: sth 158/I-94 SB Interchange
Area Type: All other areas
Jurisd: WisDOT
Year : 2017
N/S St: I-94 SB Intechange

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	1	1	2	0	0	0	0	1	1	0
LGConfig		T	R	L	T					L	LTR	
Volume		125	15	350	95					430	2	40
Lane Width		12.0	12.0	12.0	12.0					12.0	12.0	
RTOR Vol			0									0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left			
Thru		A			Thru			
Right		A			Right			
Peds					Peds			
WB Left	A	A			SB Left	A		
Thru	A	A			Thru	A		
Right					Right	A		
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	40.0	9.0				35.0		
Yellow	3.0	4.5				4.5		
All Red	0.0	2.0				2.0		

Cycle Length: 100.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
T	333	3697	0.40	0.09	43.7	D	43.6	D
R	141	1568	0.11	0.09	42.2	D		
Westbound								
L	775	1752	0.48	0.52	15.4	B		
T	1784	3431	0.06	0.52	11.9	B	14.6	B
Northbound								
Southbound								
L	569	1626	0.44	0.35	25.5	C		
LTR	568	1623	0.44	0.35	25.5	C	25.5	C

Intersection Delay = 23.3 (sec/veh) Intersection LOS = C

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 12/15/2004
Analysis Time Period: am
Intersection: sth 158/I-94 SB Interchange
Area Type: All other areas
Jurisdiction: WisDOT
Analysis Year: 2017
Project ID: 2017 background traffic - with improvements
East/West Street: sth 158
North/South Street: I-94 SB Intechange

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume		125	15	350	95					430	2	40
% Heavy Veh		3	3	3	11					11	3	3
PHF		0.94	0.94	0.94	0.94					0.94	0.94	0.94
PK 15 Vol		33	4	93	25					114	1	11
Hi Ln Vol												
% Grade		0			0						0	
Ideal Sat		2000	1900	1900	2000					1900	1900	
ParkExist												
NumPark												
No. Lanes	0	2	1	1	2	0	0	0	0	1	1	0
LGConfig		T	R	L	T					L	LTR	
Lane Width		12.0	12.0	12.0	12.0					12.0	12.0	
RTOR Vol			0									0
Adj Flow		133	16	372	101					251	251	
%InSharedLn										45		
Prop LTs		0.000		1.000	0.000						0.819	
Prop RTs		0.000	1.000		0.000						0.171	
Peds Bikes		0					0				0	
Buses		0	0	0	0					0	0	
%InProtPhase				0.0								

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0	0.0	0.0	0.0					0.0	0.0	
Arriv. Type		3	3	3	3					3	3	
Unit Ext.		3.0	3.0	3.0	3.0					3.0	3.0	
I Factor		1.000			1.000						1.000	
Lost Time		2.0	2.0	2.0	2.0					2.0	2.0	
Ext of g		2.0	2.0	2.0	2.0					2.0	2.0	
Ped Min g		3.2						3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left			
Thru		A			Thru			
Right		A			Right			
Peds					Peds			
WB Left	A	A			SB Left	A		
Thru	A	A			Thru	A		
Right					Right	A		
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	40.0	9.0				35.0		
Yellow	3.0	4.5				4.5		
All Red	0.0	2.0				2.0		

Cycle Length: 100.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V		125	15	350	95					430	2	40
PHF		0.94	0.94	0.94	0.94					0.94	0.94	0.94
Adj flow		133	16	372	101					457	2	43
No. Lanes	0	2	1	1	2	0	0	0	0	1	1	0
Lane group		T	R	L	T					L	LTR	
Adj flow		133	16	372	101					251	251	
Prop LTs		0.000		1.000	0.000						0.819	
Prop RTs		0.000	1.000		0.000					0.171		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound T	Eastbound R	Westbound L	Westbound T	Northbound			Southbound L	Southbound LTR	
So	2000	1900	1900	2000				1900	1900	
Lanes	0 2	1	1	2	0	0	0	0 1	1	0
fW	1.000	1.000	1.000	1.000				1.000	1.000	
fHV	0.971	0.971	0.971	0.901				0.901	0.913	
fG	1.000	1.000	1.000	1.000				1.000	1.000	
fP	1.000	1.000	1.000	1.000				1.000	1.000	
fBB	1.000	1.000	1.000	1.000				1.000	1.000	
fA	1.000	1.000	1.000	1.000				1.000	1.000	
fLU	0.952	1.000	1.000	0.952				1.000	1.000	
fRT	1.000	0.850		1.000					0.974	
fLT	1.000		0.950	1.000				0.950	0.961	
Sec.			0.333							
fLpb	1.000		1.000	1.000				1.000	1.000	
fRpb	1.000	1.000		1.000					1.000	
S	3697	1568	1752	3431				1626	1623	
Sec.			615							

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	133	3697	# 0.04	0.09	333	0.40
Right	R	16	1568	0.01	0.09	141	0.11
Westbound							
Prot		372	1752	# 0.21	0.400	701	0.53
Perm		0	615	0.00	0.120	74	0.00
Left	L	372			0.52	775	0.48
Prot							
Perm							
Thru	T	101	3431	0.03	0.52	1784	0.06
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Southbound							
Prot							
Perm							
Left	L	251	1626	0.15	0.35	569	0.44
Prot							
Perm							
Thru	LTR	251	1623	# 0.15	0.35	568	0.44
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.40
Total lost time per cycle, L = 19.50 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.50

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
T	0.40	0.09	42.9	1.000	333	0.11	0.8	0.0	43.7	D	43.6	D
R	0.11	0.09	41.8	1.000	141	0.11	0.4	0.0	42.2	D		
Westbound												
L	0.48	0.52	14.9	1.000	775	0.11	0.5	0.0	15.4	B		
T	0.06	0.52	11.9	1.000	1784	0.11	0.0	0.0	11.9	B	14.6	B
Northbound												
Southbound												
L	0.44	0.35	25.0	1.000	569	0.11	0.5	0.0	25.5	C		

LTR 0.44 0.35 25.0 1.000 568 0.11 0.6 0.0 25.5 C 25.5 C

Intersection delay = 23.3 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach		M		
Cycle length, C 100.0 sec				
Total actual green time for LT lane group, G (s)		52.0		
Effective permitted green time for LT lane group, g(s)		12.0		
Opposing effective green time, go (s)		9.0		
Number of lanes in LT lane group, N		1		
Number of lanes in opposing approach, No		2		
Adjusted LT flow rate, VLT (veh/h)		372		
Proportion of LT in LT lane group, PLT		1.000		
Proportion of LT in opposing flow, PLTo		0.00		
Adjusted opposing flow rate, Vo (veh/h)		133		
Lost time for LT lane group, tL		6.50		
Computation				
LT volume per cycle, LTC=VLTC/3600		10.33		
Opposing lane util. factor, fLUo	0.952	0.952	1.000	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		1.94		
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g		0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.91		
gq, (see Exhibit C16-4,5,6,7,8)		6.50		
gu=g-gq if gq>=gf, or = g-gf if gq<gf		5.50		
n=Max(gq-gf)/2,0)		3.25		
PTHo=1-PLTo		1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00		
EL1 (refer to Exhibit C16-3)		1.58		
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.33		
gdiff=max(gq-gf,0)		0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.33		

flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)
or flt=[fm+0.91(N-1)]/N**

Left-turn adjustment, fLT		0.333		

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 100.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000		0.819
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	0.952	0.952	1.000	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				

flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)
or flt=[fm+0.91(N-1)]/N**

Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				

Permitted Right Turns

Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 100.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v		372		
v/c ratio from Capacity Worksheet, X		0.48		
Protected phase effective green interval, g (s)		40.0		
Opposing queue effective green interval, gq		6.50		
Unopposed green interval, gu		5.50		
Red time r=(C-g-gq-gu)		48.0		
Arrival rate, qa=v/(3600(max[X,1.0]))		0.10		
Protected ph. departure rate, Sp=s/3600		0.487		
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)		0.37		
XPerm		0.60		
XProt		0.47		
Case		1		
Queue at beginning of green arrow, Qa		4.96		
Queue at beginning of unsaturated green, Qu		0.67		
Residual queue, Qr		0.00		
Uniform Delay, d1		14.9		

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Dur. Unmet Demand Q veh	Unmet Demand t hrs.	Uniform Delay Unadj. ds	Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 23.3 sec/veh Intersection LOS C

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound			Northbound			Southbound		
LaneGroup	T	R	L	T					L	LTR	
Init Queue	0.0	0.0	0.0	0.0					0.0	0.0	
Flow Rate	69	16	372	53					251	251	
So	2000	1900	1900	2000					1900	1900	
No.Lanes	2	1	1	2	0	0	0	0	1	1	0
SL	1941	1568	1490	1801					1626	1623	
LnCapacity	174	141	775	936					569	568	
Flow Ratio	0.04	0.01	0.25	0.03					0.15	0.15	
v/c Ratio	0.40	0.11	0.48	0.06					0.44	0.44	
Grn Ratio	0.09	0.09	0.52	0.52					0.35	0.35	
I Factor	1.000			1.000						1.000	
AT or PVG	3	3	3	3					3	3	
Pltn Ratio	1.00	1.00	1.00	1.00					1.00	1.00	
PF2	1.00	1.00	1.00	1.00					1.00	1.00	
Q1	1.8	0.4	6.1	0.7					5.4	5.4	
kB	0.3	0.2	0.6	0.7					0.5	0.5	
Q2	0.2	0.0	0.6	0.0					0.4	0.4	
Q Average	2.0	0.4	6.7	0.8					5.8	5.8	
Q Spacing	25.0	25.0	25.0	25.0					25.0	25.0	
Q Storage	0	0	0	0					0	0	
Q S Ratio											
70th Percentile Output:											
fB%	1.2	1.2	1.2	1.2					1.2	1.2	
BOQ	2.4	0.5	8.0	0.9					6.8	6.8	
QSRatio											
85th Percentile Output:											
fB%	1.6	1.6	1.5	1.6					1.5	1.5	
BOQ	3.1	0.7	10.3	1.2					8.9	8.9	
QSRatio											
90th Percentile Output:											
fB%	1.8	1.8	1.7	1.8					1.7	1.7	
BOQ	3.5	0.8	11.3	1.4					9.8	9.8	
QSRatio											
95th Percentile Output:											
fB%	2.0	2.1	1.9	2.1					1.9	1.9	
BOQ	4.0	0.9	12.8	1.6					11.2	11.2	
QSRatio											
98th Percentile Output:											
fB%	2.6	2.7	2.3	2.6					2.3	2.3	
BOQ	5.1	1.2	15.4	2.0					13.5	13.5	
QSRatio											

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: md
Agency:
Date: 12/15/2004
Period: pm
Project ID: 2017 background traffic - with improvements
E/W St: sth 158

Inter.: sth 158/I-94 SB Interchange
Area Type: All other areas
Jurisd: WisDOT
Year : 2017
N/S St: I-94 SB Intechange

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	1	1	2	0	0	0	0	1	1	0
LGConfig		T	R	L	T					L	LTR	
Volume		90	15	140	155					385	5	85
Lane Width		12.0	12.0	12.0	12.0					12.0	12.0	
RTOR Vol			0									0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left					NB Left				
Thru		A			Thru				
Right		A			Right				
Peds					Peds				
WB Left	A	A			SB Left	A			
Thru	A	A			Thru	A			
Right					Right	A			
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	35.0	17.0				42.0			
Yellow	3.0	4.5				4.5			
All Red	0.0	2.0				2.0			

Cycle Length: 110.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
T	571	3697	0.19	0.15	40.6	D	40.5	D
R	242	1568	0.07	0.15	39.9	D		
Westbound								
L	698	1736	0.24	0.50	15.6	B		
T	1849	3697	0.10	0.50	14.5	B	15.0	B
Northbound								
Southbound								
L	663	1736	0.38	0.38	25.0	C		
LTR	645	1689	0.49	0.38	26.4	C	25.7	C

Intersection Delay = 23.9 (sec/veh) Intersection LOS = C

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 12/15/2004
Analysis Time Period: pm
Intersection: sth 158/I-94 SB Interchange
Area Type: All other areas
Jurisdiction: WisDOT
Analysis Year: 2017
Project ID: 2017 background traffic - with improvements
East/West Street: sth 158
North/South Street: I-94 SB Intechange

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume		90	15	140	155					385	5	85
% Heavy Veh		3	3	4	3					4	3	3
PHF		0.84	0.84	0.84	0.84					0.84	0.84	0.84
PK 15 Vol		27	4	42	46					115	2	25
Hi Ln Vol												
% Grade		0			0						0	
Ideal Sat		2000	1900	1900	2000					1900	1900	
ParkExist												
NumPark												
No. Lanes	0	2	1		1	2	0	0	0		1	1	0
LGConfig		T	R	L	T					L	LTR	
Lane Width		12.0	12.0	12.0	12.0					12.0	12.0	
RTOR Vol			0									0
Adj Flow		107	18	167	185					252	313	
%InSharedLn										45		
Prop LTs		0.000		1.000	0.000						0.658	
Prop RTs		0.000	1.000		0.000						0.323	
Peds Bikes	0						0				0	
Buses		0	0	0	0					0	0	
%InProtPhase				0.0								

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0	0.0	0.0	0.0					0.0	0.0	
Arriv. Type		3	3	3	3					3	3	
Unit Ext.		3.0	3.0	3.0	3.0					3.0	3.0	
I Factor		1.000			1.000						1.000	
Lost Time		2.0	2.0	2.0	2.0					2.0	2.0	
Ext of g		2.0	2.0	2.0	2.0					2.0	2.0	
Ped Min g		3.2						3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left					NB Left				
Thru		A			Thru				
Right		A			Right				
Peds					Peds				
WB Left	A	A			SB Left	A			
Thru	A	A			Thru	A			
Right					Right	A			
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	35.0	17.0				42.0			
Yellow	3.0	4.5				4.5			
All Red	0.0	2.0				2.0			

Cycle Length: 110.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V		90	15	140	155					385	5	85
PHF		0.84	0.84	0.84	0.84					0.84	0.84	0.84
Adj flow		107	18	167	185					458	6	101
No. Lanes	0	2	1		1	2	0	0	0		1	1	0
Lane group		T	R	L	T					L	LTR	
Adj flow		107	18	167	185					252	313	
Prop LTs		0.000		1.000	0.000						0.658	
Prop RTs		0.000	1.000		0.000						0.323	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound T	Eastbound R	Westbound L	Westbound T			Northbound			Southbound L	Southbound LTR	
So	2000	1900	1900	2000						1900	1900	
Lanes 0	2	1	1	2	0	0	0	0	0	1	1	0
fW	1.000	1.000	1.000	1.000						1.000	1.000	
fHV	0.971	0.971	0.962	0.971						0.962	0.965	
fG	1.000	1.000	1.000	1.000						1.000	1.000	
fP	1.000	1.000	1.000	1.000						1.000	1.000	
fBB	1.000	1.000	1.000	1.000						1.000	1.000	
fA	1.000	1.000	1.000	1.000						1.000	1.000	
fLU	0.952	1.000	1.000	0.952						1.000	1.000	
fRT	1.000	0.850		1.000							0.952	
fLT	1.000		0.950	1.000						0.950	0.968	
Sec.			0.439									
fLpb	1.000		1.000	1.000						1.000	1.000	
fRpb	1.000	1.000		1.000							1.000	
S	3697	1568	1736	3697						1736	1689	
Sec.			802									

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	107	3697	# 0.03	0.15	571	0.19
Right	R	18	1568	0.01	0.15	242	0.07
Westbound							
Prot		167	1736	# 0.10	0.318	552	0.30
Perm		0	802	0.00	0.182	146	0.00
Left	L	167			0.50	698	0.24
Prot							
Perm							
Thru	T	185	3697	0.05	0.50	1849	0.10
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Southbound							
Prot							
Perm							
Left	L	252	1736	0.15	0.38	663	0.38
Prot							
Perm							
Thru	LTR	313	1689	# 0.19	0.38	645	0.49
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.31
Total lost time per cycle, L = 19.50 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.38

Control Delay and LOS Determination

Appr/ Lane Grp	v/c	g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
T	0.19	0.15	40.5	1.000	571	0.11	0.2	0.0	40.6	D	40.5	D
R	0.07	0.15	39.8	1.000	242	0.11	0.1	0.0	39.9	D		
Westbound												
L	0.24	0.50	15.4	1.000	698	0.11	0.2	0.0	15.6	B		
T	0.10	0.50	14.5	1.000	1849	0.11	0.0	0.0	14.5	B	15.0	B
Northbound												
Southbound												
L	0.38	0.38	24.6	1.000	663	0.11	0.4	0.0	25.0	C		

LTR	0.49	0.38	25.8	1.000	645	0.11	0.6	0.0	26.4	C	25.7	C

Intersection delay = 23.9 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach		M		
Cycle length, C 110.0 sec				
Total actual green time for LT lane group, G (s)		55.0		
Effective permitted green time for LT lane group, g(s)		20.0		
Opposing effective green time, go (s)		17.0		
Number of lanes in LT lane group, N		1		
Number of lanes in opposing approach, No		2		
Adjusted LT flow rate, VLT (veh/h)		167		
Proportion of LT in LT lane group, PLT		1.000		
Proportion of LT in opposing flow, PLTo		0.00		
Adjusted opposing flow rate, Vo (veh/h)		107		
Lost time for LT lane group, tL		6.50		
Computation				
LT volume per cycle, LTC=VLTC/3600		5.10		
Opposing lane util. factor, fLUo	0.952	0.952	1.000	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		1.72		
gf=G[exp(- a * (LTC ** b)]-tl, gf<=g		0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.85		
gq, (see Exhibit C16-4,5,6,7,8)		6.50		
gu=g-gq if gq>=gf, or = g-gf if gq<gf		13.50		
n=Max(gq-gf)/2,0)		3.25		
PTHo=1-PLTo		1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00		
EL1 (refer to Exhibit C16-3)		1.54		
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.20		
gdiff=max(gq-gf,0)		0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.44		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.439		

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 110.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000		0.658
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	0.952	0.952	1.000	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b)]-tl, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				

Permitted Right Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 110.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v		167		
v/c ratio from Capacity Worksheet, X		0.24		
Protected phase effective green interval, g (s)		35.0		
Opposing queue effective green interval, gq		6.50		
Unopposed green interval, gu		13.50		
Red time r=(C-g-gq-gu)		55.0		
Arrival rate, qa=v/(3600(max(X,1.0)))		0.05		
Protected ph. departure rate, Sp=s/3600		0.482		
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)		0.33		
XPerm		0.21		
XProt		0.25		
Case		1		
Queue at beginning of green arrow, Qa		2.55		
Queue at beginning of unsaturated green, Qu		0.30		
Residual queue, Qr		0.00		
Uniform Delay, d1		15.4		

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Dur. Unmet Demand Q veh	Unmet Demand t hrs.	Uniform Delay Unadj. ds	Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 23.9 sec/veh Intersection LOS C

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound			Southbound	
LaneGroup	T	R	L	T				L	LTR
Init Queue	0.0	0.0	0.0	0.0				0.0	0.0
Flow Rate	56	18	167	97				252	313
So	2000	1900	1900	2000				1900	1900
No.Lanes	2	1	1	2	0	0	0	1	1 0
SL	1941	1568	1396	1941				1736	1689
LnCapacity	299	242	698	971				663	645
Flow Ratio	0.03	0.01	0.12	0.05				0.15	0.19
v/c Ratio	0.19	0.07	0.24	0.10				0.38	0.49
Grn Ratio	0.15	0.15	0.50	0.50				0.38	0.38
I Factor	1.000			1.000					1.000
AT or PVG	3	3	3	3				3	3
Pltn Ratio	1.00	1.00	1.00	1.00				1.00	1.00
PF2	1.00	1.00	1.00	1.00				1.00	1.00
Q1	1.5	0.5	2.8	1.6				5.6	7.3
kB	0.4	0.3	0.6	0.8				0.6	0.6
Q2	0.1	0.0	0.2	0.1				0.4	0.6
Q Average	1.6	0.5	3.0	1.6				5.9	7.8
Q Spacing	25.0	25.0	25.0	25.0				25.0	25.0
Q Storage	0	0	0	0				0	0
Q S Ratio									
70th Percentile Output:									
fB%	1.2	1.2	1.2	1.2				1.2	1.2
BOQ	1.9	0.6	3.5	2.0				7.0	9.2
QSRatio									
85th Percentile Output:									
fB%	1.6	1.6	1.6	1.6				1.5	1.5
BOQ	2.5	0.8	4.6	2.6				9.2	12.0
QSRatio									
90th Percentile Output:									
fB%	1.8	1.8	1.7	1.8				1.7	1.7
BOQ	2.8	0.9	5.2	2.9				10.1	13.1
QSRatio									
95th Percentile Output:									
fB%	2.0	2.1	2.0	2.0				1.9	1.9
BOQ	3.2	1.0	5.9	3.4				11.5	14.8
QSRatio									
98th Percentile Output:									
fB%	2.6	2.7	2.5	2.6				2.3	2.2
BOQ	4.1	1.3	7.4	4.2				13.9	17.6
QSRatio									

ERROR MESSAGES

No errors to report.

HCS2000: Unsignalized Intersections Release 4.1d

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ALL-WAY STOP CONTROL(AWSC) ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/5/2005
Analysis Time Period: am
Intersection: sth 158/western frontage road
Jurisdiction: wisdot
Units: U. S. Customary
Analysis Year: 2017
Project ID: 2017 Background Traffic - With Improvements
East/West Street: sth158
North/South Street: western frontage road

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	0	0	0	130	0	1	0	1	110	30	1	0
% Thrus Left Lane												

	Eastbound L1	Eastbound L2	Westbound L1	Westbound L2	Northbound L1	Northbound L2	Southbound L1	Southbound L2
Configuration			LR		TR		LT	
PHF			1.00		1.00		1.00	
Flow Rate			131		111		31	
% Heavy Veh			0		0		0	
No. Lanes			1		1		1	
Opposing-Lanes			0		1		1	
Conflicting-lanes			1		1		1	
Geometry group			1		1		1	

Duration, T 0.25 hrs.

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound L1	Eastbound L2	Westbound L1	Westbound L2	Northbound L1	Northbound L2	Southbound L1	Southbound L2
Flow Rates:								
Total in Lane			131		111		31	
Left-Turn			130		0		30	
Right-Turn			1		110		0	
Prop. Left-Turns			1.0		0.0		1.0	
Prop. Right-Turns			0.0		1.0		0.0	
Prop. Heavy Vehicle			0.0		0.0		0.0	
Geometry Group			1		1		1	
Adjustments Exhibit 17-33:								
hLT-adj			0.2		0.2		0.2	
hRT-adj			-0.6		-0.6		-0.6	
hHV-adj			1.7		1.7		1.7	
hadj, computed			0.2		-0.6		0.2	

Worksheet 4 - Departure Headway and Service Time

	Eastbound L1	Eastbound L2	Westbound L1	Westbound L2	Northbound L1	Northbound L2	Southbound L1	Southbound L2
Flow rate			131		111		31	
hd, initial value	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20
x, initial			0.12		0.10		0.03	
hd, final value			4.38		3.65		4.51	
x, final value			0.16		0.11		0.04	
Move-up time, m			2.0		2.0		2.0	
Service Time			2.4		1.7		2.5	

Worksheet 5 - Capacity and Level of Service

	Eastbound L1	Eastbound L2	Westbound L1	Westbound L2	Northbound L1	Northbound L2	Southbound L1	Southbound L2
Flow Rate			131		111		31	
Service Time			2.4		1.7		2.5	
Utilization, x			0.16		0.11		0.04	
Dep. headway, hd			4.38		3.65		4.51	
Capacity			381		361		281	
Delay			8.21		7.11		7.69	
LOS			A		A		A	
Approach:								
Delay			8.21		7.11		7.69	
LOS			A		A		A	

Intersection Delay 7.71 Intersection LOS A

HCS2000: Unsignalized Intersections Release 4.1d

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ALL-WAY STOP CONTROL(AWSC) ANALYSIS

Analyst: md
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Date Performed: 1/5/2005
Analysis Time Period: pm
Intersection: sth 158/western frontage road
Jurisdiction: wisdot
Units: U. S. Customary
Analysis Year: 2017
Project ID: 2017 Background Traffic - With Improvements
East/West Street: sth158
North/South Street: western frontage road

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	0	0	0	240	0	1	0	1	85	20	1	0

% Thrus Left Lane

	Eastbound L1	Eastbound L2	Westbound L1	Westbound L2	Northbound L1	Northbound L2	Southbound L1	Southbound L2
Configuration			LR		TR		LT	
PHF			1.00		1.00		1.00	
Flow Rate			241		86		21	
% Heavy Veh			0		0		0	
No. Lanes			1		1		1	
Opposing-Lanes			0		1		1	
Conflicting-lanes			1		1		1	
Geometry group			1		1		1	

Duration, T 0.25 hrs.

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound L1	Eastbound L2	Westbound L1	Westbound L2	Northbound L1	Northbound L2	Southbound L1	Southbound L2
Flow Rates:								
Total in Lane			241		86		21	
Left-Turn			240		0		20	
Right-Turn			1		85		0	
Prop. Left-Turns			1.0		0.0		1.0	
Prop. Right-Turns			0.0		1.0		0.0	
Prop. Heavy Vehicle			0.0		0.0		0.0	
Geometry Group			1		1		1	
Adjustments Exhibit 17-33:								
hLT-adj			0.2		0.2		0.2	
hRT-adj			-0.6		-0.6		-0.6	
hHV-adj			1.7		1.7		1.7	
hadj, computed			0.2		-0.6		0.2	

Worksheet 4 - Departure Headway and Service Time

	Eastbound L1	Eastbound L2	Westbound L1	Westbound L2	Northbound L1	Northbound L2	Southbound L1	Southbound L2
Flow rate			241		86		21	
hd, initial value	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20
x, initial			0.21		0.08		0.02	
hd, final value			4.33		3.90		4.75	
x, final value			0.29		0.09		0.03	
Move-up time, m			2.0		2.0		2.0	
Service Time			2.3		1.9		2.7	

Worksheet 5 - Capacity and Level of Service

	Eastbound L1	Eastbound L2	Westbound L1	Westbound L2	Northbound L1	Northbound L2	Southbound L1	Southbound L2
Flow Rate			241		86		21	
Service Time			2.3		1.9		2.7	
Utilization, x			0.29		0.09		0.03	
Dep. headway, hd			4.33		3.90		4.75	
Capacity			491		336		271	
Delay			9.08		7.30		7.88	
LOS			A		A		A	
Approach:								
Delay			9.08		7.30		7.88	
LOS			A		A		A	

Intersection Delay 8.57 Intersection LOS A

HCS2000: Signalized Intersections Release 4.1e

Analyst: md
Agency:
Date: 1/4/2005
Period: am
Project ID: 2017 background traffic - with improvements
E/W St: cth k

Inter.: cth k/104th ave
Area Type: All other areas
Jurisd: kenosha county
Year : 2017
N/S St: 104th ave

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	1	1	0	1	1	0	1	1	0
LGConfig	L	TR		L	TR		L	TR		L	TR	
Volume	15	185	40	100	130	15	5	125	95	5	150	25
Lane Width	12.0	12.0		12.0	12.0		12.0	12.0		12.0	12.0	
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A	A			NB Left	A	A		
Thru		A			Thru		A		
Right		A			Right		A		
Peds					Peds				
WB Left	A	A			SB Left	A	A		
Thru		A			Thru		A		
Right		A			Right		A		
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	7.0	35.0				7.0	33.0		
Yellow	3.0	4.5				3.0	4.5		
All Red	0.0	1.5				0.0	1.5		

Cycle Length: 100.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	490	1770	0.04	0.45	15.6	B		
TR	635	1813	0.45	0.35	25.6	C	24.9	C
Westbound								
L	405	1770	0.31	0.45	17.6	B		
TR	642	1834	0.29	0.35	23.7	C	21.2	C
Northbound								
L	431	1770	0.01	0.43	16.8	B		
TR	575	1742	0.48	0.33	27.3	C	27.1	C
Southbound								
L	385	1770	0.02	0.43	17.1	B		
TR	601	1822	0.37	0.33	25.9	C	25.7	C

Intersection Delay = 24.6 (sec/veh) Intersection LOS = C

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OPERATIONAL ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/4/2005
Analysis Time Period: am
Intersection: cth k/104th ave
Area Type: All other areas
Jurisdiction: kenosha county
Analysis Year: 2017
Project ID: 2017 background traffic - with improvements
East/West Street: cth k North/South Street: 104th ave

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	15	185	40	100	130	15	5	125	95	5	150	25
% Heavy Veh	2	2	2	2	2	2	2	2	2	2	2	2
PHF	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79
PK 15 Vol	5	59	13	32	41	5	2	40	30	2	47	8
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900		1900	1900		1900	1900		1900	1900	
ParkExist												
NumPark												
No. Lanes	1	1	0	1	1	0	1	1	0	1	1	0
LGConfig	L	TR		L	TR		L	TR		L	TR	
Lane Width	12.0	12.0		12.0	12.0		12.0	12.0		12.0	12.0	
RTOR Vol			0			0			0			0
Adj Flow	19	285		127	184		6	278		6	222	
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs	0.179			0.103			0.432			0.144		
Peds Bikes	0			0			0			0		
Buses	0	0		0	0		0	0		0	0	
%InProtPhase	0.0			0.0			0.0			0.0		

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Arriv. Type	3	3		3	3		3	3		3	3	
Unit Ext.	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Ext of g	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	

Ped Min g	3.2	3.2	3.2	3.2

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A	A			NB Left	A	A		
Thru		A			Thru		A		
Right		A			Right		A		
Peds					Peds				
WB Left	A	A			SB Left	A	A		
Thru		A			Thru		A		
Right		A			Right		A		
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	7.0	35.0				7.0	33.0		
Yellow	3.0	4.5				3.0	4.5		
All Red	0.0	1.5				0.0	1.5		

Cycle Length: 100.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	15	185	40	100	130	15	5	125	95	5	150	25
PHF	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79
Adj flow	19	234	51	127	165	19	6	158	120	6	190	32
No. Lanes	1	1	0	1	1	0	1	1	0	1	1	0
Lane group	L	TR		L	TR		L	TR		L	TR	
Adj flow	19	285		127	184		6	278		6	222	
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs	0.179			0.103			0.432			0.144		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L	TR		L	TR		L	TR		L	TR	
So	1900	1900		1900	1900		1900	1900		1900	1900	
Lanes	1	1	0	1	1	0	1	1	0	1	1	0
fW	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fHV	0.980	0.980		0.980	0.980		0.980	0.980		0.980	0.980	
fG	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fP	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fBB	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fA	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fLU	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fRT		0.973			0.985			0.935			0.978	
fLT	0.950	1.000		0.950	1.000		0.950	1.000		0.950	1.000	
Sec.	0.517			0.397			0.457			0.389		
fLpb	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fRpb		1.000			1.000			1.000			1.000	
S	1770	1813		1770	1834		1770	1742		1770	1822	
Sec.	962			739			852			724		

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		19	1770	0.01	0.070	124	0.15
Perm		0	962	0.00	0.380	366	0.00
Left	L	19			0.45	490	0.04
Prot							
Perm							
Thru	TR	285	1813	# 0.16	0.35	635	0.45
Right							
Westbound							
Prot		124	1770	# 0.07	0.070	124	1.00
Perm		3	739	0.00	0.380	281	0.01
Left	L	127			0.45	405	0.31
Prot							
Perm							
Thru	TR	184	1834	0.10	0.35	642	0.29
Right							
Northbound							
Prot		6	1770	0.00	0.070	124	0.05
Perm		0	852	0.00	0.360	307	0.00
Left	L	6			0.43	431	0.01
Prot							
Perm							
Thru	TR	278	1742	# 0.16	0.33	575	0.48
Right							
Southbound							
Prot		6	1770	# 0.00	0.070	124	0.05
Perm		0	724	0.00	0.360	261	0.00
Left	L	6			0.43	385	0.02
Prot							
Perm							
Thru	TR	222	1822	0.12	0.33	601	0.37
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.39
Total lost time per cycle, L = 24.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.51

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	0.04	0.45	15.6	1.000	490	0.11	0.0	0.0	15.6	B		
TR	0.45	0.35	25.1	1.000	635	0.11	0.5	0.0	25.6	C	24.9	C
Westbound												
L	0.31	0.45	17.1	1.000	405	0.11	0.4	0.0	17.6	B		
TR	0.29	0.35	23.5	1.000	642	0.11	0.2	0.0	23.7	C	21.2	C
Northbound												
L	0.01	0.43	16.7	1.000	431	0.11	0.0	0.0	16.8	B		
TR	0.48	0.33	26.7	1.000	575	0.11	0.6	0.0	27.3	C	27.1	C
Southbound												
L	0.02	0.43	17.1	1.000	385	0.11	0.0	0.0	17.1	B		

TR	0.37	0.33	25.6	1.000	601	0.11	0.4	0.0	25.9	C	25.7	C

Intersection delay = 24.6 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M	M	M
Cycle length, C 100.0 sec				
Total actual green time for LT lane group, G (s)	45.0	45.0	43.0	43.0
Effective permitted green time for LT lane group, g(s)	38.0	38.0	36.0	36.0
Opposing effective green time, go (s)	35.0	35.0	33.0	33.0
Number of lanes in LT lane group, N	1	1	1	1
Number of lanes in opposing approach, No	1	1	1	1
Adjusted LT flow rate, VLT (veh/h)	19	127	6	6
Proportion of LT in LT lane group, PLT	1.000	1.000	1.000	1.000
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	184	285	222	278
Lost time for LT lane group, tL	6.00	6.00	6.00	6.00
Computation				
LT volume per cycle, LTC=VLTC/3600	0.53	3.53	0.17	0.17
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	5.11	7.92	6.17	7.72
gf=G[exp(- a * (LTC ** b)]-tl, gf<=g	0.0	0.0	0.0	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.65	0.65	0.67	0.67
gq, (see Exhibit C16-4,5,6,7,8)	7.40	12.23	9.43	12.24
gu=g-gq if gq>=gf, or = g-gf if gq<gf	30.60	25.77	26.57	23.76
n=Max(gq-gf)/2,0)	3.70	6.11	4.71	6.12
PTHo=1-PLTo	1.00	1.00	1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00	1.00	1.00
EL1 (refer to Exhibit C16-3)	1.56	1.71	1.61	1.70
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.11	0.11	0.11	0.11
gdiff=max(gq-gf,0)	0.00	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.52	0.40	0.46	0.39
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.517	0.397	0.457	0.389

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 100.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000	0.000	0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b)]-tl, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 100.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v	19	127	6	6
v/c ratio from Capacity Worksheet, X	0.04	0.31	0.01	0.02
Protected phase effective green interval, g (s)	7.0	7.0	7.0	7.0
Opposing queue effective green interval, gq	7.40	12.23	9.43	12.24
Unopposed green interval, gu	30.60	25.77	26.57	23.76
Red time r=(C-g-gq-gu)	55.0	55.0	57.0	57.0
Arrival rate, qa=v/(3600(max[X,1.0]))	0.01	0.04	0.00	0.00
Protected ph. departure rate, Sp=s/3600	0.492	0.492	0.492	0.492
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.33	0.30	0.32	0.30
XPerm	0.02	0.17	0.01	0.01
XProt	0.10	0.64	0.03	0.03
Case	1	1	1	1
Queue at beginning of green arrow, Qa	0.29	1.94	0.09	0.09
Queue at beginning of unsaturated green, Qu	0.04	0.43	0.02	0.02
Residual queue, Qr	0.00	0.00	0.00	0.00
Uniform Delay, d1	15.6	17.1	16.7	17.1

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 24.6 sec/veh Intersection LOS C

BACK OF QUEUE WORKSHEET

LaneGroup	Eastbound L	Eastbound TR	Westbound L	Westbound TR	Northbound L	Northbound TR	Southbound L	Southbound TR
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	19	285	127	184	6	278	6	222
So	1900	1900	1900	1900	1900	1900	1900	1900
No.Lanes	1	1 0	1	1 0	1	1 0	1	1 0
SL	1088	1813	899	1834	1001	1742	894	1822
LnCapacity	490	635	405	642	431	575	385	601
Flow Ratio	0.02	0.16	0.14	0.10	0.01	0.16	0.01	0.12
v/c Ratio	0.04	0.45	0.31	0.29	0.01	0.48	0.02	0.37
Grn Ratio	0.45	0.35	0.45	0.35	0.43	0.33	0.43	0.33
I Factor		1.000		1.000		1.000		1.000
AT or PVG	3	3	3	3	3	3	3	3
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Q1	0.3	6.1	2.0	3.7	0.1	6.2	0.1	4.7
kB	0.5	0.6	0.4	0.6	0.4	0.5	0.4	0.5
Q2	0.0	0.5	0.2	0.2	0.0	0.5	0.0	0.3
Q Average	0.3	6.6	2.2	3.9	0.1	6.6	0.1	5.0
Q Spacing	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0
Q Storage	0	0	0	0	0	0	0	0
Q S Ratio								
70th Percentile Output:								
fB%	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
BOQ	0.4	7.8	2.6	4.7	0.1	7.9	0.1	6.0
QSRatio								
85th Percentile Output:								
fB%	1.6	1.5	1.6	1.6	1.6	1.5	1.6	1.6
BOQ	0.5	10.1	3.4	6.1	0.2	10.2	0.2	7.8
QSRatio								
90th Percentile Output:								
fB%	1.8	1.7	1.8	1.7	1.8	1.7	1.8	1.7
BOQ	0.6	11.1	3.8	6.8	0.2	11.2	0.2	8.6
QSRatio								
95th Percentile Output:								
fB%	2.1	1.9	2.0	2.0	2.1	1.9	2.1	2.0
BOQ	0.6	12.6	4.4	7.8	0.2	12.7	0.2	9.8
QSRatio								
98th Percentile Output:								
fB%	2.7	2.3	2.5	2.4	2.7	2.3	2.7	2.4
BOQ	0.8	15.1	5.5	9.6	0.3	15.3	0.3	11.9
QSRatio								

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: md
Agency:
Date: 1/4/2005
Period: pm
Project ID: 2017 background traffic - with improvements
E/W St: cth k

Inter.: cth k/104th ave
Area Type: All other areas
Jurisd: kenosha county
Year : 2017
N/S St: 104th ave

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	1	1	0	1	1	0	1	1	0
LGConfig	L	TR		L	TR		L	TR		L	TR	
Volume	15	250	25	90	250	30	20	160	110	15	125	30
Lane Width	12.0	12.0		12.0	12.0		12.0	12.0		12.0	12.0	
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4			5	6	7	8
EB Left	A	A			NB	Left	A	A		
Thru		A				Thru		A		
Right		A				Right		A		
Peds						Peds				
WB Left	A	A			SB	Left	A	A		
Thru		A				Thru		A		
Right		A				Right		A		
Peds										
NB Right					EB	Right				
SB Right					WB	Right				
Green	6.0	40.0					8.0	38.0		
Yellow	3.0	4.5					3.0	4.5		
All Red	0.0	1.5					0.0	1.5		

Cycle Length: 110.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	374	1770	0.04	0.45	18.1	B		
TR	668	1838	0.45	0.36	27.1	C	26.7	C
Westbound								
L	379	1770	0.26	0.45	19.3	B		
TR	667	1833	0.46	0.36	27.3	C	25.3	C
Northbound								
L	498	1770	0.04	0.45	17.4	B		
TR	604	1749	0.49	0.35	29.0	C	28.2	C
Southbound								
L	391	1770	0.04	0.45	18.0	B		
TR	625	1809	0.27	0.35	26.2	C	25.5	C

Intersection Delay = 26.5 (sec/veh) Intersection LOS = C

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/4/2005
Analysis Time Period: pm
Intersection: cth k/104th ave
Area Type: All other areas
Jurisdiction: kenosha county
Analysis Year: 2017
Project ID: 2017 background traffic - with improvements
East/West Street: cth k North/South Street: 104th ave

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	15	250	25	90	250	30	20	160	110	15	125	30
% Heavy Veh	2	2	2	2	2	2	2	2	2	2	2	2
PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
PK 15 Vol	4	69	7	25	69	8	5	44	30	4	34	8
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900		1900	1900		1900	1900		1900	1900	
ParkExist												
NumPark												
No. Lanes	1	1	0	1	1	0	1	1	0	1	1	0
LGConfig	L	TR		L	TR		L	TR		L	TR	
Lane Width	12.0	12.0		12.0	12.0		12.0	12.0		12.0	12.0	
RTOR Vol			0			0			0			0
Adj Flow	16	302		99	308		22	297		16	170	
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.089			0.107			0.407			0.194	
Peds Bikes	0			0			0			0		
Buses	0	0		0	0		0	0		0	0	
%InProtPhase	0.0			0.0			0.0			0.0		

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Arriv. Type	3	3		3	3		3	3		3	3	
Unit Ext.	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Ext of g	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Ped Min g	3.2			3.2			3.2			3.2		

PHASE DATA

Phase Combination	1	2	3	4			5	6	7	8
EB Left	A	A			NB	Left	A	A		
Thru		A				Thru		A		
Right		A				Right		A		
Peds						Peds				
WB Left	A	A			SB	Left	A	A		
Thru		A				Thru		A		
Right		A				Right		A		
Peds						Peds				
NB Right					EB	Right				
SB Right					WB	Right				
Green	6.0	40.0					8.0	38.0		
Yellow	3.0	4.5					3.0	4.5		
All Red	0.0	1.5					0.0	1.5		

Cycle Length: 110.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	15	250	25	90	250	30	20	160	110	15	125	30
PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Adj flow	16	275	27	99	275	33	22	176	121	16	137	33
No. Lanes	1	1	0	1	1	0	1	1	0	1	1	0
Lane group	L	TR		L	TR		L	TR		L	TR	
Adj flow	16	302		99	308		22	297		16	170	
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.089			0.107			0.407			0.194	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L	TR		L	TR		L	TR		L	TR	
So	1900	1900		1900	1900		1900	1900		1900	1900	
Lanes	1	1	0	1	1	0	1	1	0	1	1	0
fW	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fHV	0.980	0.980		0.980	0.980		0.980	0.980		0.980	0.980	
fG	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fP	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fBB	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fA	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fLU	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fRT		0.987			0.984			0.939			0.971	
fLT	0.950	1.000		0.950	1.000		0.950	1.000		0.950	1.000	
Sec.	0.380			0.387			0.531			0.378		
fLpb	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fRpb		1.000			1.000			1.000			1.000	
s	1770	1838		1770	1833		1770	1749		1770	1309	
Sec.	708			721			989			704		

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		16	1770	0.01	0.055	97	0.16
Perm		0	708	0.00	0.391	277	0.00
Left	L	16			0.45	374	0.04
Prot							
Perm							
Thru	TR	302	1838	0.16	0.36	668	0.45
Right							
Westbound							
Prot		97	1770	# 0.05	0.055	97	1.00
Perm		2	721	0.00	0.391	282	0.01
Left	L	99			0.45	379	0.26
Prot							
Perm							
Thru	TR	308	1833	# 0.17	0.36	667	0.46
Right							
Northbound							
Prot		22	1770	# 0.01	0.073	129	0.17
Perm		0	989	0.00	0.373	369	0.00
Left	L	22			0.45	498	0.04
Prot							
Perm							
Thru	TR	297	1749	# 0.17	0.35	604	0.49
Right							
Southbound							
Prot		16	1770	0.01	0.073	129	0.12
Perm		0	704	0.00	0.373	262	0.00
Left	L	16			0.45	391	0.04
Prot							
Perm							
Thru	TR	170	1809	0.09	0.35	625	0.27
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.41
Total lost time per cycle, L = 24.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.52

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor Del k	Res Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	0.04	0.45	18.0	1.000	374	0.11	0.0	0.0	18.1	B		
TR	0.45	0.36	26.7	1.000	668	0.11	0.5	0.0	27.1	C	26.7	C
Westbound												
L	0.26	0.45	18.9	1.000	379	0.11	0.4	0.0	19.3	B		
TR	0.46	0.36	26.8	1.000	667	0.11	0.5	0.0	27.3	C	25.3	C
Northbound												
L	0.04	0.45	17.4	1.000	498	0.11	0.0	0.0	17.4	B		
TR	0.49	0.35	28.4	1.000	604	0.11	0.6	0.0	29.0	C	28.2	C
Southbound												
L	0.04	0.45	18.0	1.000	391	0.11	0.0	0.0	18.0	B		

TR	0.27	0.35	26.0	1.000	625	0.11	0.2	0.0	26.2	C	25.5	C

Intersection delay = 26.5 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M	M	M
Cycle length, C 110.0 sec				
Total actual green time for LT lane group, G (s)	49.0	49.0	49.0	49.0
Effective permitted green time for LT lane group, g(s)	43.0	43.0	41.0	41.0
Opposing effective green time, go (s)	40.0	40.0	38.0	38.0
Number of lanes in LT lane group, N	1	1	1	1
Number of lanes in opposing approach, No	1	1	1	1
Adjusted LT flow rate, VLT (veh/h)	16	99	22	16
Proportion of LT in LT lane group, PLT	1.000	1.000	1.000	1.000
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	308	302	170	297
Lost time for LT lane group, tL	6.00	6.00	6.00	6.00
Computation				
LT volume per cycle, LTC=VLTC/3600	0.49	3.03	0.67	0.49
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	9.41	9.23	5.19	9.07
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g	0.0	0.0	0.0	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.64	0.64	0.65	0.65
gq, (see Exhibit C16-4,5,6,7,8)	14.45	14.11	7.51	14.23
gu=g-gq if gq>=gf, or = g-gf if gq<gf	28.55	28.89	33.49	26.77
n=Max(gq-gf)/2,0)	7.23	7.06	3.75	7.11
PTHo=1-PLTo	1.00	1.00	1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00	1.00	1.00
EL1 (refer to Exhibit C16-3)	1.75	1.74	1.54	1.73
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.09	0.09	0.10	0.10
gdiff=max(gq-gf,0)	0.00	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.38	0.39	0.53	0.38
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.380	0.387	0.531	0.378

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 110.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000	0.000	0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 110.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v	16	99	22	16
v/c ratio from Capacity Worksheet, X	0.04	0.26	0.04	0.04
Protected phase effective green interval, g (s)	6.0	6.0	8.0	8.0
Opposing queue effective green interval, gq	14.45	14.11	7.51	14.23
Unopposed green interval, gu	28.55	28.89	33.49	26.77
Red time r=(C-g-gq-gu)	61.0	61.0	61.0	61.0
Arrival rate, qa=v/(3600(max[X,1.0]))	0.00	0.03	0.01	0.00
Protected ph. departure rate, Sp=s/3600	0.492	0.492	0.492	0.492
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.30	0.30	0.34	0.30
XPerm	0.02	0.14	0.02	0.02
XProt	0.10	0.62	0.11	0.08
Case	1	1	1	1
Queue at beginning of green arrow, Qa	0.27	1.68	0.37	0.27
Queue at beginning of unsaturated green, Qu	0.06	0.39	0.05	0.06
Residual queue, Qr	0.00	0.00	0.00	0.00
Uniform Delay, d1	18.0	18.9	17.4	18.0

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Dur. Unmet Demand Q veh	Initial Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 26.5 sec/veh Intersection LOS C

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	L	TR	L	TR	L	TR	L	TR
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	16	302	99	308	22	297	16	170
So	1900	1900	1900	1900	1900	1900	1900	1900
No.Lanes	1	1 0	1	1 0	1	1 0	1	1 0
SL	838	1838	849	1833	1117	1749	878	1809
LnCapacity	374	668	379	667	498	604	391	625
Flow Ratio	0.02	0.16	0.12	0.17	0.02	0.17	0.02	0.09
v/c Ratio	0.04	0.45	0.26	0.46	0.04	0.49	0.04	0.27
Grn Ratio	0.45	0.36	0.45	0.36	0.45	0.35	0.45	0.35
I Factor		1.000		1.000		1.000		1.000
AT or PVG	3	3	3	3	3	3	3	3
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Q1	0.3	7.0	1.7	7.2	0.4	7.2	0.3	3.8
kB	0.4	0.6	0.4	0.6	0.5	0.6	0.4	0.6
Q2	0.0	0.5	0.2	0.5	0.0	0.5	0.0	0.2
Q Average	0.3	7.5	1.9	7.7	0.4	7.7	0.3	4.0
Q Spacing	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0
Q Storage	0	0	0	0	0	0	0	0
Q S Ratio								
70th Percentile Output:								
fB%	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
BOQ	0.3	8.9	2.2	9.1	0.5	9.1	0.3	4.7
QSRatio								
85th Percentile Output:								
fB%	1.6	1.5	1.6	1.5	1.6	1.5	1.6	1.6
BOQ	0.5	11.5	2.9	11.8	0.6	11.8	0.5	6.2
QSRatio								
90th Percentile Output:								
fB%	1.8	1.7	1.8	1.7	1.8	1.7	1.8	1.7
BOQ	0.5	12.6	3.3	12.9	0.7	12.9	0.5	6.9
QSRatio								
95th Percentile Output:								
fB%	2.1	1.9	2.0	1.9	2.1	1.9	2.1	2.0
BOQ	0.6	14.3	3.8	14.6	0.8	14.6	0.6	7.9
QSRatio								
98th Percentile Output:								
fB%	2.7	2.3	2.6	2.3	2.7	2.3	2.7	2.4
BOQ	0.8	17.0	4.0	17.4	1.1	17.4	0.8	9.7
QSRatio								

ERROR MESSAGES

No errors to report.

HCS2000: Unsignalized Intersections Release 4.1d

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ALL-WAY STOP CONTROL(AWSC) ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/4/2005
Analysis Time Period: am
Intersection: cth k/eastern frontage road
Jurisdiction: kenosha county
Units: U. S. Customary
Analysis Year: 2017
Project ID: 2017 Background Traffic - With Improvements
East/West Street: cth k
North/South Street: eastern frontage road

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	15	145	30	50	105	5	5	95	95	1	1	1
% Thrus Left Lane												

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	LTR		LTR		LTR		LTR	
PHF	1.00		1.00		1.00		1.00	
Flow Rate	190		160		195		3	
% Heavy Veh	0		0		0		0	
No. Lanes		1		1		1		1
Opposing-Lanes		1		1		1		1
Conflicting-lanes		1		1		1		1
Geometry group		1		1		1		1

Duration, T 0.25 hrs.

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	190		160		195		3	
Left-Turn	15		50		5		1	
Right-Turn	30		5		95		1	
Prop. Left-Turns	0.1		0.3		0.0		0.3	
Prop. Right-Turns	0.2		0.0		0.5		0.3	
Prop. Heavy Vehicle	0.0		0.0		0.0		0.0	
Geometry Group		1		1		1		1
Adjustments Exhibit 17-33:								
hLT-adj		0.2		0.2		0.2		0.2
hRT-adj		-0.6		-0.6		-0.6		-0.6
hHV-adj		1.7		1.7		1.7		1.7
hadj, computed	-0.1		0.0		-0.3		-0.1	

Worksheet 4 - Departure Headway and Service Time

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow rate	190		160		195		3	
hd, initial value	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20
x, initial	0.17		0.14		0.17		0.00	
hd, final value	4.49		4.64		4.44		4.85	
x, final value	0.24		0.21		0.24		0.00	
Move-up time, m		2.0		2.0		2.0		2.0
Service Time	2.5		2.6		2.4		2.8	

Worksheet 5 - Capacity and Level of Service

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rate	190		160		195		3	
Service Time	2.5		2.6		2.4		2.8	
Utilization, x	0.24		0.21		0.24		0.00	
Dep. headway, hd	4.49		4.64		4.44		4.85	
Capacity	440		410		445		253	
Delay	8.87		8.84		8.84		7.87	
LOS	A		A		A		A	
Approach:								
Delay		8.87		8.84		8.84		7.87
LOS		A		A		A		A

Intersection Delay 8.85 Intersection LOS A

HCS2000: Unsignalized Intersections Release 4.1d

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ALL-WAY STOP CONTROL(AWSC) ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/4/2005
Analysis Time Period: pm
Intersection: cth k/eastern frontage road
Jurisdiction: kenosha county
Units: U. S. Customary
Analysis Year: 2017
Project ID: 2017 Background Traffic - With Improvements
East/West Street: cth k
North/South Street: eastern frontage road

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	30	170	70	70	160	25	20	140	105	10	5	10

% Thrus Left Lane

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	LTR		LTR		LTR		LTR	
PHF	1.00		1.00		1.00		1.00	
Flow Rate	270		255		265		25	
% Heavy Veh	0		0		0		0	
No. Lanes	1		1		1		1	
Opposing-Lanes	1		1		1		1	
Conflicting-lanes	1		1		1		1	
Geometry group	1		1		1		1	

Duration, T 0.25 hrs.

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	270		255		265		25	
Left-Turn	30		70		20		10	
Right-Turn	70		25		105		10	
Prop. Left-Turns	0.1		0.3		0.1		0.4	
Prop. Right-Turns	0.3		0.1		0.4		0.4	
Prop. Heavy Vehicle	0.0		0.0		0.0		0.0	
Geometry Group	1		1		1		1	
Adjustments Exhibit 17-33:								
hLT-adj	0.2		0.2		0.2		0.2	
hRT-adj	-0.6		-0.6		-0.6		-0.6	
hHV-adj	1.7		1.7		1.7		1.7	
hadj, computed	-0.1		-0.0		-0.2		-0.2	

Worksheet 4 - Departure Headway and Service Time

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow rate	270		255		265		25	
hd, initial value	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20
x, initial	0.24		0.23		0.24		0.02	
hd, final value	4.92		5.06		5.04		5.53	
x, final value	0.37		0.36		0.37		0.04	
Move-up time, m	2.0		2.0		2.0		2.0	
Service Time	2.9		3.1		3.0		3.5	

Worksheet 5 - Capacity and Level of Service

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rate	270		255		265		25	
Service Time	2.9		3.1		3.0		3.5	
Utilization, x	0.37		0.36		0.37		0.04	
Dep. headway, hd	4.92		5.06		5.04		5.53	
Capacity	520		505		515		275	
Delay	10.76		10.85		10.99		8.75	
LOS	B		B		B		A	
Approach:								
Delay	10.76		10.85		10.99		8.75	
LOS	B		B		B		A	

Intersection Delay 10.80 Intersection LOS B

2017 BACKGROUND TRAFFIC CAPACITY ANALYSIS – WITHOUT IMPROVEMENTS

HCS2000: Signalized Intersections Release 4.1e

Analyst: md
Agency:
Date: 1/4/2005
Period: am
Project ID: 2017 background traffic - no improvements
E/W St: sth 158

Inter.: sth 158/cth h
Area Type: All other areas
Jurisd: wisdot
Year : 2017
N/S St: cth h

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	1	1	0	0	1	0	0	1	0
LGConfig	L	TR		L	TR			LTR			LTR	
Volume	75	600	20	75	655	30	5	185	75	65	305	90
Lane Width	12.0	12.0		12.0	12.0			12.0			12.0	
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A	A			NB Left	A			
Thru		A			Thru	A			
Right		A			Right	A			
Peds					Peds				
WB Left	A	A			SB Left	A			
Thru		A			Thru	A			
Right		A			Right	A			
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	6.0	39.0				30.0			
Yellow	3.0	4.5				4.5			
All Red	0.0	1.5				1.5			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	201	1770	0.42	0.53	20.1	C		
TR	728	1679	0.97	0.43	50.6	D	47.3	D
Westbound								
L	199	1752	0.43	0.53	18.5	B		
TR	765	1766	1.02	0.43	62.4	E	58.0	E
Northbound								
LTR	591	1773	0.51	0.33	24.8	C	24.8	C
Southbound								
LTR	519	1556	1.01	0.33	71.4	E	71.4	E

Intersection Delay = 53.4 (sec/veh) Intersection LOS = D

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/4/2005
Analysis Time Period: am
Intersection: sth 158/cth h
Area Type: All other areas
Jurisdiction: wisdot
Analysis Year: 2017
Project ID: 2017 background traffic - no improvements
East/West Street: sth 158 North/South Street: cth h

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	75	600	20	75	655	30	5	185	75	65	305	90
% Heavy Veh	2	13	0	3	7	4	20	1	3	10	2	4
PHF	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
PK 15 Vol	21	170	6	21	186	9	2	53	21	18	87	26
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900		1900	1900			1900			1900	
ParkExist												
NumPark												
No. Lanes	1	1	0	1	1	0	0	1	0	0	1	0
LGConfig	L	TR		L	TR			LTR			LTR	
Lane Width	12.0	12.0		12.0	12.0			12.0			12.0	
RTOR Vol			0			0			0			0
Adj Flow	85	705		85	778			301			523	
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000			0.020			0.141	
Prop RTs		0.033			0.044		0.282			0.195		
Peds Bikes		0			0		0			0		
Buses	0	0		0	0			0			0	
%InProtPhase	0.0			0.0								

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0	0.0			0.0			0.0	
Arriv. Type	3	3		3	3			3			3	
Unit Ext.	3.0	3.0		3.0	3.0			3.0			3.0	
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0		2.0	2.0			2.0			2.0	
Ext of g	2.0	2.0		2.0	2.0			2.0			2.0	

Ped Min g	3.2	3.2	3.2	3.2

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A	A			NB Left	A			
Thru		A			Thru	A			
Right		A			Right	A			
Peds					Peds				
WB Left	A	A			SB Left	A			
Thru		A			Thru	A			
Right		A			Right	A			
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	6.0	39.0				30.0			
Yellow	3.0	4.5				4.5			
All Red	0.0	1.5				1.5			

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	75	600	20	75	655	30	5	185	75	65	305	90
PHF	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Adj flow	85	682	23	85	744	34	6	210	85	74	347	102
No. Lanes	1	1	0	1	1	0	0	1	0	0	1	0
Lane group	L	TR		L	TR			LTR			LTR	
Adj flow	85	705		85	778			301			523	
Prop LTs	1.000	0.000		1.000	0.000			0.020			0.141	
Prop RTs		0.033			0.044		0.282			0.195		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound L	Eastbound TR	Westbound L	Westbound TR	Northbound LTR	Southbound LTR
So	1900	1900	1900	1900	1900	1900
Lanes	1	1 0	1	1 0 0	1 0 0	1 0
fW	1.000	1.000	1.000	1.000	1.000	1.000
fHV	0.980	0.888	0.971	0.936	0.981	0.966
fG	1.000	1.000	1.000	1.000	1.000	1.000
fP	1.000	1.000	1.000	1.000	1.000	1.000
fBB	1.000	1.000	1.000	1.000	1.000	1.000
fA	1.000	1.000	1.000	1.000	1.000	1.000
fLU	1.000	1.000	1.000	1.000	1.000	1.000
fRT		0.995		0.993	0.962	0.974
fLT	0.950	1.000	0.950	1.000	0.989	0.871
Sec.	0.095		0.095			
fLpb	1.000	1.000	1.000	1.000	1.000	1.000
fRpb		1.000		1.000	1.000	1.000
S	1770	1679	1752	1766	1773	1556
Sec.	177		176			

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		85	1770	0.05	0.067	118	0.72
Perm		0	177	0.00	0.467	83	0.00
Left	L	85			0.53	201	0.42
Prot							
Perm							
Thru	TR	705	1679	0.42	0.43	728	0.97
Right							
Westbound							
Prot		85	1752	# 0.05	0.067	117	0.73
Perm		0	176	0.00	0.467	82	0.00
Left	L	85			0.53	199	0.43
Prot							
Perm							
Thru	TR	778	1766	# 0.43	0.43	765	1.02
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	301	1773	0.17	0.33	591	0.51
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	523	1556	# 0.34	0.33	519	1.01
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.82
Total lost time per cycle, L = 18.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.02

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	0.42	0.53	18.7	1.000	201	0.11	1.4	0.0	20.1	C		
TR	0.97	0.43	24.9	1.000	728	0.48	25.7	0.0	50.6	D	47.3	D
Westbound												
L	0.43	0.53	17.0	1.000	199	0.11	1.5	0.0	18.5	B		
TR	1.02	0.43	25.5	1.000	765	0.50	36.9	0.0	62.4	E	58.0	E
Northbound												
LTR	0.51	0.33	24.1	1.000	591	0.12	0.7	0.0	24.8	C	24.8	C
Southbound												

LTR	1.01	0.33	30.0	1.000	519	0.50	41.4	0.0	71.4	E	71.4	E

Intersection delay = 53.4 (sec/veh) Intersection LOS = D

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M		
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	48.0	48.0		
Effective permitted green time for LT lane group, g(s)	42.0	42.0		
Opposing effective green time, go (s)	39.0	39.0		
Number of lanes in LT lane group, N	1	1		
Number of lanes in opposing approach, No	1	1		
Adjusted LT flow rate, VLT (veh/h)	85	85		
Proportion of LT in LT lane group, PLT	1.000	1.000		
Proportion of LT in opposing flow, PLTo	0.00	0.00		
Adjusted opposing flow rate, Vo (veh/h)	778	705		
Lost time for LT lane group, tL	6.00	6.00		
Computation				
LT volume per cycle, LTC=VLTC/3600	2.13	2.13		
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	19.45	17.63		
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g	0.0	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.57	0.57		
gq, (see Exhibit C16-4,5,6,7,8)	38.00	32.84		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	4.00	9.16		
n=Max(gq-gf)/2,0)	19.00	16.42		
PTHo=1-PLTo	1.00	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00		
EL1 (refer to Exhibit C16-3)	2.70	2.52		
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.10	0.10		
gdiff=max(gq-gf,0)	0.00	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.10	0.10		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.095	0.095		

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach			S	S
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)			30.0	30.0
Effective permitted green time for LT lane group, g(s)			30.0	30.0
Opposing effective green time, go (s)			30.0	30.0
Number of lanes in LT lane group, N			1	1
Number of lanes in opposing approach, No			1	1
Adjusted LT flow rate, VLT (veh/h)			6	74
Proportion of LT in LT lane group, PLT	0.000	0.000	0.020	0.141
Proportion of LT in opposing flow, PLTo			0.14	0.02
Adjusted opposing flow rate, Vo (veh/h)			523	301
Lost time for LT lane group, tL			6.00	6.00
Computation				
LT volume per cycle, LTC=VLTC/3600			0.15	1.85
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			13.07	7.53
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g			17.1	2.5
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.67	0.67
gq, (see Exhibit C16-4,5,6,7,8)			16.80	8.96
gu=g-gq if gq>=gf, or = g-gf if gq<gf			12.89	21.04
n=Max(gq-gf)/2,0)			0.00	3.25
PTHo=1-PLTo			0.86	0.98
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			0.02	0.14
EL1 (refer to Exhibit C16-3)			2.35	1.88
EL2=Max((1-Ptho**n)/Plto, 1.0)			1.00	3.18
fmin=2(1+PL)/g or fmin=2(1+Pl)/g			0.07	0.08
gdiff=max(gq-gf,0)			0.00	6.51
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.99	0.87
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.989	0.871

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 90.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v	85	85		
v/c ratio from Capacity Worksheet, X	0.42	0.43		
Protected phase effective green interval, g (s)	6.0	6.0		
Opposing queue effective green interval, gq	38.00	32.84		
Unopposed green interval, gu	4.00	9.16		
Red time r=(C-g-gq-gu)	42.0	42.0		
Arrival rate, qa=v/(3600(max[X,1.0]))	0.02	0.02		
Protected ph. departure rate, Sp=s/3600	0.492	0.487		
Permitted ph. departure rate, Sa=s(gq+gu)/(gu*3600)	0.52	0.22		
XPerm	0.48	0.48		
XProt	0.38	0.39		
Case	1	1		
Queue at beginning of green arrow, Qa	0.99	0.99		
Queue at beginning of unsaturated green, Qu	0.90	0.78		
Residual queue. Qr	0.00	0.00		
Uniform Delay, d1	18.7	17.0		

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 53.4 sec/veh Intersection LOS D

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound	Southbound
LaneGroup	L	TR	L	TR	LTR	LTR
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	85	705	85	778	301	523
So	1900	1900	1900	1900	1900	1900
No.Lanes	1	1 0	1	1 0	0 1 0	0 1 0
SL	376	1679	373	1766	1773	1556
LnCapacity	201	728	199	765	591	519
Flow Ratio	0.23	0.42	0.23	0.44	0.17	0.34
v/c Ratio	0.42	0.97	0.43	1.02	0.51	1.01
Grn Ratio	0.53	0.43	0.53	0.43	0.33	0.33
I Factor		1.000		1.000	1.000	1.000
AT or PVG	3	3	3	3	3	3
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00	1.00	1.00	1.00	1.00	1.00
Q1	1.0	17.2	1.0	19.5	6.0	13.1
kB	0.3	0.6	0.3	0.6	0.5	0.5
Q2	0.2	5.8	0.2	8.4	0.5	5.8
Q Average	1.2	23.0	1.2	27.9	6.6	18.8
Q Spacing	25.0	25.0	25.0	25.0	25.0	25.0
Q Storage	0	0	0	0	0	0
Q S Ratio						
70th Percentile Output:						
fB%	1.2	1.2	1.2	1.1	1.2	1.2
BOQ	1.4	26.6	1.5	32.0	7.8	21.9
QSRatio						
85th Percentile Output:						
fB%	1.6	1.4	1.6	1.4	1.5	1.5
BOQ	1.9	33.1	1.9	39.5	10.1	27.5
QSRatio						
90th Percentile Output:						
fB%	1.8	1.5	1.8	1.5	1.7	1.6
BOQ	2.2	35.1	2.2	41.8	11.1	29.3
QSRatio						
95th Percentile Output:						
fB%	2.1	1.7	2.1	1.6	1.9	1.7
BOQ	2.5	38.4	2.5	45.4	12.6	32.2
QSRatio						
98th Percentile Output:						
fB%	2.6	1.9	2.6	1.8	2.3	1.9
BOQ	3.2	43.0	3.2	50.6	15.1	36.5
QSRatio						

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: md
Agency:
Date: 1/4/2005
Period: pm
Project ID: 2017 background traffic - no improvements
E/W St: sth 158

Inter.: sth 158/cth h
Area Type: All other areas
Jurisd: wisdot
Year : 2017
N/S St: cth h

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	1	1	0	0	1	0	0	1	0
LGConfig	L	TR		L	TR			LTR			LTR	
Volume	145	765	25	45	450	70	10	365	60	65	325	45
Lane Width	12.0	12.0		12.0	12.0			12.0			12.0	
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4			5	6	7	8
EB Left	A	A			NB	Left	A			
Thru		A				Thru	A			
Right		A				Right	A			
Peds						Peds				
WB Left	A	A			SB	Left	A			
Thru		A				Thru	A			
Right		A				Right	A			
Peds						Peds				
NB Right					EB	Right				
SB Right					WB	Right				
Green	6.0	38.0					31.0			
Yellow	3.0	4.5					4.5			
All Red	0.0	1.5					1.5			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	265	1805	0.62	0.52	20.3	C		
TR	762	1804	1.18	0.42	119.2	F	103.8	F
Westbound								
L	204	1805	0.25	0.52	19.0	B		
TR	760	1799	0.78	0.42	27.5	C	26.8	C
Northbound								
LTR	618	1795	0.80	0.34	34.1	C	34.1	C
Southbound								
LTR	463	1344	1.07	0.34	90.3	F	90.3	F

Intersection Delay = 70.2 (sec/veh) Intersection LOS = E

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/4/2005
Analysis Time Period: pm
Intersection: sth 158/cth h
Area Type: All other areas
Jurisdiction: wisdot
Analysis Year: 2017
Project ID: 2017 background traffic - no improvements
East/West Street: sth 158 North/South Street: cth h

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	145	765	25	45	450	70	10	365	60	65	325	45
% Heavy Veh	0	5	0	0	4	0	10	2	4	2	3	11
PHF	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
PK 15 Vol	41	217	7	13	128	20	3	104	17	18	92	13
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900		1900	1900			1900			1900	
ParkExist												
NumPark												
No. Lanes	1	1	0	1	1	0	0	1	0	0	1	0
LGConfig	L	TR		L	TR			LTR			LTR	
Lane Width	12.0	12.0		12.0	12.0			12.0			12.0	
RTOR Vol			0			0			0			0
Adj Flow	165	897		51	591			494			494	
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000			0.022			0.150	
Prop RTs		0.031			0.135		0.138			0.103		
Peds Bikes		0			0		0			0		
Buses	0	0		0	0		0			0		
%InProtPhase	0.0			0.0								

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0	0.0			0.0			0.0	
Arriv. Type	3	3		3	3			3			3	
Unit Ext.	3.0	3.0		3.0	3.0			3.0			3.0	
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0		2.0	2.0			2.0			2.0	
Ext of g	2.0	2.0		2.0	2.0			2.0			2.0	

Ped Min g	3.2	3.2	3.2	3.2

PHASE DATA

Phase Combination	1	2	3	4			5	6	7	8
EB Left	A	A			NB	Left	A			
Thru		A				Thru	A			
Right		A				Right	A			
Peds						Peds				
WB Left	A	A			SB	Left	A			
Thru		A				Thru	A			
Right		A				Right	A			
Peds						Peds				
NB Right					EB	Right				
SB Right					WB	Right				
Green	6.0	38.0					31.0			
Yellow	3.0	4.5					4.5			
All Red	0.0	1.5					1.5			

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	145	765	25	45	450	70	10	365	60	65	325	45
PHF	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Adj flow	165	869	28	51	511	80	11	415	68	74	369	51
No. Lanes	1	1	0	1	1	0	0	1	0	0	1	0
Lane group	L	TR		L	TR			LTR			LTR	
Adj flow	165	897		51	591			494			494	
Prop LTs	1.000	0.000		1.000	0.000			0.022			0.150	
Prop RTs		0.031			0.135		0.138			0.103		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L	TR		L	TR		LTR			LTR		
So	1900	1900		1900	1900		1900			1900		
Lanes	1	1	0	1	1	0	1	0	0	1	0	0
fW	1.000	1.000		1.000	1.000		1.000			1.000		
fHV	1.000	0.954		1.000	0.967		0.976			0.965		
fG	1.000	1.000		1.000	1.000		1.000			1.000		
fP	1.000	1.000		1.000	1.000		1.000			1.000		
fBB	1.000	1.000		1.000	1.000		1.000			1.000		
fA	1.000	1.000		1.000	1.000		1.000			1.000		
fLU	1.000	1.000		1.000	1.000		1.000			1.000		
fRT		0.995			0.980		0.981			0.986		
fLT	0.950	1.000		0.950	1.000		0.986			0.744		
Sec.	0.168			0.098								
fLpb	1.000	1.000		1.000	1.000		1.000			1.000		
fRpb		1.000			1.000		1.000			1.000		
S	1805	1804		1805	1799		1795			1344		
Sec.	319			185								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	Lane Group Capacity (c)	v/c Ratio
Eastbound							
Prot		120	1805	# 0.07	0.067	120	1.00
Perm		45	319	0.14	0.456	145	0.31
Left	L	165			0.52	265	0.62
Prot							
Perm							
Thru	TR	897	1804	# 0.42	0.42	762	1.18
Right							
Westbound							
Prot		51	1805	0.03	0.067	120	0.43
Perm		0	185	0.00	0.456	84	0.00
Left	L	51			0.52	204	0.25
Prot							
Perm							
Thru	TR	591	1799	0.33	0.42	760	0.78
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	494	1795	0.28	0.34	618	0.80
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	494	1344	# 0.37	0.34	463	1.07
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.86
Total lost time per cycle, L = 18.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.07

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	0.62	0.52	15.8	1.000	265	0.21	4.5	0.0	20.3	C		
TR	1.18	0.42	26.0	1.000	762	0.50	93.2	0.0	119.2	F	103.8	F
Westbound												
L	0.25	0.52	18.4	1.000	204	0.11	0.6	0.0	19.0	B		
TR	0.78	0.42	22.4	1.000	760	0.33	5.1	0.0	27.5	C	26.8	C
Northbound												
LTR	0.80	0.34	26.7	1.000	618	0.34	7.4	0.0	34.1	C	34.1	C
Southbound												

LTR	1.07	0.34	29.5	1.000	463	0.50	60.8	0.0	90.3	F	90.3	F

Intersection delay = 70.2 (sec/veh) Intersection LOS = E

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M		
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	47.0	47.0		
Effective permitted green time for LT lane group, g(s)	41.0	41.0		
Opposing effective green time, go (s)	38.0	38.0		
Number of lanes in LT lane group, N	1	1		
Number of lanes in opposing approach, No	1	1		
Adjusted LT flow rate, VLT (veh/h)	165	51		
Proportion of LT in LT lane group, PLT	1.000	1.000		
Proportion of LT in opposing flow, PLTo	0.00	0.00		
Adjusted opposing flow rate, Vo (veh/h)	591	897		
Lost time for LT lane group, tL	6.00	6.00		
Computation				
LT volume per cycle, LTC=VLTC/3600	4.13	1.27		
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	14.77	22.42		
gf=G[exp(- a * (LTC ** b)]-tl, gf<=g	0.0	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.58	0.58		
gq, (see Exhibit C16-4,5,6,7,8)	25.42	37.00		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	15.58	4.00		
n=Max(gq-gf)/2,0)	12.71	18.50		
PTHo=1-PLTo	1.00	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00		
EL1 (refer to Exhibit C16-3)	2.27	3.01		
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.10	0.10		
gdiff=max(gq-gf,0)	0.00	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.17	0.10		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.168	0.098		

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach			S	S
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)			31.0	31.0
Effective permitted green time for LT lane group, g(s)			31.0	31.0
Opposing effective green time, go (s)			31.0	31.0
Number of lanes in LT lane group, N			1	1
Number of lanes in opposing approach, No			1	1
Adjusted LT flow rate, VLT (veh/h)			11	74
Proportion of LT in LT lane group, PLT	0.000	0.000	0.022	0.150
Proportion of LT in opposing flow, PLTo			0.15	0.02
Adjusted opposing flow rate, Vo (veh/h)			494	494
Lost time for LT lane group, tL			6.00	6.00
Computation				
LT volume per cycle, LTC=VLTC/3600			0.28	1.85
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			12.35	12.35
gf=G[exp(- a * (LTC ** b)]-tl, gf<=g			15.2	2.7
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.66	0.66
gq, (see Exhibit C16-4,5,6,7,8)			15.44	15.44
gu=g-gq if gq>=gf, or = g-gf if gq<gf			15.56	15.56
n=Max(gq-gf)/2,0)			0.14	6.35
PTHo=1-PLTo			0.85	0.98
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			0.02	0.15
EL1 (refer to Exhibit C16-3)			2.29	2.29
EL2=Max((1-Ptho**n)/Plto, 1.0)			1.00	5.99
fmin=2(1+PL)/g or fmin=2(1+Pl)/g			0.07	0.07
gdiff=max(gq-gf,0)			0.28	12.70
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.99	0.74
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.986	0.744

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 90.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v	165	51		
v/c ratio from Capacity Worksheet, X	0.62	0.25		
Protected phase effective green interval, g (s)	6.0	6.0		
Opposing queue effective green interval, gq	25.42	37.00		
Unopposed green interval, gu	15.58	4.00		
Red time r=(C-g-gq-gu)	43.0	43.0		
Arrival rate, qa=v/(3600(max[X,1.0]))	0.05	0.01		
Protected ph. departure rate, Sp=s/3600	0.501	0.501		
Permitted ph. departure rate, Sa=s(gq+gu)/(gu*3600)	0.23	0.53		
XPerm	0.52	0.28		
XProt	0.75	0.23		
Case	1	1		
Queue at beginning of green arrow, Qa	1.97	0.61		
Queue at beginning of unsaturated green, Qu	1.17	0.52		
Residual queue, Qr	0.00	0.00		
Uniform Delay, d1	15.8	18.4		

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 70.2 sec/veh Intersection LOS E

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	L	TR	L	TR	LTR		LTR	
Init Queue	0.0	0.0	0.0	0.0	0.0		0.0	
Flow Rate	165	897	51	591	494		494	
So	1900	1900	1900	1900	1900		1900	
No.Lanes	1	1 0	1	1 0	0 1	0	0 1	0
SL	509	1804	392	1799	1795		1344	
LnCapacity	265	762	204	760	618		463	
Flow Ratio	0.32	0.50	0.13	0.33	0.28		0.37	
v/c Ratio	0.62	1.18	0.25	0.78	0.80		1.07	
Grn Ratio	0.52	0.42	0.52	0.42	0.34		0.34	
I Factor		1.000		1.000	1.000		1.000	
AT or PVG	3	3	3	3	3		3	
Pltn Ratio	1.00	1.00	1.00	1.00	1.00		1.00	
PF2	1.00	1.00	1.00	1.00	1.00		1.00	
Q1	2.1	22.4	0.6	12.7	11.2		12.4	
kB	0.3	0.6	0.3	0.6	0.5		0.4	
Q2	0.5	20.1	0.1	1.9	1.8		7.5	
Q Average	2.6	42.6	0.7	14.6	13.0		19.8	
Q Spacing	25.0	25.0	25.0	25.0	25.0		25.0	
Q Storage	0	0	0	0	0		0	
Q S Ratio								
70th Percentile Output:								
fB%	1.2	1.1	1.2	1.2	1.2		1.2	
BOQ	3.0	48.3	0.8	17.1	15.3		23.0	
QSRatio								
85th Percentile Output:								
fB%	1.6	1.4	1.6	1.5	1.5		1.5	
BOQ	4.0	58.4	1.1	21.7	19.4		28.8	
QSRatio								
90th Percentile Output:								
fB%	1.8	1.4	1.8	1.6	1.6		1.5	
BOQ	4.5	61.6	1.3	23.2	20.9		30.7	
QSRatio								
95th Percentile Output:								
fB%	2.0	1.6	2.1	1.8	1.8		1.7	
BOQ	5.2	66.2	1.5	25.8	23.3		33.7	
QSRatio								
98th Percentile Output:								
fB%	2.5	1.7	2.6	2.0	2.1		1.9	
BOQ	6.4	74.0	1.9	29.5	26.9		38.0	
QSRatio								

ERROR MESSAGES

No errors to report.

HCS2000: Unsignalized Intersections Release 4.1d

TWO-WAY STOP CONTROL SUMMARY

Analyst:
Agency/Co.:
Date Performed: 11/12/2004
Analysis Time Period: am
Intersection: sth 158/104th avenue
Jurisdiction: wisdot
Units: U. S. Customary
Analysis Year: 2017
Project ID: 2017 background traffic - no improvements
East/West Street: sth 158
North/South Street: 104th Avenue
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1 L	2 T	3 R	4 L	5 T	6 R
Volume	5	620	25	145	540	5
Peak-Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate, HFR	5	620	25	145	540	5
Percent Heavy Vehicles	0	--	--	0	--	--
Median Type/Storage	Undivided		/			
RT Channelized?			No			No
Lanes	1	2	1	1	2	1
Configuration	L	T	R	L	T	R
Upstream Signal?		No			No	

Minor Street: Approach	Northbound			Southbound		
Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume	40	5	120	5	10	5
Peak Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate, HFR	40	5	120	5	10	5
Percent Heavy Vehicles	0	0	0	0	0	0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No /			No /
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	L	L		LTR			LTR	
v (vph)	5	145		165			20	
C(m) (vph)	1034	950		294			136	
v/c	0.00	0.15		0.56			0.15	
95% queue length	0.01	0.54		3.20			0.50	
Control Delay	8.5	9.5		31.8			36.0	
LOS	A	A		D			E	
Approach Delay				31.8			36.0	
Approach LOS				D			E	

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn							
Through							
S5 Left-Turn							
Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1	4.1	7.5	6.5	6.9	7.5	6.5	6.9
t(c,hv)		2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
P(hv)		0	0	0	0	0	0	0	0
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Grade/100				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage	4.1	4.1	7.5	6.5	6.9	7.5	6.5	6.9
	2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20	2.20	3.50	4.00	3.30	3.50	4.00	3.30
t(f,HV)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(HV)	0	0	0	0	0	0	0	0
t(f)	2.2	2.2	3.5	4.0	3.3	3.5	4.0	3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2 V(t)	Movement 2 V(l,prot)	Movement 5 V(t)	Movement 5 V(l,prot)
V prog				

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TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst:
Agency/Co.:
Date Performed: 11/12/2004
Analysis Time Period: am
Intersection: sth 158/104th avenue
Jurisdiction: wisdot
Units: U. S. Customary
Analysis Year: 2017
Project ID: 2017 background traffic - no improvements
East/West Street: sth 158
North/South Street: 104th Avenue
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume	5	620	25	145	540	5
Peak-Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Peak-15 Minute Volume	1	155	6	36	135	1
Hourly Flow Rate, HFR	5	620	25	145	540	5
Percent Heavy Vehicles	0	--	--	0	--	--
Median Type/Storage	Undivided		/			
RT Channelized?			No			No
Lanes	1	2	1	1	2	1
Configuration	L	T	R	L	T	R
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume	40	5	120	5	10	5
Peak Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Peak-15 Minute Volume	10	1	30	1	2	1
Hourly Flow Rate, HFR	40	5	120	5	10	5
Percent Heavy Vehicles	0	0	0	0	0	0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No /			No /
RT Channelized?						
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2 V(t)	Movement 2 V(l,prot)	Movement 5 V(t)	Movement 5 V(l,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p		0.000		0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5
Single-Stage Process

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x	545	645	1195	1465	310	1152	1485	270
a								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		3000		3000		3000		3000
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	310	270
Potential Capacity	692	734
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	692	734
Probability of Queue free St.	0.83	0.99

Step 2: LT from Major St.	4	1
Conflicting Flows	645	545
Potential Capacity	950	1034
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	950	1034
Probability of Queue free St.	0.85	1.00
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows	1465	1485
Potential Capacity	129	126
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.84	0.84
Movement Capacity	109	106
Probability of Queue free St.	0.95	0.91

Step 4: LT from Minor St.	7	10
Conflicting Flows	1195	1152
Potential Capacity	144	155
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.76	0.80
Maj. L, Min T Adj. Imp Factor.	0.82	0.85
Cap. Adj. factor due to Impeding mvmnt	0.81	0.70
Movement Capacity	117	109

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	1465	1485
Potential Capacity	129	126
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.84	0.84
Movement Capacity	109	106
Result for 2 stage process:		
a		
y		
C t	109	106
Probability of Queue free St.	0.95	0.91

Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	1195	1152
Potential Capacity	144	155
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.76	0.80
Maj. L, Min T Adj. Imp Factor.	0.82	0.85
Cap. Adj. factor due to Impeding mvmnt	0.81	0.70
Movement Capacity	117	109
Results for Two-stage process:		
a		
y		
C t	117	109

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	40	5	120	5	10	5
Movement Capacity (vph)	117	109	692	109	106	734
Shared Lane Capacity (vph)		294			136	

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	117	109	692	109	106	734
Volume	40	5	120	5	10	5
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh		294			136	
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	L	L		LTR			LTR	
v (vph)	5	145		165			20	
C(m) (vph)	1034	950		294			136	
v/c	0.00	0.15		0.56			0.15	
95% queue length	0.01	0.54		3.20			0.50	
Control Delay	8.5	9.5		31.8			36.0	
LOS	A	A		D			E	
Approach Delay				31.8			36.0	
Approach LOS				D			E	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.85
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4	8.5	9.)
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

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TWO-WAY STOP CONTROL SUMMARY

Analyst:
Agency/Co.:
Date Performed: 11/12/2004
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Intersection: sth 158/104th avenue
Jurisdiction: wisdot
Units: U. S. Customary
Analysis Year: 2017
Project ID: 2017 background traffic - no improvements
East/West Street: sth 158
North/South Street: 104th Avenue
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1 L	2 T	3 R	4 L	5 T	6 R
Volume	5	710	25	140	415	5
Peak-Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate, HFR	5	710	25	140	415	5
Percent Heavy Vehicles	0	--	--	0	--	--
Median Type/Storage	Undivided		/			
RT Channelized?			No			No
Lanes	1	2	1	1	2	1
Configuration	L	T	R	L	T	R
Upstream Signal?		No			No	

Minor Street: Approach	Northbound			Southbound		
Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume	25	5	185	15	5	15
Peak Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate, HFR	25	5	185	15	5	15
Percent Heavy Vehicles	0	0	0	0	0	0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No /			No /
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	L	L		LTR			LTR	
v (vph)	5	140		215			35	
C(m) (vph)	1150	879		396			174	
v/c	0.00	0.16		0.54			0.20	
95% queue length	0.01	0.56		3.13			0.73	
Control Delay	8.1	9.9		24.4			30.8	
LOS	A	A		C			D	
Approach Delay				24.4			30.8	
Approach LOS				C			D	

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TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst:
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East/West Street: sth 158
North/South Street: 104th Avenue
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume	5	710	25	140	415	5
Peak-Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Peak-15 Minute Volume	1	178	6	35	104	1
Hourly Flow Rate, HFR	5	710	25	140	415	5
Percent Heavy Vehicles	0	--	--	0	--	--
Median Type/Storage	Undivided		/			
RT Channelized?			No			No
Lanes	1	2	1	1	2	1
Configuration	L	T	R	L	T	R
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume	25	5	185	15	5	15
Peak Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Peak-15 Minute Volume	6	1	46	4	1	4
Hourly Flow Rate, HFR	25	5	185	15	5	15
Percent Heavy Vehicles	0	0	0	0	0	0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No /			No /
RT Channelized?						
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn							
Through							
S5 Left-Turn							
Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1	4.1	7.5	6.5	6.9	7.5	6.5	6.9
t(c,hv)		2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
P(hv)		0	0	0	0	0	0	0	0
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Grade/100				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage	4.1	4.1	7.5	6.5	6.9	7.5	6.5	6.9
	2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20	2.20	3.50	4.00	3.30	3.50	4.00	3.30
t(f,HV)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(HV)	0	0	0	0	0	0	0	0
t(f)	2.2	2.2	3.5	4.0	3.3	3.5	4.0	3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2 V(t)	Movement 2 V(l,prot)	Movement 5 V(t)	Movement 5 V(l,prot)
V prog				
Total Saturation Flow Rate, s (vph)				
Arrival Type				
Effective Green, g (sec)				
Cycle Length, C (sec)				
Rp (from Exhibit 16-11)				
Proportion vehicles arriving on green P				
g(q1)				
g(q2)				
g(q)				

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2 V(t)	Movement 2 V(l,prot)	Movement 5 V(t)	Movement 5 V(l,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p		0.000		0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5
Single-Stage Process

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x	420	735	1210	1420	355	1063	1440	208
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process

	7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		3000		3000		3000		3000
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	355	208
Potential Capacity	647	804
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	647	804
Probability of Queue free St.	0.71	0.98

Step 2: LT from Major St.	4	1
Conflicting Flows	735	420
Potential Capacity	879	1150
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	879	1150
Probability of Queue free St.	0.84	1.00
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows	1420	1440
Potential Capacity	138	134
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.84	0.84
Movement Capacity	116	112
Probability of Queue free St.	0.96	0.96

Step 4: LT from Minor St.	7	10
Conflicting Flows	1210	1063
Potential Capacity	141	180
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.80	0.80
Maj. L, Min T Adj. Imp Factor.	0.85	0.85
Cap. Adj. factor due to Impeding mvmnt	0.83	0.60
Movement Capacity	117	109

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	1420	1440
Potential Capacity	138	134
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.84	0.84
Movement Capacity	116	112
Result for 2 stage process:		
a		
y		
C t	116	112
Probability of Queue free St.	0.96	0.96

Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	1210	1063
Potential Capacity	141	180
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.80	0.80
Maj. L, Min T Adj. Imp Factor.	0.85	0.85
Cap. Adj. factor due to Impeding mvmnt	0.83	0.60
Movement Capacity	117	109
Results for Two-stage process:		
a		
y		
C t	117	109

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	25	5	185	15	5	15
Movement Capacity (vph)	117	116	647	109	112	804
Shared Lane Capacity (vph)		396			174	

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	117	116	647	109	112	804
Volume	25	5	185	15	5	15
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh		396			174	
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	L	L		LTR			LTR	
v (vph)	5	140		215			35	
C(m) (vph)	1150	879		396			174	
v/c	0.00	0.16		0.54			0.20	
95% queue length	0.01	0.56		3.13			0.73	
Control Delay	8.1	9.9		24.4			30.8	
LOS	A	A		C			D	
Approach Delay				24.4			30.8	
Approach LOS				C			D	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.84
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4	8.1	9.9
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS2000: Signalized Intersections Release 4.1e

Analyst: md
Agency:
Date: 1/3/2005
Period: am
Project ID: 2017 background traffic - no improvements
E/W St: sth 158

Inter.: sth 158/greyhound access
Area Type: All other areas
Jurisd: wisdot
Year : 2017
N/S St: greyhound access

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	1	2	0	2	0	1	0	0	0
LGConfig		T		L	T		L		R			
Volume		645		5	585		5		5			
Lane Width		12.0		12.0	12.0		12.0		12.0			
RTOR Vol									0			

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left					NB Left	A			
Thru		A			Thru				
Right					Right	A			
Peds					Peds				
WB Left	A	A			SB Left				
Thru	A	A			Thru				
Right					Right				
Peds					Peds				
NB Right	A				EB Right				
SB Right					WB Right				
Green	15.0	52.0				18.0			
Yellow	3.0	4.5				4.5			
All Red	0.0	1.5				1.5			

Cycle Length: 100.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
T	1636	3146	0.44	0.52	15.1	B	15.1	B
Westbound								
L	576	1805	0.01	0.70	5.3	A		
T	2345	3350	0.26	0.70	5.5	A	5.5	A
Northbound								
L	631	3505	0.01	0.18	33.7	C		
							26.2	C
R	630	1615	0.01	0.39	18.7	B		
Southbound								

Intersection Delay = 10.9 (sec/veh) Intersection LOS = B

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/3/2005
Analysis Time Period: am
Intersection: sth 158/greyhound access
Area Type: All other areas
Jurisdiction: wisdot
Analysis Year: 2017
Project ID: 2017 background traffic - no improvements
East/West Street: sth 158 North/South Street: greyhound access

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume		645		5	585		5		5			
% Heavy Veh		15		0	8		0		0			
PHF		0.90		0.90	0.97		0.90		0.90			
PK 15 Vol		179		2	151		2		2			
Hi Ln Vol												
% Grade		0			0			0				
Ideal Sat		1900		1900	1900		1900		1900			
ParkExist												
NumPark												
No. Lanes	0	2	0	1	2	0	2	0	1	0	0	0
LGConfig		T		L	T		L		R			
Lane Width		12.0		12.0	12.0		12.0		12.0			
RTOR Vol									0			
Adj Flow		717		6	603		6		6			
%InSharedLn												
Prop LTs		0.000		1.000	0.000							
Prop RTs	0.000				0.000				1.000			
Peds Bikes	0							0			0	
Buses		0		0	0		0		0			
%InProtPhase				0.0								

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmat		0.0		0.0	0.0		0.0		0.0			
Arriv. Type		3		3	3		3		3			
Unit Ext.		3.0		3.0	3.0		3.0		3.0			
I Factor		1.000			1.000			1.000				
Lost Time		2.0		2.0	2.0		2.0		2.0			
Ext of g		2.0		2.0	2.0		2.0		2.0			
Ped Min g		3.2					3.2		3.2			

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left					NB Left	A			
Thru		A			Thru				
Right					Right	A			
Peds					Peds				
WB Left	A	A			SB Left				
Thru	A	A			Thru				
Right					Right				
Peds					Peds				
NB Right	A				EB Right				
SB Right					WB Right				
Green	15.0	52.0				18.0			
Yellow	3.0	4.5				4.5			
All Red	0.0	1.5				1.5			

Cycle Length: 100.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V		645		5	585		5		5			
PHF		0.90		0.90	0.97		0.90		0.90			
Adj flow		717		6	603		6		6			
No. Lanes	0	2	0	1	2	0	2	0	1	0	0	0
Lane group		T		L	T		L		R			
Adj flow		717		6	603		6		6			
Prop LTs		0.000		1.000	0.000							
Prop RTs	0.000				0.000				1.000			

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound T			Westbound L	T		Northbound L		R		Southbound	
So	1900			1900	1900		1900		1900			
Lanes	0	2	0	1	2	0	2	0	1	0	0	0
fW		1.000			1.000	1.000		1.000		1.000		
fHV		0.870			1.000	0.926		1.000		1.000		
fG		1.000			1.000	1.000		1.000		1.000		
fP		1.000			1.000	1.000		1.000		1.000		
fBB		1.000			1.000	1.000		1.000		1.000		
fA		1.000			1.000	1.000		1.000		1.000		
fLU		0.952			1.000	0.952		0.971		1.000		
fRT		1.000				1.000				0.850		
fLT		1.000			0.950	1.000		0.950				
Sec.					0.292							
fLpb		1.000			1.000	1.000		1.000				
fRpb		1.000				1.000				1.000		
S		3146			1805	3350		3505		1615		
Sec.					555							

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	717	3146	# 0.23	0.52	1636	0.44
Right							
Westbound							
Prot		6	1805	# 0.00	0.150	271	0.02
Perm		0	555	0.00	0.550	305	0.00
Left	L	6			0.70	576	0.01
Prot							
Perm							
Thru	T	603	3350	0.18	0.70	2345	0.26
Right							
Northbound							
Prot							
Perm							
Left	L	6	3505	# 0.00	0.18	631	0.01
Prot							
Perm							
Thru							
Right	R	6	1615	0.00	0.39	630	0.01
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.23
Total lost time per cycle, L = 18.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.28

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
T	0.44	0.52	14.9	1.000	1636	0.11	0.2	0.0	15.1	B	15.1	B
Westbound												
L	0.01	0.70	5.3	1.000	576	0.11	0.0	0.0	5.3	A		
T	0.26	0.70	5.5	1.000	2345	0.11	0.1	0.0	5.5	A	5.5	A
Northbound												
L	0.01	0.18	33.7	1.000	631	0.11	0.0	0.0	33.7	C		
											26.2	C
R	0.01	0.39	18.7	1.000	630	0.11	0.0	0.0	18.7	B		
Southbound												

Intersection delay = 10.9 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

		EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach			M		
Cycle length, C	100.0 sec				
Total actual green time for LT lane group, G (s)			70.0		
Effective permitted green time for LT lane group, g(s)			55.0		
Opposing effective green time, go (s)			52.0		
Number of lanes in LT lane group, N			1		
Number of lanes in opposing approach, No			2		
Adjusted LT flow rate, VLT (veh/h)			6		
Proportion of LT in LT lane group, PLT			1.000		
Proportion of LT in opposing flow, PLTo			0.00		
Adjusted opposing flow rate, Vo (veh/h)			717		
Lost time for LT lane group, tL			6.00		
Computation					
LT volume per cycle, LTC=VLTC/3600			0.17		
Opposing lane util. factor, fLUo		0.952	0.952		
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			10.46		
gf=G[exp(- a * (LTC ** b)]-tl, gf<=g			0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.48		
gq, (see Exhibit C16-4,5,6,7,8)			12.70		
gu=g-gq if gq>=gf, or = g-gf if gq<gf			42.30		
n=Max(gq-gf)/2,0)			6.35		
PTHo=1-PLTo			1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00		
EL1 (refer to Exhibit C16-3)			2.63		
EL2=Max((1-Ptho**n)/Plto, 1.0)					
fmin=2(1+PL)/g or fmin=2(1+Pl)/g			0.07		
gdiff=max(gq-gf,0)			0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.29		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)					
or flt=[fm+0.91(N-1)]/N**					
Left-turn adjustment, fLT			0.292		

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

		EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach					
Cycle length, C	100.0 sec				
Total actual green time for LT lane group, G (s)					
Effective permitted green time for LT lane group, g(s)					
Opposing effective green time, go (s)					
Number of lanes in LT lane group, N					
Number of lanes in opposing approach, No					
Adjusted LT flow rate, VLT (veh/h)					
Proportion of LT in LT lane group, PLT		0.000	0.000		
Proportion of LT in opposing flow, PLTo					
Adjusted opposing flow rate, Vo (veh/h)					
Lost time for LT lane group, tL					
Computation					
LT volume per cycle, LTC=VLTC/3600					
Opposing lane util. factor, fLUo		0.952	0.952		
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)					
gf=G[exp(- a * (LTC ** b)]-tl, gf<=g					
Opposing platoon ratio, Rpo (refer Exhibit 16-11)					
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]					
gq, (see Exhibit C16-4,5,6,7,8)					
gu=g-gq if gq>=gf, or = g-gf if gq<gf					
n=Max(gq-gf)/2,0)					
PTHo=1-PLTo					
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]					
EL1 (refer to Exhibit C16-3)					
EL2=Max((1-Ptho**n)/Plto, 1.0)					
fmin=2(1+PL)/g or fmin=2(1+Pl)/g					
gdiff=max(gq-gf,0)					
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)					
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)					
or flt=[fm+0.91(N-1)]/N**					
Left-turn adjustment, fLT					

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

		EBLT	WBLT	NBLT	SBLT
Cycle length, C	100.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v			6		
v/c ratio from Capacity Worksheet, X			0.01		
Protected phase effective green interval, g (s)			15.0		
Opposing queue effective green interval, gq			12.70		
Unopposed green interval, gu			42.30		
Red time r=(C-g-gq-gu)			30.0		
Arrival rate, qa=v/(3600(max[X,1.0]))			0.00		
Protected ph. departure rate, Sp=s/3600			0.501		
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)			0.20		
XPerm			0.01		
XProt			0.01		
Case			1		
Queue at beginning of green arrow, Qa			0.05		
Queue at beginning of unsaturated green, Qu			0.02		
Residual queue, Qr			0.00		
Uniform Delay, d1			5.3		

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Dur. Unmet Demand Q veh	Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 10.9 sec/veh Intersection LOS B

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup		T		L	T		L	R				
Init Queue		0.0		0.0	0.0		0.0	0.0				
Flow Rate		376		6	316		3	6				
So		1900		1900	1900		1900	1900				
No.Lanes	0	2	0	1	2	0	2 0	1	0	0	0	
SL		1652		823	1759		1805	1615				
LnCapacity		859		576	1231		324	630				
Flow Ratio		0.23		0.01	0.18		0.00	0.00				
v/c Ratio		0.44		0.01	0.26		0.01	0.01				
Grn Ratio		0.52		0.70	0.70		0.18	0.39				
I Factor		1.000			1.000		1.000					
AT or PVG		3		3	3		3	3				
Pltn Ratio		1.00		1.00	1.00		1.00	1.00				
PF2		1.00		1.00	1.00		1.00	1.00				
Q1		6.5		0.1	3.2		0.1	0.1				
kB		0.7		0.5	0.8		0.4	0.6				
Q2		0.5		0.0	0.3		0.0	0.0				
Q Average		7.0		0.1	3.5		0.1	0.1				
Q Spacing		25.0		25.0	25.0		25.0	25.0				
Q Storage		0		0	0		0	0				
Q S Ratio												
70th Percentile Output:												
fB%		1.2		1.2	1.2		1.2	1.2				
BOQ		8.3		0.1	4.2		0.1	0.1				
QSRatio												
85th Percentile Output:												
fB%		1.5		1.6	1.6		1.6	1.6				
BOQ		10.8		0.1	5.5		0.1	0.2				
QSRatio												
90th Percentile Output:												
fB%		1.7		1.8	1.7		1.8	1.8				
BOQ		11.8		0.1	6.1		0.1	0.2				
QSRatio												
95th Percentile Output:												
fB%		1.9		2.1	2.0		2.1	2.1				
BOQ		13.4		0.1	7.0		0.2	0.2				
QSRatio												
98th Percentile Output:												
fB%		2.3		2.7	2.5		2.7	2.7				
BOQ		16.0		0.1	8.6		0.2	0.3				
QSRatio												

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: md
Agency:
Date: 1/3/2005
Period: pm
Project ID: 2017 background traffic - no improvements
E/W St: sth 158

Inter.: sth 158/greyhound access
Area Type: All other areas
Jurisd: wisdot
Year : 2017
N/S St: greyhound access

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	1	2	0	2	0	1	0	0	0
LGConfig		T		L	T		L		R			
Volume		435		30	425		15		5			
Lane Width		12.0		12.0	12.0		12.0		12.0			
RTOR Vol									0			

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left					NB Left	A			
Thru		A			Thru				
Right					Right	A			
Peds					Peds				
WB Left	A	A			SB Left				
Thru	A	A			Thru				
Right					Right				
Peds					Peds				
NB Right	A				EB Right				
SB Right					WB Right				
Green	40.0	39.0				16.0			
Yellow	3.0	4.5				4.5			
All Red	0.0	1.5				1.5			

Cycle Length: 110.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
T	1221	3445	0.38	0.35	26.7	C	26.7	C
Westbound								
L	913	1805	0.04	0.75	4.2	A		
T	2544	3413	0.18	0.75	4.1	A	4.2	A
Northbound								
L	510	3505	0.03	0.15	40.4	D	33.3	C
R	910	1615	0.01	0.56	10.5	B		
Southbound								

Intersection Delay = 15.6 (sec/veh) Intersection LOS = B

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/3/2005
Analysis Time Period: pm
Intersection: sth 158/greyhound access
Area Type: All other areas
Jurisdiction: wisdot
Analysis Year: 2017
Project ID: 2017 background traffic - no improvements
East/West Street: sth 158 North/South Street: greyhound access

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume		435		30	425		15		5			
% Heavy Veh		5		0	6		0		0			
PHF		0.93		0.93	0.93		0.93		0.93			
PK 15 Vol		117		8	114		4		2			
Hi Ln Vol												
% Grade		0			0			0				
Ideal Sat		1900		1900	1900		1900		1900			
ParkExist												
NumPark												
No. Lanes	0	2	0	1	2	0	2	0	1	0	0	0
LGConfig		T		L	T		L		R			
Lane Width		12.0		12.0	12.0		12.0		12.0			
RTOR Vol									0			
Adj Flow		468		32	457		16		5			
%InSharedLn												
Prop LTs		0.000		1.000	0.000							
Prop RTs	0.000				0.000				1.000			
Peds Bikes	0							0			0	
Buses		0		0	0		0		0			
%InProtPhase					0.0							

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0		0.0	0.0		0.0		0.0			
Arriv. Type		3		3	3		3		3			
Unit Ext.		3.0		3.0	3.0		3.0		3.0			
I Factor		1.000			1.000			1.000				
Lost Time		2.0		2.0	2.0		2.0		2.0			
Ext of g		2.0		2.0	2.0		2.0		2.0			
Ped Min g		3.2						3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left					NB Left	A			
Thru		A			Thru				
Right					Right	A			
Peds					Peds				
WB Left	A	A			SB Left				
Thru	A	A			Thru				
Right					Right				
Peds					Peds				
NB Right	A				EB Right				
SB Right					WB Right				
Green	40.0	39.0				16.0			
Yellow	3.0	4.5				4.5			
All Red	0.0	1.5				1.5			

Cycle Length: 110.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V		435		30	425		15		5			
PHF		0.93		0.93	0.93		0.93		0.93			
Adj flow		468		32	457		16		5			
No. Lanes	0	2	0	1	2	0	2	0	1	0	0	0
Lane group		T		L	T		L		R			
Adj flow		468		32	457		16		5			
Prop LTs		0.000		1.000	0.000							
Prop RTs	0.000				0.000				1.000			

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound T			Westbound L	T		Northbound L		R		Southbound	
So	1900			1900	1900		1900		1900			
Lanes	0	2	0	1	2	0	2	0	1	0	0	0
fW		1.000		1.000	1.000		1.000		1.000			
fHV		0.952		1.000	0.943		1.000		1.000			
fG		1.000		1.000	1.000		1.000		1.000			
fP		1.000		1.000	1.000		1.000		1.000			
fBB		1.000		1.000	1.000		1.000		1.000			
fA		1.000		1.000	1.000		1.000		1.000			
fLU		0.952		1.000	0.952		0.971		1.000			
fRT		1.000			1.000				0.850			
fLT		1.000		0.950	1.000		0.950					
Sec.				0.355								
fLpb		1.000		1.000	1.000		1.000					
fRpb		1.000			1.000				1.000			
S		3445		1805	3413		3505		1615			
Sec.				674								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	468	3445	# 0.14	0.35	1221	0.38
Right							
Westbound							
Prot		32	1805	# 0.02	0.364	656	0.05
Perm		0	674	0.00	0.382	257	0.00
Left	L	32			0.75	913	0.04
Prot							
Perm							
Thru	T	457	3413	0.13	0.75	2544	0.18
Right							
Northbound							
Prot							
Perm							
Left	L	16	3505	# 0.00	0.15	510	0.03
Prot							
Perm							
Thru							
Right	R	5	1615	0.00	0.56	910	0.01
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.16
Total lost time per cycle, L = 18.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.19

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
T	0.38	0.35	26.5	1.000	1221	0.11	0.2	0.0	26.7	C	26.7	C
Westbound												
L	0.04	0.75	4.2	1.000	913	0.11	0.0	0.0	4.2	A		
T	0.18	0.75	4.1	1.000	2544	0.11	0.0	0.0	4.1	A	4.2	A
Northbound												
L	0.03	0.15	40.3	1.000	510	0.11	0.0	0.0	40.4	D	33.3	C
R	0.01	0.56	10.5	1.000	910	0.11	0.0	0.0	10.5	B		
Southbound												

Intersection delay = 15.6 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach		M		
Cycle length, C	110.0 sec			
Total actual green time for LT lane group, G (s)		82.0		
Effective permitted green time for LT lane group, g(s)		42.0		
Opposing effective green time, go (s)		39.0		
Number of lanes in LT lane group, N		1		
Number of lanes in opposing approach, No		2		
Adjusted LT flow rate, VLT (veh/h)		32		
Proportion of LT in LT lane group, PLT		1.000		
Proportion of LT in opposing flow, PLTo		0.00		
Adjusted opposing flow rate, Vo (veh/h)		468		
Lost time for LT lane group, tL		6.00		
Computation				
LT volume per cycle, LTC=VLTC/3600		0.98		
Opposing lane util. factor, fLUo	0.952	0.952		
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		7.51		
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g		0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.65		
gq, (see Exhibit C16-4,5,6,7,8)		11.23		
gu=g-gq if gq>=gf, or = g-gf if gq<gf		30.77		
n=Max(gq-gf)/2,0)		5.61		
PTHo=1-PLTo		1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00		
EL1 (refer to Exhibit C16-3)		2.07		
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.10		
gdiff=max(gq-gf,0)		0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.35		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.355		

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	110.0 sec			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT		0.000	0.000	
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo		0.952	0.952	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	110.0 sec			
Adj. LT vol from Vol Adjustment Worksheet, v		32		
v/c ratio from Capacity Worksheet, X		0.04		
Protected phase effective green interval, g (s)		40.0		
Opposing queue effective green interval, gq		11.23		
Unopposed green interval, gu		30.77		
Red time r=(C-g-gq-gu)		28.0		
Arrival rate, qa=v/(3600(max(X,1.0)))		0.01		
Protected ph. departure rate, Sp=s/3600		0.501		
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)		0.26		
XPerm		0.05		
XProt		0.03		
Case		1		
Queue at beginning of green arrow, Qa		0.25		
Queue at beginning of unsaturated green, Qu		0.10		
Residual queue, Qr		0.00		
Uniform Delay, d1		4.2		

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Dur. Unmet Demand Q veh	Unmet Demand t hrs.	Uniform Delay Unadj. ds	Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Lane Queue Delay d3 sec	Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 15.6 sec/veh Intersection LOS B

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	T		L	T	L	R		
Init Queue	0.0		0.0	0.0	0.0	0.0		
Flow Rate	245		32	240	8	5		
So	1900		1900	1900	1900	1900		
No.Lanes	2	0	1	2 0	2 0	1	0 0	0
SL	1809		1226	1792	1805	1615		
LnCapacity	641		913	1336	262	910		
Flow Ratio	0.14		0.03	0.13	0.00	0.00		
v/c Ratio	0.38		0.04	0.18	0.03	0.01		
Grn Ratio	0.35		0.75	0.75	0.15	0.56		
I Factor	1.000			1.000	1.000			
AT or PVG	3		3	3	3	3		
Pltn Ratio	1.00		1.00	1.00	1.00	1.00		
PF2	1.00		1.00	1.00	1.00	1.00		
Q1	5.6		0.3	2.2	0.2	0.1		
kB	0.6		0.7	0.9	0.3	0.7		
Q2	0.4		0.0	0.2	0.0	0.0		
Q Average	6.0		0.3	2.4	0.2	0.1		
Q Spacing	25.0		25.0	25.0	25.0	25.0		
Q Storage	0		0	0	0	0		
Q $ Ratio								
70th Percentile Output:								
fB%	1.2		1.2	1.2	1.2	1.2		
BOQ	7.1		0.3	2.8	0.3	0.1		
QSRatio								
85th Percentile Output:								
fB%	1.5		1.6	1.6	1.6	1.6		
BOQ	9.2		0.4	3.7	0.4	0.1		
QSRatio								
90th Percentile Output:								
fB%	1.7		1.8	1.8	1.8	1.8		
BOQ	10.1		0.5	4.1	0.4	0.1		
QSRatio								
95th Percentile Output:								
fB%	1.9		2.1	2.0	2.1	2.1		
BOQ	11.5		0.6	4.8	0.5	0.1		
QSRatio								
98th Percentile Output:								
fB%	2.3		2.7	2.5	2.7	2.7		
BOQ	13.9		0.7	6.0	0.6	0.2		
QSRatio								

ERROR MESSAGES

No errors to report.

HCS2000: Unsignalized Intersections Release 4.1d

TWO-WAY STOP CONTROL SUMMARY

Analyst:
Agency/Co.:
Date Performed: 12/15/2004
Analysis Time Period: am
Intersection: STH 158/Eastern Frontage Road
Jurisdiction: WisDOT
Units: U. S. Customary
Analysis Year: 2017
Project ID: 2017 background traffic - no improvements
East/West Street: STH 158
North/South Street: Frontage Road
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1 L	2 T	3 R	4 L	5 T	6 R
Volume	1	730	1	1	705	10
Peak-Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate, HFR	1	730	1	1	705	10
Percent Heavy Vehicles	0	--	--	0	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						No
Lanes	1	2	0	1	2	1
Configuration	L	T	TR	L	T	R
Upstream Signal?		No			No	

Minor Street: Approach	Northbound			Southbound		
Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume	50	10	55	10	1	10
Peak Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate, HFR	50	10	55	10	1	10
Percent Heavy Vehicles	0	0	0	0	0	0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No /			No /
Lanes	1	1	0	1	1	0
Configuration	L		TR	L		TR

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	L	L	L		TR	L		TR
v (vph)	1	1	50		65	10		11
C(m) (vph)	895	883	169		401	150		481
v/c	0.00	0.00	0.30		0.16	0.07		0.02
95% queue length	0.00	0.00	1.17		0.57	0.21		0.07
Control Delay	9.0	9.1	35.0+		15.7	30.7		12.7
LOS	A	A	E		C	D		B
Approach Delay				24.1			21.3	
Approach LOS				C			C	

HCS2000: Unsignalized Intersections Release 4.1d

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TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst:
Agency/Co.:
Date Performed: 12/15/2004
Analysis Time Period: am
Intersection: STH 158/Eastern Frontage Road
Jurisdiction: WisDOT
Units: U. S. Customary
Analysis Year: 2017
Project ID: 2017 background traffic - no improvements
East/West Street: STH 158
North/South Street: Frontage Road
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume	1	730	1	1	705	10
Peak-Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Peak-15 Minute Volume	0	182	0	0	176	2
Hourly Flow Rate, HFR	1	730	1	1	705	10
Percent Heavy Vehicles	0	--	--	0	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						No
Lanes	1	2	0	1	2	1
Configuration	L	T	TR	L	T	R
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume	50	10	55	10	1	10
Peak Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Peak-15 Minute Volume	12	2	14	2	0	2
Hourly Flow Rate, HFR	50	10	55	10	1	10
Percent Heavy Vehicles	0	0	0	0	0	0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No /			No /
RT Channelized?						
Lanes	1	1	0	1	1	0
Configuration	L		TR	L		TR

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn							
Through							
S5 Left-Turn							
Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1	4.1	7.5	6.5	6.9	7.5	6.5	6.9
t(c,hv)		2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
P(hv)		0	0	0	0	0	0	0	0
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Grade/100				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage	4.1	4.1	7.5	6.5	6.9	7.5	6.5	6.9
	2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20	2.20	3.50	4.00	3.30	3.50	4.00	3.30
t(f,HV)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(HV)	0	0	0	0	0	0	0	0
t(f)	2.2	2.2	3.5	4.0	3.3	3.5	4.0	3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2 V(t)	Movement 2 V(l,prot)	Movement 5 V(t)	Movement 5 V(l,prot)
V prog				
Total Saturation Flow Rate, s (vph)				
Arrival Type				
Effective Green, g (sec)				
Cycle Length, C (sec)				
Rp (from Exhibit 16-11)				
Proportion vehicles arriving on green P				
g(q1)				
g(q2)				
g(q)				

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2 V(t)	Movement 2 V(l,prot)	Movement 5 V(t)	Movement 5 V(l,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p		0.000		0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x	715	731	1086	1449	366	1079	1440	352
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process

	7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		3000		3000		3000		3000
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	366	352
Potential Capacity	637	650
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	637	650
Probability of Queue free St.	0.91	0.98

Step 2: LT from Major St.	4	1
Conflicting Flows	731	715
Potential Capacity	883	895
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	883	895
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows	1449	1440
Potential Capacity	132	134
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	132	134
Probability of Queue free St.	0.92	0.99

Step 4: LT from Minor St.	7	10
Conflicting Flows	1086	1079
Potential Capacity	173	175
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.99	0.92
Maj. L, Min T Adj. Imp Factor.	0.99	0.94
Cap. Adj. factor due to Impeding mvmnt	0.98	0.86
Movement Capacity	169	150

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	1449	1440
Potential Capacity	132	134
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	132	134
Result for 2 stage process:		
a		
y		
C t	132	134
Probability of Queue free St.	0.92	0.99

Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	1086	1079
Potential Capacity	173	175
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.99	0.92
Maj. L, Min T Adj. Imp Factor.	0.99	0.94
Cap. Adj. factor due to Impeding mvmnt	0.98	0.86
Movement Capacity	169	150
Results for Two-stage process:		
a		
y		
C t	169	150

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	50	10	55	10	1	10
Movement Capacity (vph)	169	132	637	150	134	650
Shared Lane Capacity (vph)			401			481

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	169	132	637	150	134	650
Volume	50	10	55	10	1	10
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh			401			481
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	L	L	L		TR	L		TR
v (vph)	1	1	50		65	10		11
C(m) (vph)	895	883	169		401	150		481
v/c	0.00	0.00	0.30		0.16	0.07		0.02
95% queue length	0.00	0.00	1.17		0.57	0.21		0.07
Control Delay	9.0	9.1	35.0+		15.7	30.7		12.7
LOS	A	A	E		C	D		B
Approach Delay				24.1			21.3	
Approach LOS				C			C	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4	9.0	9.1
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS2000: Unsignalized Intersections Release 4.1d

TWO-WAY STOP CONTROL SUMMARY

Analyst:
Agency/Co.:
Date Performed: 12/15/2004
Analysis Time Period: pm
Intersection: STH 158/Eastern Frontage Road
Jurisdiction: WisDOT
Units: U. S. Customary
Analysis Year: 2017
Project ID: 2017 background traffic - no improvements
East/West Street: STH 158
North/South Street: Frontage Road
Intersection Orientation: EW
Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1 L	2 T	3 R	4 L	5 T	6 R
Volume	1	870	1	1	505	25
Peak-Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate, HFR	1	870	1	1	505	25
Percent Heavy Vehicles	0	--	--	0	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						No
Lanes	1	2	0	1	2	1
Configuration	L	T	TR	L	T	R
Upstream Signal?		No			No	

Minor Street: Approach	Northbound			Southbound		
Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume	105	25	65	10	1	10
Peak Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate, HFR	105	25	65	10	1	10
Percent Heavy Vehicles	0	0	0	0	0	0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No /			No /
Lanes	1	1	0	1	1	0
Configuration	L		TR	L		TR

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	L	L	L		TR	L		TR
v (vph)	1	1	105		90	10		11
C(m) (vph)	1048	783	159		310	164		547
v/c	0.00	0.00	0.66		0.29	0.06		0.02
95% queue length	0.00	0.00	3.75		1.18	0.19		0.06
Control Delay	8.4	9.6	63.3		21.3	28.4		11.7
LOS	A	A	F		C	D		B
Approach Delay				43.9			19.6	
Approach LOS				E			C	

HCS2000: Unsignalized Intersections Release 4.1d

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TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst:
Agency/Co.:
Date Performed: 12/15/2004
Analysis Time Period: pm
Intersection: STH 158/Eastern Frontage Road
Jurisdiction: WisDOT
Units: U. S. Customary
Analysis Year: 2017
Project ID: 2017 background traffic - no improvements
East/West Street: STH 158
North/South Street: Frontage Road
Intersection Orientation: EW
Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume	1	870	1	1	505	25
Peak-Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Peak-15 Minute Volume	0	218	0	0	126	6
Hourly Flow Rate, HFR	1	870	1	1	505	25
Percent Heavy Vehicles	0	--	--	0	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						No
Lanes	1	2	0	1	2	1
Configuration	L	T	TR	L	T	R
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume	105	25	65	10	1	10
Peak Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Peak-15 Minute Volume	26	6	16	2	0	2
Hourly Flow Rate, HFR	105	25	65	10	1	10
Percent Heavy Vehicles	0	0	0	0	0	0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No /			No /
RT Channelized?						
Lanes	1	1	0	1	1	0
Configuration	L		TR	L		TR

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn							
Through							
S5 Left-Turn							
Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1	4.1	7.5	6.5	6.9	7.5	6.5	6.9
t(c,hv)		2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
P(hv)		0	0	0	0	0	0	0	0
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Grade/100				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage	4.1	4.1	7.5	6.5	6.9	7.5	6.5	6.9
	2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20	2.20	3.50	4.00	3.30	3.50	4.00	3.30
t(f,HV)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(HV)	0	0	0	0	0	0	0	0
t(f)	2.2	2.2	3.5	4.0	3.3	3.5	4.0	3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2 V(t)	Movement 2 V(1,prot)	Movement 5 V(t)	Movement 5 V(1,prot)
V prog				
Total Saturation Flow Rate, s (vph)				
Arrival Type				
Effective Green, g (sec)				
Cycle Length, C (sec)				
Rp (from Exhibit 16-11)				
Proportion vehicles arriving on green P				
g(q1)				
g(q2)				
g(q)				

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2 V(t)	Movement 2 V(1,prot)	Movement 5 V(t)	Movement 5 V(1,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p		0.000		0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5
Single-Stage Process

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x	530	871	1126	1404	436	957	1380	252
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process

	7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		3000		3000		3000		3000
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	436	252
Potential Capacity	574	754
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	574	754
Probability of Queue free St.	0.89	0.99

Step 2: LT from Major St.	4	1
Conflicting Flows	871	530
Potential Capacity	783	1048
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	783	1048
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows	1404	1380
Potential Capacity	141	146
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	141	146
Probability of Queue free St.	0.82	0.99

Step 4: LT from Minor St.	7	10
Conflicting Flows	1126	957
Potential Capacity	162	215
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.99	0.82
Maj. L, Min T Adj. Imp Factor.	0.99	0.86
Cap. Adj. factor due to Impeding mvmnt	0.98	0.76
Movement Capacity	159	164

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	1404	1380
Potential Capacity	141	146
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	141	146
Result for 2 stage process:		
a		
y		
C t	141	146
Probability of Queue free St.	0.82	0.99

Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	1126	957
Potential Capacity	162	215
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.99	0.82
Maj. L, Min T Adj. Imp Factor.	0.99	0.86
Cap. Adj. factor due to Impeding mvmnt	0.98	0.76
Movement Capacity	159	164
Results for Two-stage process:		
a		
y		
C t	159	164

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	105	25	65	10	1	10
Movement Capacity (vph)	159	141	574	164	146	754
Shared Lane Capacity (vph)			310			547

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	159	141	574	164	146	754
Volume	105	25	65	10	1	10
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh			310			547
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	L	L	L		TR	L		TR
v (vph)	1	1	105		90	10		11
C(m) (vph)	1048	783	159		310	164		547
v/c	0.00	0.00	0.66		0.29	0.06		0.02
95% queue length	0.00	0.00	3.75		1.18	0.19		0.06
Control Delay	8.4	9.6	63.3		21.3	28.4		11.7
LOS	A	A	F		C	D		B
Approach Delay				43.9			19.6	
Approach LOS				E			C	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4	8.4	9.6
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS2000: Unsignalized Intersections Release 4.1d

TWO-WAY STOP CONTROL SUMMARY

Analyst:
Agency/Co.:
Date Performed: 12/15/2004
Analysis Time Period: am
Intersection: sth 158/i-94 nb interchange
Jurisdiction: wisdot
Units: U. S. Customary
Analysis Year: 2017
Project ID: 2017 background traffic - no improvements
East/West Street: sth 158
North/South Street: i-94 nb interchange
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	25	530			445	320
Peak-Hour Factor, PHF	1.00	1.00			1.00	1.00
Hourly Flow Rate, HFR	25	530			445	320
Percent Heavy Vehicles	0	--	--		--	--
Median Type/Storage	Undivided		/			
RT Channelized?					No	
Lanes	1	2			2	1
Configuration	L	T			T	R
Upstream Signal?		No			No	

Minor Street: Approach	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	1	1				
Peak Hour Factor, PHF	1.00	1.00				
Hourly Flow Rate, HFR	1	1				
Percent Heavy Vehicles	0	0				
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/			/
Lanes	0	1				
Configuration	LT					

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	L		LT					
v (vph)	25		2					
C(m) (vph)	857		203					
v/c	0.03		0.01					
95% queue length	0.09		0.03					
Control Delay	9.3		22.9					
LOS	A		C					
Approach Delay				22.9				
Approach LOS				C				

HCS2000: Unsignalized Intersections Release 4.1d

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TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst:
Agency/Co.:
Date Performed: 12/15/2004
Analysis Time Period: am
Intersection: sth 158/i-94 nb interchange
Jurisdiction: wisdot
Units: U. S. Customary
Analysis Year: 2017
Project ID: 2017 background traffic - no improvements
East/West Street: sth 158
North/South Street: i-94 nb interchange
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	25	530			445	320
Peak-Hour Factor, PHF	1.00	1.00			1.00	1.00
Peak-15 Minute Volume	6	132			111	80
Hourly Flow Rate, HFR	25	530			445	320
Percent Heavy Vehicles	0	--	--		--	--
Median Type/Storage	Undivided		/			
RT Channelized?					No	
Lanes	1	2			2	1
Configuration	L	T			T	R
Upstream Signal?		No			No	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	1	1				
Peak Hour Factor, PHF	1.00	1.00				
Peak-15 Minute Volume	0	0				
Hourly Flow Rate, HFR	1	1				
Percent Heavy Vehicles	0	0				
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/			/
RT Channelized?						
Lanes	0	1				
Configuration	LT					

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

		Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2	Left-Turn							
	Through							
S5	Left-Turn							
	Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1		7.5	6.5				
t(c,hv)		2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
P(hv)		0		0	0				
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Grade/100				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00		0.70	0.00				
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage	4.1		6.8	6.5				
	2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20		3.50	4.00				
t(f,HV)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(HV)	0		0	0				
t(f)	2.2		3.5	4.0				

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2 V(t)	Movement 2 V(l,prot)	Movement 5 V(t)	Movement 5 V(l,prot)
V prog				
Total Saturation Flow Rate, s (vph)				
Arrival Type				
Effective Green, g (sec)				
Cycle Length, C (sec)				
Rp (from Exhibit 16-11)				
Proportion vehicles arriving on green P				
g(q1)				
g(q2)				
g(q)				

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2 V(t)	Movement 2 V(l,prot)	Movement 5 V(t)	Movement 5 V(l,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p		0.000		0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x	765		802	1345				
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		3000		3000				
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 2: LT from Major St.	4	1
Conflicting Flows		765
Potential Capacity		857
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		857
Probability of Queue free St.	1.00	0.97
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows	1345	
Potential Capacity	153	
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.97	0.97
Movement Capacity	149	
Probability of Queue free St.	0.99	1.00

Step 4: LT from Minor St.	7	10
Conflicting Flows	802	
Potential Capacity	326	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.96
Maj. L, Min T Adj. Imp Factor.		0.97
Cap. Adj. factor due to Impeding mvmnt	0.97	0.97
Movement Capacity	316	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	1345	
Potential Capacity	153	
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.97	0.97
Movement Capacity	149	
Result for 2 stage process:		
a		
y		
C t	149	
Probability of Queue free St.	0.99	1.00

Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	802	
Potential Capacity	326	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.96
Maj. L, Min T Adj. Imp Factor.		0.97
Cap. Adj. factor due to Impeding mvmnt	0.97	0.97
Movement Capacity	316	
Results for Two-stage process:		
a		
y		
C t	316	

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	1	1				
Movement Capacity (vph)	316	149				
Shared Lane Capacity (vph)	203					

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	316	149				
Volume	1	1				
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh	203					
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	L		LT					
v (vph)	25		2					
C(m) (vph)	857		203					
v/c	0.03		0.01					
95% queue length	0.09		0.03					
Control Delay	9.3		22.9					
LOS	A		C					
Approach Delay				22.9				
Approach LOS				C				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.97	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4	9.3	
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS2000: Unsignalized Intersections Release 4.1d

TWO-WAY STOP CONTROL SUMMARY

Analyst:
Agency/Co.:
Date Performed: 12/15/2004
Analysis Time Period: pm
Intersection: sth 158/i-94 nb interchange
Jurisdiction: wisdot
Units: U. S. Customary
Analysis Year: 2017
Project ID: 2017 background traffic - no improvements
East/West Street: sth 158
North/South Street: i-94 nb interchange
Intersection Orientation: EW
Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	15	455			295	325
Peak-Hour Factor, PHF	1.00	1.00			1.00	1.00
Hourly Flow Rate, HFR	15	455			295	325
Percent Heavy Vehicles	0	--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?						No
Lanes	1	2			2	1
Configuration	L	T			T	R
Upstream Signal?		No			No	

Minor Street: Approach	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	1	1				
Peak Hour Factor, PHF	1.00	1.00				
Hourly Flow Rate, HFR	1	1				
Percent Heavy Vehicles	0	0				
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/			/
Lanes	0	1				
Configuration		LT				

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	L		LT					
v (vph)	15		2					
C(m) (vph)	970		278					
v/c	0.02		0.01					
95% queue length	0.05		0.02					
Control Delay	8.8		18.0					
LOS	A		C					
Approach Delay				18.0				
Approach LOS				C				

HCS2000: Unsignalized Intersections Release 4.1d

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TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst:
Agency/Co.:
Date Performed: 12/15/2004
Analysis Time Period: pm
Intersection: sth 158/i-94 nb interchange
Jurisdiction: wisdot
Units: U. S. Customary
Analysis Year: 2017
Project ID: 2017 background traffic - no improvements
East/West Street: sth 158
North/South Street: i-94 nb interchange
Intersection Orientation: EW
Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	15	455			295	325
Peak-Hour Factor, PHF	1.00	1.00			1.00	1.00
Peak-15 Minute Volume	4	114			74	81
Hourly Flow Rate, HFR	15	455			295	325
Percent Heavy Vehicles	0	--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?						No
Lanes	1	2			2	1
Configuration	L	T			T	R
Upstream Signal?		No			No	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	1	1				
Peak Hour Factor, PHF	1.00	1.00				
Peak-15 Minute Volume	0	0				
Hourly Flow Rate, HFR	1	1				
Percent Heavy Vehicles	0	0				
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/			/
RT Channelized?						
Lanes	0	1				
Configuration		LT				

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

		Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2	Left-Turn							
	Through							
S5	Left-Turn							
	Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1	4	7	8	9	10	11	12
		L	L	L	T	R	L	T	R
t(c,base)		4.1		7.5	6.5				
t(c,hv)		2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
P(hv)		0		0	0				
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Grade/100				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00		0.70	0.00				
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage	4.1		6.8	6.5				
	2-stage								

Follow-Up Time Calculations

Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)	2.20		3.50	4.00				
t(f,HV)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(HV)	0		0	0				
t(f)	2.2		3.5	4.0				

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(1,prot)	V(t)	V(1,prot)
V prog				
Total Saturation Flow Rate, s (vph)				
Arrival Type				
Effective Green, g (sec)				
Cycle Length, C (sec)				
Rp (from Exhibit 16-11)				
Proportion vehicles arriving on green P				
g(q1)				
g(q2)				
g(q)				

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2		Movement 5	
	V(t)	V(1,prot)	V(t)	V(1,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p		0.000		0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5
Single-Stage Process

Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
V c,x	620		632	1105				
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		3000		3000				
P(X)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 2: LT from Major St.	4	1
Conflicting Flows		620
Potential Capacity		970
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		970
Probability of Queue free St.	1.00	0.98
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows	1105	
Potential Capacity	213	
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.98	0.98
Movement Capacity	210	
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Conflicting Flows	632	
Potential Capacity	417	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.98
Maj. L, Min T Adj. Imp Factor.		0.98
Cap. Adj. factor due to Impeding mvmnt	0.98	0.98
Movement Capacity	411	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	1105	
Potential Capacity	213	
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.98	0.98
Movement Capacity	210	
Result for 2 stage process:		
a		
y		
C t	210	
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	632	
Potential Capacity	417	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.98
Maj. L, Min T Adj. Imp Factor.		0.98
Cap. Adj. factor due to Impeding mvmnt	0.98	0.98
Movement Capacity	411	
Results for Two-stage process:		
a		
y		
C t	411	

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	1	1				
Movement Capacity (vph)	411	210				
Shared Lane Capacity (vph)	278					

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	411	210				
Volume	1	1				
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh	278					
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	L		LT					
v (vph)	15		2					
C(m) (vph)	970		278					
v/c	0.02		0.01					
95% queue length	0.05		0.02					
Control Delay	8.8		18.0					
LOS	A		C					
Approach Delay				18.0				
Approach LOS				C				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.98	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4	8.8	
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS2000: Signalized Intersections Release 4.1e

Analyst: md
Agency:
Date: 12/15/2004
Period: am
Project ID: 2017 background traffic - no improvements
E/W St: sth 158

Inter.: sth 158/I-94 SB Interchange
Area Type: All other areas
Jurisd: WisDOT
Year : 2017
N/S St: I-94 SB Intechange

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	1	1	2	0	0	0	0	1	1	0
LGConfig		T	R	L	T					L	LTR	
Volume		125	15	350	95					430	2	40
Lane Width		12.0	12.0	12.0	12.0					12.0	12.0	
RTOR Vol			0								0	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	3
EB Left					NB Left				
Thru		A			Thru				
Right		A			Right				
Peds					Peds				
WB Left	A	A			SB Left	A			
Thru	A	A			Thru	A			
Right					Right	A			
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	40.0	9.0				35.0			
Yellow	3.0	4.5				4.5			
All Red	0.0	2.0				2.0			

Cycle Length: 100.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
T	326	3618	0.41	0.09	43.8	D	43.6	D
R	145	1615	0.11	0.09	42.2	D		
Westbound								
L	722	1626	0.52	0.52	15.9	B		
T	1881	3618	0.05	0.52	11.9	B	15.0	B
Northbound								
Southbound								
L	569	1626	0.44	0.35	25.5	C		
LTR	571	1631	0.44	0.35	25.5	C	25.5	C

Intersection Delay = 23.5 (sec/veh) Intersection LOS = C

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 12/15/2004
Analysis Time Period: am
Intersection: sth 158/I-94 SB Interchange
Area Type: All other areas
Jurisdiction: WisDOT
Analysis Year: 2017
Project ID: 2017 background traffic - no improvements
East/West Street: sth 158 North/South Street: I-94 SB Intechange

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume		125	15	350	95					430	2	40
% Heavy Veh		0	0	11	0					11	0	0
PHF		0.94	0.94	0.94	0.94					0.94	0.94	0.94
PK 15 Vol		33	4	93	25					114	1	11
Hi Ln Vol												
% Grade		0			0						0	
Ideal Sat		1900	1900	1900	1900					1900	1900	
ParkExist												
NumPark												
No. Lanes	0	2	1	1	2	0	0	0	0	1	1	0
LGConfig		T	R	L	T					L	LTR	
Lane Width		12.0	12.0	12.0	12.0					12.0	12.0	
RTOR Vol			0								0	
Adj Flow		133	16	372	101					251	251	
%InSharedLn										45		
Prop LTs		0.000		1.000	0.000						0.819	
Prop RTs		0.000	1.000		0.000						0.171	
Peds Bikes	0						0				0	
Buses		0	0	0	0					0	0	
%InProtPhase				0.0								

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0	0.0	0.0	0.0					0.0	0.0	
Arriv. Type		3	3	3	3					3	3	
Unit Ext.		3.0	3.0	3.0	3.0					3.0	3.0	
I Factor		1.000			1.000						1.000	
Lost Time		2.0	2.0	2.0	2.0					2.0	2.0	
Ext of g		2.0	2.0	2.0	2.0					2.0	2.0	
Ped Min g		3.2						3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left					NB Left				
Thru		A			Thru				
Right		A			Right				
Peds					Peds				
WB Left	A	A			SB Left	A			
Thru	A	A			Thru	A			
Right					Right	A			
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	40.0	9.0				35.0			
Yellow	3.0	4.5				4.5			
All Red	0.0	2.0				2.0			

Cycle Length: 100.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V		125	15	350	95					430	2	40
PHF		0.94	0.94	0.94	0.94					0.94	0.94	0.94
Adj flow		133	16	372	101					457	2	43
No. Lanes	0	2	1		2	0	0	0	0	1	1	0
Lane group		T	R	L	T					L	LTR	
Adj flow		133	16	372	101					251	251	
Prop LTs		0.000		1.000	0.000						0.819	
Prop RTs		0.000	1.000		0.000						0.171	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound T	Eastbound R	Westbound L	Westbound T	Northbound				Southbound L	Southbound LTR	
So	1900	1900	1900	1900					1900	1900	
Lanes	2	1	1	2	0	0	0	0	1	1	0
fW	1.000	1.000	1.000	1.000					1.000	1.000	
fHV	1.000	1.000	0.901	1.000					0.901	0.917	
fG	1.000	1.000	1.000	1.000					1.000	1.000	
fP	1.000	1.000	1.000	1.000					1.000	1.000	
fBB	1.000	1.000	1.000	1.000					1.000	1.000	
fA	1.000	1.000	1.000	1.000					1.000	1.000	
fLU	0.952	1.000	1.000	0.952						0.974	
fRT	1.000	0.850		1.000					0.950	0.961	
fLT	1.000		0.950	1.000							
Sec.			0.333						1.000	1.000	
fLpb	1.000		1.000	1.000						1.000	
fRpb	1.000	1.000		1.000					1626	1631	
S	3618	1615	1626	3618							
Sec.			571								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	Lane Group Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	133	3618	# 0.04	0.09	326	0.41
Right	R	16	1615	0.01	0.09	145	0.11
Westbound							
Prot		372	1626	# 0.23	0.400	650	0.57
Perm		0	571	0.00	0.120	72	0.00
Left	L	372			0.52	722	0.52
Prot							
Perm							
Thru	T	101	3618	0.03	0.52	1881	0.05
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Southbound							
Prot							
Perm							
Left	L	251	1626	# 0.15	0.35	569	0.44
Prot							
Perm							
Thru	LTR	251	1631	0.15	0.35	571	0.44
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.42
Total lost time per cycle, L = 19.50 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.52

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
T	0.41	0.09	43.0	1.000	326	0.11	0.8	0.0	43.8	D	43.6	D
R	0.11	0.09	41.8	1.000	145	0.11	0.3	0.0	42.2	D		
Westbound												
L	0.52	0.52	15.2	1.000	722	0.12	0.6	0.0	15.9	B		
T	0.05	0.52	11.9	1.000	1881	0.11	0.0	0.0	11.9	B	15.0	B
Northbound												
Southbound												
L	0.44	0.35	25.0	1.000	569	0.11	0.5	0.0	25.5	C		

LTR 0.44 0.35 25.0 1.000 571 0.11 0.5 0.0 25.5 C 25.5 C

Intersection delay = 23.5 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach		M		
Cycle length, C 100.0 sec				
Total actual green time for LT lane group, G (s)		52.0		
Effective permitted green time for LT lane group, g(s)		12.0		
Opposing effective green time, go (s)		9.0		
Number of lanes in LT lane group, N		1		
Number of lanes in opposing approach, No		2		
Adjusted LT flow rate, VLT (veh/h)		372		
Proportion of LT in LT lane group, PLT		1.000		
Proportion of LT in opposing flow, PLTo		0.00		
Adjusted opposing flow rate, Vo (veh/h)		133		
Lost time for LT lane group, tL		6.50		
Computation				
LT volume per cycle, LTC=VLTC/3600		10.33		
Opposing lane util. factor, fLUo	0.952	0.952	1.000	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		1.94		
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g		0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.91		
gq, (see Exhibit C16-4,5,6,7,8)		6.50		
gu=g-gq if gq>=gf, or = g-gf if gq<gf		5.50		
n=Max(gq-gf)/2,0)		3.25		
PTHo=1-PLTo		1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00		
EL1 (refer to Exhibit C16-3)		1.50		
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.33		
gdiff=max(gq-gf,0)		0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.33		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.333		

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 100.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000		0.819
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	0.952	0.952	1.000	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 100.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v		372		
v/c ratio from Capacity Worksheet, X		0.52		
Protected phase effective green interval, g (s)		40.0		
Opposing queue effective green interval, gq		6.50		
Unopposed green interval, gu		5.50		
Red time r=(C-g-gq-gu)		48.0		
Arrival rate, qa=v/(3600(max[X,1.0]))		0.10		
Protected ph. departure rate, Sp=s/3600		0.452		
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)		0.35		
XPerm		0.65		
XProt		0.50		
Case		1		
Queue at beginning of green arrow, Qa		4.96		
Queue at beginning of unsaturated green, Qu		0.67		
Residual queue, Qr		0.00		
Uniform Delay, d1		15.2		

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 23.5 sec/veh Intersection LOS C

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	T	R	L	T			L	LTR
Init Queue	0.0	0.0	0.0	0.0			0.0	0.0
Flow Rate	69	16	372	53			251	251
So	1900	1900	1900	1900			1900	1900
No.Lanes	2	1	1	2	0	0 0 0	1	1 0
SL	1900	1615	1383	1900			1626	1631
LnCapacity	171	145	722	987			569	571
Flow Ratio	0.04	0.01	0.27	0.03			0.15	0.15
v/c Ratio	0.40	0.11	0.52	0.05			0.44	0.44
Grn Ratio	0.09	0.09	0.52	0.52			0.35	0.35
I Factor	1.000			1.000				1.000
AT or PVG	3	3	3	3			3	3
Pltn Ratio	1.00	1.00	1.00	1.00			1.00	1.00
PF2	1.00	1.00	1.00	1.00			1.00	1.00
Q1	1.8	0.4	6.2	0.7			5.4	5.4
kB	0.3	0.2	0.6	0.7			0.5	0.5
Q2	0.2	0.0	0.6	0.0			0.4	0.4
Q Average	2.0	0.4	6.9	0.8			5.8	5.8
Q Spacing	25.0	25.0	25.0	25.0			25.0	25.0
Q Storage	0	0	0	0			0	0
Q S Ratio								
70th Percentile Output:								
fB%	1.2	1.2	1.2	1.2			1.2	1.2
BOQ	2.4	0.5	8.1	0.9			6.8	6.8
QSRatio								
85th Percentile Output:								
fB%	1.6	1.6	1.5	1.6			1.5	1.5
BOQ	3.1	0.7	10.6	1.2			8.9	8.9
QSRatio								
90th Percentile Output:								
fB%	1.8	1.8	1.7	1.8			1.7	1.7
BOQ	3.5	0.8	11.6	1.4			9.8	9.8
QSRatio								
95th Percentile Output:								
fB%	2.0	2.1	1.9	2.1			1.9	1.9
BOQ	4.0	0.9	13.1	1.6			11.2	11.2
QSRatio								
98th Percentile Output:								
fB%	2.6	2.7	2.3	2.6			2.3	2.3
BOQ	5.1	1.2	15.7	2.0			13.5	13.5
QSRatio								

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: md
Agency:
Date: 12/15/2004
Period: am
Project ID: 2017 background traffic - no improvements
E/W St: sth 158

Inter.: sth 158/I-94 SB Interchange
Area Type: All other areas
Jurisd: WisDOT
Year : 2017
N/S St: I-94 SB Intechange

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	1	1	2	0	0	0	0	1	1	0
LGConfig		T	R	L	T					L	LTR	
Volume		90	15	140	155					385	5	85
Lane Width		12.0	12.0	12.0	12.0					12.0	12.0	
RTOR Vol			0									0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left					NB Left				
Thru		A			Thru				
Right		A			Right				
Peds					Peds				
WB Left	A	A			SB Left	A			
Thru	A	A			Thru	A			
Right					Right	A			
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	35.0	17.0				42.0			
Yellow	3.0	4.5				4.5			
All Red	0.0	2.0				2.0			

Cycle Length: 110.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
T	559	3618	0.20	0.15	40.7	D	40.6	D
R	250	1615	0.08	0.15	39.9	D		
Westbound								
L	698	1719	0.25	0.50	15.7	B		
T	1809	3618	0.11	0.50	14.6	B	15.1	B
Northbound								
Southbound								
L	656	1719	0.40	0.38	25.3	C		
LTR	647	1694	0.51	0.38	26.7	C	26.1	C

Intersection Delay = 24.1 (sec/veh) Intersection LOS = C

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 12/15/2004
Analysis Time Period: am
Intersection: sth 158/I-94 SB Interchange
Area Type: All other areas
Jurisdiction: WisDOT
Analysis Year: 2017
Project ID: 2017 background traffic - no improvements

East/West Street: sth 158
North/South Street: I-94 SB Intechange

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume		90	15	140	155					385	5	85
% Heavy Veh		0	0	5	0					5	0	0
PHF		0.80	0.80	0.80	0.80					0.80	0.80	0.80
PK 15 Vol		28	5	44	48					120	2	27
Hi Ln Vol												
% Grade		0			0						0	
Ideal Sat		1900	1900	1900	1900					1900	1900	
ParkExist												
NumPark												
No. Lanes	0	2	1	1	2	0	0	0	0	1	1	0
LGConfig		T	R	L	T					L	LTR	
Lane Width		12.0	12.0	12.0	12.0					12.0	12.0	
RTOR Vol			0									0
Adj Flow		112	19	175	194					265	328	
%InSharedLn										45		
Prop LTs		0.000		1.000	0.000						0.660	
Prop RTs		0.000	1.000		0.000						0.323	
Peds Bikes		0					0				0	
Buses		0	0	0	0					0	0	
%InProtPhase				0.0								

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0	0.0	0.0	0.0					0.0	0.0	
Arriv. Type		3	3	3	3					3	3	
Unit Ext.		3.0	3.0	3.0	3.0					3.0	3.0	
I Factor		1.000			1.000						1.000	
Lost Time		2.0	2.0	2.0	2.0					2.0	2.0	
Ext of g		2.0	2.0	2.0	2.0					2.0	2.0	
Ped Min g		3.2						3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left					NB Left				
Thru		A			Thru				
Right		A			Right				
Peds					Peds				
WB Left	A	A			SB Left	A			
Thru	A	A			Thru	A			
Right					Right	A			
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	35.0	17.0				42.0			
Yellow	3.0	4.5				4.5			
All Red	0.0	2.0				2.0			

Cycle Length: 110.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V		90	15	140	155					385	5	85
PHF		0.80	0.80	0.80	0.80					0.80	0.80	0.80
Adj flow		112	19	175	194					481	6	106
No. Lanes	0	2	1	1	2	0	0	0	0	1	1	0
Lane group		T	R	L	T					L	LTR	
Adj flow		112	19	175	194					265	328	
Prop LTs		0.000		1.000	0.000						0.660	
Prop RTs		0.000	1.000		0.000						0.323	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound T	Eastbound R	Westbound L	Westbound T	Northbound			Southbound L	Southbound LTR	
So	1900	1900	1900	1900				1900	1900	
Lanes	0 2	1	1	2	0	0	0	0 1	1	0
fW	1.000	1.000	1.000	1.000				1.000	1.000	
fHV	1.000	1.000	0.952	1.000				0.952	0.968	
fG	1.000	1.000	1.000	1.000				1.000	1.000	
fP	1.000	1.000	1.000	1.000				1.000	1.000	
fBB	1.000	1.000	1.000	1.000				1.000	1.000	
fA	1.000	1.000	1.000	1.000				1.000	1.000	
fLU	0.952	1.000	1.000	0.952					1.000	
fRT	1.000	0.850		1.000					0.952	
fLT	1.000		0.950	1.000				0.950	0.968	
Sec.			0.460							
fLpb	1.000		1.000	1.000				1.000	1.000	
fRpb	1.000	1.000		1.000					1.000	
S	3618	1615	1719	3618				1719	1694	
Sec.			832							

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	112	3618	# 0.03	0.15	559	0.20
Right	R	19	1615	0.01	0.15	250	0.08
Westbound							
Prot		175	1719	# 0.10	0.318	547	0.32
Perm		0	832	0.00	0.182	151	0.00
Left	L	175			0.50	698	0.25
Prot							
Perm							
Thru	T	194	3618	0.05	0.50	1809	0.11
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Southbound							
Prot							
Perm							
Left	L	265	1719	0.15	0.38	656	0.40
Prot							
Perm							
Thru	LTR	328	1694	# 0.19	0.38	647	0.51
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.33
Total lost time per cycle, L = 19.50 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.40

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
T	0.20	0.15	40.6	1.000	559	0.11	0.2	0.0	40.7	D	40.6	D
R	0.08	0.15	39.8	1.000	250	0.11	0.1	0.0	39.9	D		
Westbound												
L	0.25	0.50	15.5	1.000	698	0.11	0.2	0.0	15.7	B		
T	0.11	0.50	14.5	1.000	1809	0.11	0.0	0.0	14.6	B	15.1	B
Northbound												
Southbound												
L	0.40	0.38	24.9	1.000	656	0.11	0.4	0.0	25.3	C		

LTR	0.51	0.38	26.1	1.000	647	0.12	0.7	0.0	26.7	C	26.1	C

Intersection delay = 24.1 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach		M		
Cycle length, C 110.0 sec				
Total actual green time for LT lane group, G (s)		55.0		
Effective permitted green time for LT lane group, g(s)		20.0		
Opposing effective green time, go (s)		17.0		
Number of lanes in LT lane group, N		1		
Number of lanes in opposing approach, No		2		
Adjusted LT flow rate, VLT (veh/h)		175		
Proportion of LT in LT lane group, PLT		1.000		
Proportion of LT in opposing flow, PLTo		0.00		
Adjusted opposing flow rate, Vo (veh/h)		112		
Lost time for LT lane group, tL		6.50		
Computation				
LT volume per cycle, LTC=VLTC/3600		5.35		
Opposing lane util. factor, fLUo	0.952	0.952	1.000	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		1.80		
gf=G[exp(- a * (LTC ** b)]-tl, gf<=g		0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.85		
gq, (see Exhibit C16-4,5,6,7,8)		6.50		
gu=g-gq if gq>=gf, or = g-gf if gq<gf		13.50		
n=Max(gq-gf)/2,0)		3.25		
PTHo=1-PLTo		1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00		
EL1 (refer to Exhibit C16-3)		1.47		
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.20		
gdiff=max(gq-gf,0)		0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.46		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.460		

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 110.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000	0.660	
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	0.952	0.952	1.000	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b)]-tl, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 110.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v		175		
v/c ratio from Capacity Worksheet, X		0.25		
Protected phase effective green interval, g (s)		35.0		
Opposing queue effective green interval, gq		6.50		
Unopposed green interval, gu		13.50		
Red time r=(C-g-gq-gu)		55.0		
Arrival rate, qa=v/(3600(max[X,1.0]))		0.05		
Protected ph. departure rate, Sp=s/3600		0.478		
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)		0.34		
XPerm		0.21		
XProt		0.26		
Case		1		
Queue at beginning of green arrow, Qa		2.67		
Queue at beginning of unsaturated green, Qu		0.32		
Residual queue, Qr		0.00		
Uniform Delay, d1		15.5		

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Dur. Unmet Demand Q veh	Unmet Demand t hrs.	Uniform Delay Unadj. ds	Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 24.1 sec/veh Intersection LOS C

BACK OF QUEUE WORKSHEET

LaneGroup	Eastbound T	R	Westbound L	T	Northbound			Southbound L	LTR	
Init Queue	0.0	0.0	0.0	0.0				0.0	0.0	
Flow Rate	58	19	175	101				265	328	
So	1900	1900	1900	1900				1900	1900	
No.Lanes	2	1	1	2	0	0	0	1	1	0
SL	1900	1615	1396	1900				1719	1694	
LnCapacity	293	250	698	950				656	647	
Flow Ratio	0.03	0.01	0.13	0.05				0.15	0.19	
v/c Ratio	0.20	0.08	0.25	0.11				0.40	0.51	
Grn Ratio	0.15	0.15	0.50	0.50				0.38	0.38	
I Factor	1.000			1.000					1.000	
AT or PVG	3	3	3	3				3	3	
Pltn Ratio	1.00	1.00	1.00	1.00				1.00	1.00	
PF2	1.00	1.00	1.00	1.00				1.00	1.00	
Q1	1.5	0.5	2.9	1.6				5.9	7.7	
kB	0.4	0.3	0.6	0.8				0.6	0.6	
Q2	0.1	0.0	0.2	0.1				0.4	0.6	
Q Average	1.6	0.5	3.1	1.7				6.3	8.3	
Q Spacing	25.0	25.0	25.0	25.0				25.0	25.0	
Q Storage	0	0	0	0				0	0	
Q S Ratio										
70th Percentile Output:										
fB%	1.2	1.2	1.2	1.2				1.2	1.2	
BOQ	2.0	0.6	3.7	2.1				7.5	9.8	
QSRatio										
85th Percentile Output:										
fB%	1.6	1.6	1.6	1.6				1.5	1.5	
BOQ	2.6	0.8	4.9	2.7				9.8	12.7	
QSRatio										
90th Percentile Output:										
fB%	1.8	1.8	1.7	1.8				1.7	1.7	
BOQ	2.9	0.9	5.4	3.0				10.7	13.8	
QSRatio										
95th Percentile Output:										
fB%	2.0	2.1	2.0	2.0				1.9	1.9	
BOQ	3.4	1.1	6.2	3.5				12.2	15.6	
QSRatio										
98th Percentile Output:										
fB%	2.6	2.7	2.5	2.6				2.3	2.2	
BOQ	4.2	1.4	7.7	4.4				14.6	18.5	
QSRatio										

ERROR MESSAGES

No errors to report.

HCS2000: Unsignalized Intersections Release 4.1d

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ALL-WAY STOP CONTROL(AWSC) ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/5/2005
Analysis Time Period: am
Intersection: sth 158/western frontage road
Jurisdiction: wisdot
Units: U. S. Customary
Analysis Year: 2017
Project ID: 2017 background traffic - no improvements
East/West Street: sth158
North/South Street: western frontage road

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	0	0	0	130	0	1	0	1	110	30	1	0

% Thrus Left Lane

	Eastbound L1	Eastbound L2	Westbound L1	Westbound L2	Northbound L1	Northbound L2	Southbound L1	Southbound L2
Configuration			LR		TR		LT	
PHF			1.00		1.00		1.00	
Flow Rate			131		111		31	
% Heavy Veh			0		0		0	
No. Lanes			1		1		1	
Opposing-Lanes			0		1		1	
Conflicting-lanes			1		1		1	
Geometry group			1		1		1	

Duration, T 0.25 hrs.

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound L1	Eastbound L2	Westbound L1	Westbound L2	Northbound L1	Northbound L2	Southbound L1	Southbound L2
Flow Rates:								
Total in Lane			131		111		31	
Left-Turn			130		0		30	
Right-Turn			1		110		0	
Prop. Left-Turns			1.0		0.0		1.0	
Prop. Right-Turns			0.0		1.0		0.0	
Prop. Heavy Vehicle			0.0		0.0		0.0	
Geometry Group			1		1		1	
Adjustments Exhibit 17-33:								
hLT-adj			0.2		0.2		0.2	
hRT-adj			-0.6		-0.6		-0.6	
hHV-adj			1.7		1.7		1.7	
hadj, computed			0.2		-0.6		0.2	

Worksheet 4 - Departure Headway and Service Time

	Eastbound L1	Eastbound L2	Westbound L1	Westbound L2	Northbound L1	Northbound L2	Southbound L1	Southbound L2
Flow rate			131		111		31	
hd, initial value	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20
x, initial			0.12		0.10		0.03	
hd, final value			4.38		3.65		4.51	
x, final value			0.16		0.11		0.04	
Move-up time, m			2.0		2.0		2.0	
Service Time			2.4		1.7		2.5	

Worksheet 5 - Capacity and Level of Service

	Eastbound L1	Eastbound L2	Westbound L1	Westbound L2	Northbound L1	Northbound L2	Southbound L1	Southbound L2
Flow Rate			131		111		31	
Service Time			2.4		1.7		2.5	
Utilization, x			0.16		0.11		0.04	
Dep. headway, hd			4.38		3.65		4.51	
Capacity			381		361		281	
Delay			8.21		7.11		7.69	
LOS			A		A		A	
Approach:								
Delay			8.21		7.11		7.69	
LOS			A		A		A	

Intersection Delay 7.71 Intersection LOS A

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ALL-WAY STOP CONTROL(AWSC) ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/5/2005
Analysis Time Period: pm
Intersection: sth 158/western frontage road
Jurisdiction: wisdot
Units: U. S. Customary
Analysis Year: 2017
Project ID: 2017 background traffic - no improvements
East/West Street: sth158
North/South Street: western frontage road

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	0	0	0	240	0	1	0	1	85	20	1	0
% Thrus Left Lane												

	Eastbound L1	Eastbound L2	Westbound L1	Westbound L2	Northbound L1	Northbound L2	Southbound L1	Southbound L2
Configuration			LR		TR		LT	
PHF			1.00		1.00		1.00	
Flow Rate			241		86		21	
% Heavy Veh			0		0		0	
No. Lanes			1		1		1	
Opposing-Lanes			0		1		1	
Conflicting-lanes			1		1		1	
Geometry group			1		1		1	

Duration, T 0.25 hrs.

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound L1	Eastbound L2	Westbound L1	Westbound L2	Northbound L1	Northbound L2	Southbound L1	Southbound L2
Flow Rates:								
Total in Lane			241		86		21	
Left-Turn			240		0		20	
Right-Turn			1		85		0	
Prop. Left-Turns			1.0		0.0		1.0	
Prop. Right-Turns			0.0		1.0		0.0	
Prop. Heavy Vehicle			0.0		0.0		0.0	
Geometry Group			1		1		1	
Adjustments Exhibit 17-33:								
hLT-adj			0.2		0.2		0.2	
hRT-adj			-0.6		-0.6		-0.6	
hHV-adj			1.7		1.7		1.7	
hadj, computed			0.2		-0.6		0.2	

Worksheet 4 - Departure Headway and Service Time

	Eastbound L1	Eastbound L2	Westbound L1	Westbound L2	Northbound L1	Northbound L2	Southbound L1	Southbound L2
Flow rate			241		86		21	
hd, initial value	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20
x, initial			0.21		0.08		0.02	
hd, final value			4.33		3.90		4.75	
x, final value			0.29		0.09		0.03	
Move-up time, m			2.0		2.0		2.0	
Service Time			2.3		1.9		2.7	

Worksheet 5 - Capacity and Level of Service

	Eastbound L1	Eastbound L2	Westbound L1	Westbound L2	Northbound L1	Northbound L2	Southbound L1	Southbound L2
Flow Rate			241		86		21	
Service Time			2.3		1.9		2.7	
Utilization, x			0.29		0.09		0.03	
Dep. headway, hd			4.33		3.90		4.75	
Capacity			491		336		271	
Delay			9.08		7.30		7.88	
LOS			A		A		A	
Approach:								
Delay			9.08		7.30		7.88	
LOS			A		A		A	

Intersection Delay 8.57 Intersection LOS A

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ALL-WAY STOP CONTROL(AWSC) ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 11/15/2004
Analysis Time Period: am
Intersection: CTH K/104th
Jurisdiction: Kenosha County
Units: U. S. Customary
Analysis Year: 2017
Project ID: 2017 background traffic - no improvements
East/West Street: CTH K
North/South Street: 104th

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	15	185	40	100	130	15	5	125	95	5	150	25
% Thrus Left Lane												

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	LT	R	LTR		L	TR	LT	R
PHF	1.00	1.00	1.00		1.00	1.00	1.00	1.00
Flow Rate	200	40	245		5	220	155	25
% Heavy Veh	0	0	0		0	0	0	0
No. Lanes	2		1		2		2	
Opposing-Lanes	1		2		2		2	
Conflicting-lanes	2		2		2		2	
Geometry group	5		4b		5		5	

Duration, T 0.25 hrs.

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	200	40	245		5	220	155	25
Left-Turn	15	0	100		5	0	5	0
Right-Turn	0	40	15		0	95	0	25
Prop. Left-Turns	0.1	0.0	0.4		1.0	0.0	0.0	0.0
Prop. Right-Turns	0.0	1.0	0.1		0.0	0.4	0.0	1.0
Prop. Heavy Vehicle	0.0	0.0	0.0		0.0	0.0	0.0	0.0
Geometry Group	5		4b		5		5	
Adjustments Exhibit 17-33:								
hLT-adj	0.5		0.2		0.5		0.5	
hRT-adj	-0.7		-0.6		-0.7		-0.7	
hHV-adj	1.7		1.7		1.7		1.7	
hadj, computed	0.0	-0.7	0.0		0.5	-0.3	0.0	-0.7

Worksheet 4 - Departure Headway and Service Time

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow rate	200	40	245		5	220	155	25
hd, initial value	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20
x, initial	0.18	0.04	0.22		0.00	0.20	0.14	0.02
hd, final value	6.13	5.39	6.12		6.77	5.96	6.35	5.62
x, final value	0.34	0.06	0.42		0.01	0.36	0.27	0.04
Move-up time, m	2.3		2.3		2.3		2.3	
Service Time	3.8	3.1	3.8		4.5	3.7	4.0	3.3

Worksheet 5 - Capacity and Level of Service

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rate	200	40	245		5	220	155	25
Service Time	3.8	3.1	3.8		4.5	3.7	4.0	3.3
Utilization, x	0.34	0.06	0.42		0.01	0.36	0.27	0.04
Dep. headway, hd	6.13	5.39	6.12		6.77	5.96	6.35	5.62
Capacity	450	290	495		255	470	405	275
Delay	11.97	8.43	13.12		9.53	12.02	11.42	8.55
LOS	B	A	B		A	B	B	A
Approach:								
Delay	11.38		13.12		11.97		11.02	
LOS	B		B		B		B	

Intersection Delay 11.93 Intersection LOS B

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ALL-WAY STOP CONTROL(AWSC) ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 11/15/2004
Analysis Time Period: pm
Intersection: CTH K/104th
Jurisdiction: Kenosha County
Units: U. S. Customary
Analysis Year: 2017
Project ID: 2017 background traffic - no improvements
East/West Street: CTH K
North/South Street: 104th

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	15	250	25	90	205	30	20	160	110	15	125	30
% Thrus Left Lane												

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	LT	R	LTR		L	TR	LT	R
PHF	1.00	1.00	1.00		1.00	1.00	1.00	1.00
Flow Rate	265	25	325		20	270	140	30
% Heavy Veh	0	0	0		0	0	0	0
No. Lanes	2		1		2		2	
Opposing-Lanes	1		2		2		2	
Conflicting-lanes	2		2		2		2	
Geometry group	5		4b		5		5	

Duration, T 0.25 hrs.

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	265	25	325		20	270	140	30
Left-Turn	15	0	90		20	0	15	0
Right-Turn	0	25	30		0	110	0	30
Prop. Left-Turns	0.1	0.0	0.3		1.0	0.0	0.1	0.0
Prop. Right-Turns	0.0	1.0	0.1		0.0	0.4	0.0	1.0
Prop. Heavy Vehicle	0.0	0.0	0.0		0.0	0.0	0.0	0.0
Geometry Group	5		4b		5		5	
Adjustments Exhibit 17-33:								
hLT-adj	0.5		0.2		0.5		0.5	
hRT-adj	-0.7		-0.6		-0.7		-0.7	
hHV-adj	1.7		1.7		1.7		1.7	
hadj, computed	0.0	-0.7	0.0		0.5	-0.3	0.1	-0.7

Worksheet 4 - Departure Headway and Service Time

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow rate	265	25	325		20	270	140	30
hd, initial value	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20
x, initial	0.24	0.02	0.29		0.02	0.24	0.12	0.03
hd, final value	6.64	5.90	6.51		7.34	6.54	7.16	6.39
x, final value	0.49	0.04	0.59		0.04	0.49	0.28	0.05
Move-up time, m	2.3		2.3		2.3		2.3	
Service Time	4.3	3.6	4.2		5.0	4.2	4.9	4.1

Worksheet 5 - Capacity and Level of Service

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rate	265	25	325		20	270	140	30
Service Time	4.3	3.6	4.2		5.0	4.2	4.9	4.1
Utilization, x	0.49	0.04	0.59		0.04	0.49	0.28	0.05
Dep. headway, hd	6.64	5.90	6.51		7.34	6.54	7.16	6.39
Capacity	513	275	530		270	517	390	280
Delay	15.51	8.85	18.09		10.36	15.39	12.59	9.45
LOS	C	A	C		B	C	B	A
Approach:								
Delay	14.94		18.09		15.04		12.04	
LOS	B		C		C		B	

Intersection Delay 15.46 Intersection LOS C

HCS2000: Unsignalized Intersections Release 4.1d

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ALL-WAY STOP CONTROL(AWSC) ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/4/2005
Analysis Time Period: am
Intersection: cth k/eastern frontage road
Jurisdiction: kenosha county
Units: U. S. Customary
Analysis Year: 2017
Project ID: 2017 background traffic - no improvements
East/West Street: cth k
North/South Street: eastern frontage road

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	15	145	30	50	105	5	5	95	95	1	1	1

% Thrus Left Lane

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	LTR		LTR		LTR		LTR	
PHF	1.00		1.00		1.00		1.00	
Flow Rate	190		160		195		3	
% Heavy Veh	0		0		0		0	
No. Lanes	1		1		1		1	
Opposing-Lanes	1		1		1		1	
Conflicting-lanes	1		1		1		1	
Geometry group	1		1		1		1	

Duration, T 0.25 hrs.

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	190		160		195		3	
Left-Turn	15		50		5		1	
Right-Turn	30		5		95		1	
Prop. Left-Turns	0.1		0.3		0.0		0.3	
Prop. Right-Turns	0.2		0.0		0.5		0.3	
Prop. Heavy Vehicle	0.0		0.0		0.0		0.0	
Geometry Group	1		1		1		1	
Adjustments Exhibit 17-33:								
hLT-adj	0.2		0.2		0.2		0.2	
hRT-adj	-0.6		-0.6		-0.6		-0.6	
hHV-adj	1.7		1.7		1.7		1.7	
hadj, computed	-0.1		0.0		-0.3		-0.1	

Worksheet 4 - Departure Headway and Service Time

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow rate	190		160		195		3	
hd, initial value	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20
x, initial	0.17		0.14		0.17		0.00	
hd, final value	4.49		4.64		4.44		4.85	
x, final value	0.24		0.21		0.24		0.00	
Move-up time, m	2.0		2.0		2.0		2.0	
Service Time	2.5		2.6		2.4		2.8	

Worksheet 5 - Capacity and Level of Service

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rate	190		160		195		3	
Service Time	2.5		2.6		2.4		2.8	
Utilization, x	0.24		0.21		0.24		0.00	
Dep. headway, hd	4.49		4.64		4.44		4.85	
Capacity	440		410		445		253	
Delay	8.87		8.84		8.84		7.87	
LOS	A		A		A		A	
Approach:								
Delay	8.87		8.84		8.84		7.87	
LOS	A		A		A		A	

Intersection Delay 8.85 Intersection LOS A

HCS2000: Unsignalized Intersections Release 4.1d

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ALL-WAY STOP CONTROL(AWSC) ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/4/2005
Analysis Time Period: pm
Intersection: cth k/eastern frontage road
Jurisdiction: kenosha county
Units: U. S. Customary
Analysis Year: 2017
Project ID: 2017 background traffic - no improvements
East/West Street: cth k
North/South Street: eastern frontage road

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	30	170	70	70	160	25	20	140	105	10	5	10

% Thrus Left Lane

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	LTR		LTR		LTR		LTR	
PHF	1.00		1.00		1.00		1.00	
Flow Rate	270		255		265		25	
% Heavy Veh	0		0		0		0	
No. Lanes	1		1		1		1	
Opposing-Lanes	1		1		1		1	
Conflicting-lanes	1		1		1		1	
Geometry group	1		1		1		1	

Duration, T 0.25 hrs.

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	270		255		265		25	
Left-Turn	30		70		20		10	
Right-Turn	70		25		105		10	
Prop. Left-Turns	0.1		0.3		0.1		0.4	
Prop. Right-Turns	0.3		0.1		0.4		0.4	
Prop. Heavy Vehicle	0.0		0.0		0.0		0.0	
Geometry Group	1		1		1		1	
Adjustments Exhibit 17-33:								
hLT-adj	0.2		0.2		0.2		0.2	
hRT-adj	-0.6		-0.6		-0.6		-0.6	
hHV-adj	1.7		1.7		1.7		1.7	
hadj, computed	-0.1		-0.0		-0.2		-0.2	

Worksheet 4 - Departure Headway and Service Time

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow rate	270		255		265		25	
hd, initial value	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20
x, initial	0.24		0.23		0.24		0.02	
hd, final value	4.92		5.06		5.04		5.53	
x, final value	0.37		0.36		0.37		0.04	
Move-up time, m	2.0		2.0		2.0		2.0	
Service Time	2.9		3.1		3.0		3.5	

Worksheet 5 - Capacity and Level of Service

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rate	270		255		265		25	
Service Time	2.9		3.1		3.0		3.5	
Utilization, x	0.37		0.36		0.37		0.04	
Dep. headway, hd	4.92		5.06		5.04		5.53	
Capacity	520		505		515		275	
Delay	10.76		10.85		10.99		8.75	
LOS	B		B		B		A	
Approach:								
Delay	10.76		10.85		10.99		8.75	
LOS	B		B		B		A	

Intersection Delay 10.80 Intersection LOS B

2017 SITE+BACKGROUND TRAFFIC CAPACITY ANALYSIS – WITH IMPROVEMENTS

HCS2000: Signalized Intersections Release 4.1e

Analyst: md
Agency:
Date: 1/4/2005
Period: am
Project ID: 2017 total traffic - with improvements
E/W St: sth 158

Inter.: sth 158/cth h
Area Type: All other areas
Jurisd: wisdot
Year : 2017
N/S St: cth h

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	2	1	1	2	0	0	1	0	0	1	1
LGConfig	L	T	R	L	TR			LTR			LT	R
Volume	95	760	135	75	880	30	5	185	75	65	305	120
Lane Width	12.0	12.0	12.0	12.0	12.0			12.0			12.0	12.0
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4			5	6	7	8
EB Left	A	A			NB	Left		A		
Thru		A				Thru		A		
Right		A				Right		A		
Peds						Peds				
WB Left	A	A			SB	Left	A	A		
Thru		A				Thru	A	A		
Right		A				Right	A	A		
Peds						Peds				
NB Right					EB	Right				
SB Right	A				WB	Right				
Green	5.0	39.0					10.0	28.0		
Yellow	3.0	4.5					3.0	4.5		
All Red	0.0	1.5					0.0	1.5		

Cycle Length: 100.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	164	1752	0.66	0.47	28.8	C		
T	1314	3370	0.66	0.39	26.2	C	25.7	C
R	630	1615	0.24	0.39	20.8	C		
Westbound								
L	218	1752	0.39	0.47	18.4	B		
TR	1313	3367	0.79	0.39	30.1	C	29.2	C
Northbound								
LTR	497	1776	0.61	0.28	33.3	C	33.3	C
Southbound								
LT	527	1783	0.80	0.41	34.4	C	29.1	C
R	808	1553	0.17	0.52	12.7	B		

Intersection Delay = 28.3 (sec/veh) Intersection LOS = C

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/4/2005
Analysis Time Period: am
Intersection: sth 158/cth h
Area Type: All other areas
Jurisdiction: wisdot
Analysis Year: 2017
Project ID: 2017 total traffic - with improvements
East/West Street: sth 158 North/South Street: cth h

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	95	760	135	75	880	30	5	185	75	65	305	120
% Heavy Veh	3	13	0	3	7	4	20	1	3	4	6	4
PHF	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
PK 15 Vol	27	216	38	21	250	9	2	53	21	18	87	34
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	2000	1900	1900	1900			1900			1900	1900
ParkExist												
NumPark												
No. Lanes	1	2	1	1	2	0	0	1	0	0	1	1
LGConfig	L	T	R	L	TR			LTR			LT	R
Lane Width	12.0	12.0	12.0	12.0	12.0			12.0			12.0	12.0
RTOR Vol			0			0			0			0
Adj Flow	108	864	153	85	1034			301			421	136
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000			0.020			0.176	
Prop RTs		0.000	1.000		0.033			0.282			0.000	1.000
Peds Bikes	0			0			0			0		
Buses	0	0	0	0	0			0			0	0
%InProtPhase	0.0			0.0						0.0		

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0	0.0	0.0	0.0			0.0			0.0	0.0
Arriv. Type	3	3	3	3	3			3			3	3
Unit Ext.	3.0	3.0	3.0	3.0	3.0			3.0			3.0	3.0
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0	2.0	2.0	2.0			2.0			2.0	2.0
Ext of g	2.0	2.0	2.0	2.0	2.0			2.0			2.0	2.0

Ped Min g	3.2	3.2	3.2	3.2

PHASE DATA

Phase Combination	1	2	3	4			5	6	7	8
EB Left	A	A			NB	Left		A		
Thru		A				Thru		A		
Right		A				Right		A		
Peds						Peds				
WB Left	A	A			SB	Left	A	A		
Thru		A				Thru	A	A		
Right		A				Right	A	A		
Peds						Peds				
NB Right					EB	Right				
SB Right	A				WB	Right				
Green	5.0	39.0					10.0	28.0		
Yellow	3.0	4.5					3.0	4.5		
All Red	0.0	1.5					0.0	1.5		

Cycle Length: 100.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	95	760	135	75	880	30	5	185	75	65	305	120
PHF	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Adj flow	108	864	153	85	1000	34	6	210	85	74	347	136
No. Lanes	1	2	1	1	2	0	0	1	0	0	1	1
Lane group	L	T	R	L	TR			LTR			LT	R
Adj flow	108	864	153	85	1034			301			421	136
Prop LTs	1.000	0.000		1.000	0.000			0.020			0.176	
Prop RTs		0.000	1.000		0.033			0.282			0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L	T	R	L	TR			LTR			LT	R
So	1900	2000	1900	1900	1900			1900			1900	1900
Lanes	1	2	1	1	2	0	0	1	0	0	1	1
fW	1.000	1.000	1.000	1.000	1.000			1.000			1.000	1.000
fHV	0.971	0.885	1.000	0.971	0.935			0.981			0.947	0.962
fG	1.000	1.000	1.000	1.000	1.000			1.000			1.000	1.000
fP	1.000	1.000	1.000	1.000	1.000			1.000			1.000	1.000
fBB	1.000	1.000	1.000	1.000	1.000			1.000			1.000	1.000
fA	1.000	1.000	1.000	1.000	1.000			1.000			1.000	1.000
fLU	1.000	0.952	1.000	1.000	0.952			0.962			1.000	0.850
fRT		1.000	0.850		0.995			0.991			0.991	
fLT	0.950	1.000		0.950	1.000						0.626	
Sec.	0.098			0.168				1.000			1.000	
fLpb	1.000	1.000		1.000	1.000			1.000			1.000	1.000
fRpb		1.000	1.000		1.000			1776			1783	1553
S	1752	3370	1615	1752	3367						1126	
Sec.	181			309								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		88	1752	# 0.05	0.050	88	1.00
Perm		20	181	0.11	0.420	76	0.26
Left	L	108			0.47	164	0.66
Prot							
Perm							
Thru	T	864	3370	0.26	0.39	1314	0.66
Right	R	153	1615	0.09	0.39	630	0.24
Westbound							
Prot		85	1752	0.05	0.050	88	0.97
Perm		0	309	0.00	0.420	130	0.00
Left	L	85			0.47	218	0.39
Prot							
Perm							
Thru	TR	1034	3367	# 0.31	0.39	1313	0.79
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	301	1776	0.17	0.28	497	0.61
Right							
Southbound							
Prot							
Perm							
Left							
Prot		178	1783	# 0.10	0.100	178	1.00
Perm		243	1126	# 0.22	0.310	349	0.70
Thru	LT	421			0.41	527	0.80
Right	R	136	1553	0.09	0.52	808	0.17

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.67
Total lost time per cycle, L = 18.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.82

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	0.66	0.47	19.4	1.000	164	0.23	9.3	0.0	28.8	C		
T	0.66	0.39	25.0	1.000	1314	0.23	1.2	0.0	26.2	C	25.7	C
R	0.24	0.39	20.6	1.000	630	0.11	0.2	0.0	20.8	C		
Westbound												
L	0.39	0.47	17.2	1.000	218	0.11	1.2	0.0	18.4	B		
TR	0.79	0.39	26.9	1.000	1313	0.33	3.3	0.0	30.1	C	29.2	C
Northbound												
LTR	0.61	0.28	31.2	1.000	497	0.19	2.1	0.0	33.3	C	33.3	C
Southbound												

LT	0.80	0.41	25.9	1.000	527	0.34	8.5	0.0	34.4	C	29.1	C
R	0.17	0.52	12.6	1.000	808	0.11	0.1	0.0	12.7	B		

Intersection delay = 28.3 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	N		
Cycle length, C 100.0 sec				
Total actual green time for LT lane group, G (s)	47.0	47.0		
Effective permitted green time for LT lane group, g(s)	42.0	42.0		
Opposing effective green time, go (s)	39.0	39.0		
Number of lanes in LT lane group, N	1	1		
Number of lanes in opposing approach, No	2	2		
Adjusted LT flow rate, VLT (veh/h)	108	85		
Proportion of LT in LT lane group, PLT	1.000	1.000		
Proportion of LT in opposing flow, PLTo	0.00	0.00		
Adjusted opposing flow rate, Vo (veh/h)	1034	864		
Lost time for LT lane group, tL	6.00	6.00		
Computation				
LT volume per cycle, LTC=VLTC/3600	3.00	2.36		
Opposing lane util. factor, fLUo	0.952	0.952	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	15.09	12.61		
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g	0.0	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(gc/C),0]	0.61	0.61		
gq, (see Exhibit C16-4,5,6,7,8)	26.36	20.56		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	15.64	21.44		
n=Max(gq-gf)/2,0)	13.18	10.28		
PTHo=1-PLTo	1.00	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00		
EL1 (refer to Exhibit C16-3)	3.79	3.04		
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.10	0.10		
gdiff=max(gq-gf,0)	0.00	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.10	0.17		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.098	0.168		

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach			M	S
Cycle length, C 100.0 sec				
Total actual green time for LT lane group, G (s)			28.0	41.0
Effective permitted green time for LT lane group, g(s)			28.0	31.0
Opposing effective green time, go (s)			41.0	28.0
Number of lanes in LT lane group, N			1	1
Number of lanes in opposing approach, No			1	1
Adjusted LT flow rate, VLT (veh/h)			6	74
Proportion of LT in LT lane group, PLT	0.000	0.000	0.020	0.176
Proportion of LT in opposing flow, PLTo			0.18	0.02
Adjusted opposing flow rate, Vo (veh/h)			421	301
Lost time for LT lane group, tL			6.00	6.00
Computation				
LT volume per cycle, LTC=VLTC/3600			0.17	2.06
Opposing lane util. factor, fLUo	0.952	0.952	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			11.69	8.36
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g			15.9	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.59	0.72
gq, (see Exhibit C16-4,5,6,7,8)			0.00	17.59
gu=g-gq if gq>=gf, or = g-gf if gq<gf			12.06	13.41
n=Max(gq-gf)/2,0)			0.00	8.80
PTHo=1-PLTo			0.82	0.98
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			0.02	0.18
EL1 (refer to Exhibit C16-3)			2.13	1.88
EL2=Max((1-Ptho**n)/Plto, 1.0)			1.00	8.14
fmin=2(1+PL)/g or fmin=2(1+Pl)/g			0.07	0.08
gdiff=max(gq-gf,0)			0.00	17.59
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.99	0.63
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.991	0.626

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 100.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v	108	85		
v/c ratio from Capacity Worksheet, X	0.66	0.39		
Protected phase effective green interval, g (s)	5.0	5.0		
Opposing queue effective green interval, gq	26.36	20.56		
Unopposed green interval, gu	15.64	21.44		
Red time r=(C-g-gq-gu)	53.0	53.0		
Arrival rate, qa=v/(3600(max[X,1.0]))	0.03	0.02		
Protected ph. departure rate, Sp=s/3600	0.487	0.487		
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.13	0.17		
XPerm	0.60	0.28		
XProt	0.72	0.56		
Case	1	1		
Queue at beginning of green arrow, Qa	1.59	1.25		
Queue at beginning of unsaturated green, Qu	0.79	0.49		
Residual queue, Qr	0.00	0.00		
Uniform Delay, d1	19.4	17.2		

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Dur. Unmet Demand Q veh	Initial Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 28.3 sec/veh Intersection LOS C

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound	
LaneGroup	L	T	R	L	TR		LTR			LT	R
Init Queue	0.0	0.0	0.0	0.0	0.0		0.0			0.0	0.0
Flow Rate	108	453	153	85	543		301			421	136
So	1900	2000	1900	1900	1900		1900			1900	1900
No.Lanes	1	2	1	1	2	0	0 1	0	0 1	1	
SL	348	1769	1615	463	1768		1776			1286	1553
LnCapacity	164	690	630	218	689		497			527	808
Flow Ratio	0.31	0.26	0.09	0.18	0.31		0.17			0.33	0.09
v/c Ratio	0.66	0.66	0.24	0.39	0.79		0.61			0.80	0.17
Grn Ratio	0.47	0.39	0.39	0.47	0.39		0.28			0.41	0.52
I Factor		1.000			1.000		1.000			1.000	
AT or PVG	3	3	3	3	3		3			3	3
Pltn Ratio	1.00	1.00	1.00	1.00	1.00		1.00			1.00	1.00
PF2	1.00	1.00	1.00	1.00	1.00		1.00			1.00	1.00
Q1	1.6	10.3	2.9	1.3	13.3		7.2			7.5	2.0
kB	0.2	0.6	0.6	0.3	0.6		0.5			0.5	0.6
Q2	0.4	1.1	0.2	0.2	2.0		0.7			1.8	0.1
Q Average	2.1	11.4	3.0	1.5	15.3		8.0			9.3	2.1
Q Spacing	25.0	25.0	25.0	25.0	25.0		25.0			25.0	25.0
Q Storage	0	0	0	0	0		0			0	0
Q S Ratio											
70th Percentile Output:											
fB%	1.2	1.2	1.2	1.2	1.2		1.2			1.2	1.2
BOQ	2.5	13.4	3.6	1.7	17.8		9.4			10.9	2.5
QSRatio											
85th Percentile Output:											
fB%	1.6	1.5	1.6	1.6	1.5		1.5			1.5	1.6
BOQ	3.3	17.2	4.8	2.3	22.6		12.2			14.1	3.3
QSRatio											
90th Percentile Output:											
fB%	1.8	1.6	1.7	1.8	1.6		1.7			1.7	1.8
BOQ	3.7	18.5	5.3	2.6	24.2		13.3			15.3	3.7
QSRatio											
95th Percentile Output:											
fB%	2.0	1.8	2.0	2.1	1.8		1.9			1.9	2.0
BOQ	4.3	20.7	6.1	3.0	26.8		15.0			17.2	4.3
QSRatio											
98th Percentile Output:											
fB%	2.6	2.1	2.5	2.6	2.0		2.2			2.2	2.5
BOQ	5.3	24.1	7.6	3.8	30.7		17.9			20.3	5.4
QSRatio											

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: md
Agency:
Date: 1/4/2005
Period: pm
Project ID: 2017 total traffic - with improvements
E/W St: sth 158

Inter.: sth 158/cth h
Area Type: All other areas
Jurisd: wisdot
Year : 2017
N/S St: cth h

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	2	1	1	2	0	0	1	0	0	1	1
LGConfig	L	T	R	L	TR			LTR			LT	R
Volume	205	1060	170	45	760	70	10	365	60	65	325	75
Lane Width	12.0	12.0	12.0	12.0	12.0			12.0			12.0	12.0
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A	A	A		NB Left		A		
Thru		A	A		Thru		A		
Right		A	A		Right		A		
Peds					Peds				
WB Left	A		A		SB Left	A	A		
Thru			A		Thru	A	A		
Right			A		Right	A	A		
Peds					Peds				
NB Right					EB Right				
SB Right	A	A			WB Right				
Green	6.0	5.0	33.0			11.0	34.0		
Yellow	3.0	3.0	4.5			3.0	4.5		
All Red	0.0	0.0	1.5			0.0	1.5		

Cycle Length: 110.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	299	1805	0.78	0.45	38.2	D		
T	1352	3627	0.89	0.37	40.2	D	38.1	D
R	602	1615	0.32	0.37	24.9	C		
Westbound								
L	167	1805	0.31	0.35	26.7	C		
TR	1034	3445	0.91	0.30	49.2	D	48.0	D
Northbound								
LTR	555	1796	0.89	0.31	52.6	D	52.6	D
Southbound								
LT	490	1832	0.90	0.44	48.9	D	42.4	D
R	899	1455	0.09	0.62	8.6	A		

Intersection Delay = 43.4 (sec/veh) Intersection LOS = D

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/4/2005
Analysis Time Period: pm
Intersection: sth 158/cth h
Area Type: All other areas
Jurisdiction: wisdot
Analysis Year: 2017
Project ID: 2017 total traffic - with improvements
East/West Street: sth 158 North/South Street: cth h

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	205	1060	170	45	760	70	10	365	60	65	325	75
% Heavy Veh	0	5	0	0	4	0	10	2	4	2	3	11
PHF	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
PK 15 Vol	58	301	48	13	216	20	3	104	17	18	92	21
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	2000	1900	1900	1900			1900			1900	1900
ParkExist												
NumPark												
No. Lanes	1	2	1	1	2	0	0	1	0	0	1	1
LGConfig	L	T	R	L	TR			LTR			LT	R
Lane Width	12.0	12.0	12.0	12.0	12.0			12.0			12.0	12.0
RTOR Vol			0			0			0			0
Adj Flow	233	1205	193	51	944			494			443	85
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000			0.022			0.167	
Prop RTs		0.000	1.000		0.085			0.138			0.000	1.000
Peds Bikes	0			0			0			0		
Buses	0	0	0	0	0			0			0	0
%InProtPhase	0.0			0.0						0.0		

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0	0.0	0.0	0.0			0.0			0.0	0.0
Arriv. Type	3	3	3	3	3			3			3	3
Unit Ext.	3.0	3.0	3.0	3.0	3.0			3.0			3.0	3.0
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0	2.0	2.0	2.0			2.0			2.0	2.0
Ext of g	2.0	2.0	2.0	2.0	2.0			2.0			2.0	2.0

Ped Min g	3.2	3.2	3.2	3.2

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A	A	A		NB Left		A		
Thru		A	A		Thru		A		
Right		A	A		Right		A		
Peds					Peds				
WB Left	A		A		SB Left	A	A		
Thru			A		Thru	A	A		
Right			A		Right	A	A		
Peds					Peds				
NB Right					EB Right				
SB Right	A	A			WB Right				
Green	6.0	5.0	33.0			11.0	34.0		
Yellow	3.0	3.0	4.5			3.0	4.5		
All Red	0.0	0.0	1.5			0.0	1.5		

Cycle Length: 110.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	205	1060	170	45	760	70	10	365	60	65	325	75
PHF	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Adj flow	233	1205	193	51	864	80	11	415	68	74	369	85
No. Lanes	1	2	1	1	2	0	0	1	0	0	1	1
Lane group	L	T	R	L	TR			LTR			LT	R
Adj flow	233	1205	193	51	944			494			443	85
Prop LTs	1.000	0.000		1.000	0.000			0.022			0.167	
Prop RTs		0.000	1.000		0.085			0.138			0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L	T	R	L	TR			LTR			LT	R
So	1900	2000	1900	1900	1900			1900			1900	1900
Lanes	1	2	1	1	2	0	0	1	0	0	1	1
fW	1.000	1.000	1.000	1.000	1.000			1.000			1.000	1.000
fHV	1.000	0.952	1.000	1.000	0.965			0.976			0.972	0.901
fG	1.000	1.000	1.000	1.000	1.000			1.000			1.000	1.000
fP	1.000	1.000	1.000	1.000	1.000			1.000			1.000	1.000
fBB	1.000	1.000	1.000	1.000	1.000			1.000			1.000	1.000
fA	1.000	1.000	1.000	1.000	1.000			1.000			1.000	1.000
fLU	1.000	0.952	1.000	1.000	0.952			1.000			1.000	1.000
fRT		1.000	0.850		0.987			0.981			1.000	0.850
fLT	0.950	1.000		0.950	1.000			0.987			0.992	
Sec.	0.111			0.121							0.494	
fLpb	1.000	1.000		1.000	1.000			1.000			1.000	
fRpb		1.000	1.000		1.000			1.000			1.000	1.000
S	1805	3627	1615	1805	3445			1796			1832	1455
Sec.	211			230							913	

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		230	1805	# 0.13	0.127	230	1.00
Perm		3	211	0.01	0.327	69	0.04
Left	L	233			0.45	299	0.78
Prot							
Perm							
Thru	T	1205	3627	0.33	0.37	1352	0.89
Right	R	193	1615	0.12	0.37	602	0.32
Westbound							
Prot		51	1805	0.03	0.055	98	0.52
Perm		0	230	0.00	0.300	69	0.00
Left	L	51			0.35	167	0.31
Prot							
Perm							
Thru	TR	944	3445	# 0.27	0.30	1034	0.91
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	494	1796	0.28	0.31	555	0.89
Right							
Southbound							
Prot							
Perm							
Left							
Prot		183	1832	# 0.10	0.100	183	1.00
Perm		260	913	# 0.28	0.336	307	0.85
Thru	LT	443			0.44	490	0.90
Right	R	85	1455	0.06	0.62	899	0.09

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.79
Total lost time per cycle, L = 18.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.94

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	0.78	0.45	25.8	1.000	299	0.33	12.4	0.0	38.2	D		
T	0.89	0.37	32.4	1.000	1352	0.42	7.8	0.0	40.2	D	38.1	D
R	0.32	0.37	24.6	1.000	602	0.11	0.3	0.0	24.9	C		
Westbound												
L	0.31	0.35	25.6	1.000	167	0.11	1.0	0.0	26.7	C		
TR	0.91	0.30	37.1	1.000	1034	0.43	12.1	0.0	49.2	D	48.0	D
Northbound												
LTR	0.89	0.31	36.2	1.000	555	0.41	16.4	0.0	52.6	D	52.6	D
Southbound												

LT	0.90	0.44	28.9	1.000	490	0.43	20.1	0.0	48.9	D	42.4	D
R	0.09	0.62	8.5	1.000	899	0.11	0.0	0.0	8.6	A		

Intersection delay = 43.4 (sec/veh) Intersection LOS = D

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M		
Cycle length, C 110.0 sec				
Total actual green time for LT lane group, G (s)	50.0	39.0		
Effective permitted green time for LT lane group, g(s)	36.0	33.0		
Opposing effective green time, go (s)	33.0	41.0		
Number of lanes in LT lane group, N	1	1		
Number of lanes in opposing approach, No	2	2		
Adjusted LT flow rate, VLT (veh/h)	233	51		
Proportion of LT in LT lane group, PLT	1.000	1.000		
Proportion of LT in opposing flow, PLTo	0.00	0.00		
Adjusted opposing flow rate, Vo (veh/h)	944	1205		
Lost time for LT lane group, tL	6.00	9.00		
Computation				
LT volume per cycle, LTC=VLTC/3600	7.12	1.56		
Opposing lane util. factor, fLUo	0.952	0.952	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	15.15	19.34		
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g	0.0	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.70	0.63		
gq, (see Exhibit C16-4,5,6,7,8)	29.27	20.42		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	6.73	12.58		
n=Max(gq-gf)/2,0)	14.64	10.21		
PTHo=1-PLTo	1.00	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00		
EL1 (refer to Exhibit C16-3)	3.47	4.27		
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.11	0.12		
gdiff=max(gq-gf,0)	0.00	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.11	0.12		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.111	0.121		

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach			M	S
Cycle length, C 110.0 sec				
Total actual green time for LT lane group, G (s)			34.0	48.0
Effective permitted green time for LT lane group, g(s)			34.0	37.0
Opposing effective green time, go (s)			48.0	34.0
Number of lanes in LT lane group, N			1	1
Number of lanes in opposing approach, No			1	1
Adjusted LT flow rate, VLT (veh/h)			11	74
Proportion of LT in LT lane group, PLT	0.000	0.000	0.022	0.167
Proportion of LT in opposing flow, PLTo			0.17	0.02
Adjusted opposing flow rate, Vo (veh/h)			443	494
Lost time for LT lane group, tL			6.00	6.00
Computation				
LT volume per cycle, LTC=VLTC/3600			0.34	2.26
Opposing lane util. factor, fLUo	0.952	0.952	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			13.54	15.09
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g			16.7	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.56	0.69
gq, (see Exhibit C16-4,5,6,7,8)			0.00	26.42
gu=g-gq if gq>=gf, or = g-gf if gq<gf			17.29	10.58
n=Max(gq-gf)/2,0)			0.00	13.21
PTHo=1-PLTo			0.83	0.98
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			0.02	0.17
EL1 (refer to Exhibit C16-3)			2.17	2.29
EL2=Max((1-Ptho**n)/Plto, 1.0)			1.00	11.55
fmin=2(1+PL)/g or fmin=2(1+Pl)/g			0.06	0.06
gdiff=max(gq-gf,0)			0.00	26.42
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.99	0.49
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.987	0.494

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 110.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v	233	51		
v/c ratio from Capacity Worksheet, X	0.78	0.31		
Protected phase effective green interval, g (s)	14.0	6.0		
Opposing queue effective green interval, gq	29.27	20.42		
Unopposed green interval, gu	6.73	12.58		
Red time r=(C-g-gq-gu)	60.0	71.0		
Arrival rate, qa=v/(3600(max(X,1.0)))	0.06	0.01		
Protected ph. departure rate, Sp=s/3600	0.501	0.501		
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.31	0.17		
XPerm	1.10	0.22		
XProt	0.68	0.36		
Case	3	1		
Queue at beginning of green arrow, Qa	4.10	1.01		
Queue at beginning of unsaturated green, Qu	1.89	0.29		
Residual queue, Qr	0.22	0.00		
Uniform Delay, d1	25.8	25.6		

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Dur. Unmet Demand Q veh	Initial Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 43.4 sec/veh Intersection LOS D

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	T	R	L	TR		LTR			LT	R	
Init Queue	0.0	0.0	0.0	0.0	0.0		0.0			0.0	0.0	
Flow Rate	233	632	193	51	495		494			443	85	
So	1900	2000	1900	1900	1900		1900			1900	1900	
No.Lanes	1	2	1	1	2	0	0	1	0	0	1	1
SL	657	1904	1615	472	1809		1796			1123	1455	
LnCapacity	299	710	602	167	543		555			490	899	
Flow Ratio	0.35	0.33	0.12	0.11	0.27		0.28			0.39	0.06	
v/c Ratio	0.78	0.89	0.32	0.31	0.91		0.89			0.90	0.09	
Grn Ratio	0.45	0.37	0.37	0.35	0.30		0.31			0.44	0.62	
I Factor		1.000			1.000		1.000			1.000		
AT or PVG	3	3	3	3	3		3			3	3	
Fltn Ratio	1.00	1.00	1.00	1.00	1.00		1.00			1.00	1.00	
FF2	1.00	1.00	1.00	1.00	1.00		1.00			1.00	1.00	
Q1	4.3	18.1	4.2	1.0	14.6		14.4			8.4	1.1	
kB	0.4	0.6	0.6	0.3	0.5		0.5			0.5	0.7	
Q2	1.2	3.7	0.3	0.1	3.5		3.1			3.1	0.1	
Q Average	5.5	21.8	4.5	1.1	18.1		17.5			11.5	1.1	
Q Spacing	25.0	25.0	25.0	25.0	25.0		25.0			25.0	25.0	
Q Storage	0	0	0	0	0		0			0	0	
Q S Ratio												
70th Percentile Output:												
fB%	1.2	1.2	1.2	1.2	1.2		1.2			1.2	1.2	
BOQ	6.5	25.3	5.3	1.4	21.0		20.4			13.5	1.4	
QSRatio												
85th Percentile Output:												
fB%	1.5	1.4	1.6	1.6	1.5		1.5			1.5	1.6	
BOQ	8.5	31.6	7.0	1.8	26.5		25.7			17.3	1.8	
QSRatio												
90th Percentile Output:												
fB%	1.7	1.5	1.7	1.8	1.6		1.6			1.6	1.8	
BOQ	9.3	33.5	7.7	2.0	28.2		27.5			18.7	2.0	
QSRatio												
95th Percentile Output:												
fB%	1.9	1.7	2.0	2.1	1.7		1.7			1.8	2.1	
BOQ	10.6	36.7	8.8	2.3	31.1		30.3			20.9	2.3	
QSRatio												
98th Percentile Output:												
fB%	2.4	1.9	2.4	2.6	1.9		2.0			2.1	2.6	
BOQ	12.9	41.2	10.8	3.0	35.2		34.3			24.3	3.0	
QSRatio												

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: md
Agency:
Date: 1/10/2005
Period: am
Project ID: 2017 total traffic - with improvements
E/W St: STH 158

Inter.: STH 158/104th
Area Type: All other areas
Jurisd: WisDOT
Year : 2017
N/S St: 104th Ave

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	2	1	1	2	1	1	1	1	1	1	0
LGConfig	L	T	R	L	T	R	L	LT	R	L	TR	
Volume	5	640	95	195	745	5	570	5	395	5	10	5
Lane Width	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4			5	6	7	8
EB Left	A		A		NB	Left	A			
Thru			A			Thru	A			
Right			A			Right	A			
Peds						Peds				
WB Left	A	A	A		SB	Left		A		
Thru		A	A			Thru		A		
Right		A	A			Right		A		
Peds						Peds				
NB Right	A	A			EB	Right	A			
SB Right					WB	Right		A		
Green	5.0	4.0	29.0				30.0	8.0		
Yellow	3.0	3.0	4.5				4.5	4.5		
All Red	0.0	0.0	1.5				1.5	1.5		

Cycle Length: 100.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	214	1770	0.03	0.34	22.1	C		
T	960	3311	0.80	0.29	37.9	D	33.8	C
R	1029	1583	0.11	0.65	6.6	A		
Westbound								
L	287	1770	0.82	0.44	38.4	D		
T	1269	3526	0.71	0.36	29.3	C	31.1	C
R	697	1583	0.01	0.44	15.7	B		
Northbound								
L	542	1805	0.63	0.30	32.7	C		
LT	543	1811	0.64	0.30	33.0	C	30.6	C
R	672	1599	0.71	0.42	27.4	C		
Southbound								
L	142	1770	0.04	0.08	42.6	D		
TR	142	1770	0.13	0.08	43.2	D	43.0	D

Intersection Delay = 31.8 (sec/veh) Intersection LOS = C

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/10/2005
Analysis Time Period: am
Intersection: STH 158/104th
Area Type: All other areas
Jurisdiction: WisDOT
Analysis Year: 2017
Project ID: 2017 total traffic - with improvements
East/West Street: STH 158 North/South Street: 104th Ave

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	5	640	95	195	745	5	570	5	395	5	10	5
% Heavy Veh	2	15	2	2	8	2	0	0	1	2	2	2
PHF	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83
PK 15 Vol	2	193	29	59	224	2	172	2	119	2	3	2
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	2000	1900	1900	2000	1900	1900	1900	1900	1900	1900	
ParkExist												
NumPark												
No. Lanes	1	2	1	1	2	1	1	1	1	1	1	0
LGConfig	L	T	R	L	T	R	L	LT	R	L	TR	
Lane Width	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	
RTOR Vol			0			0			0			0
Adj Flow	6	771	114	235	898	6	344	349	476	6	18	
%InSharedLn							50					
Prop LTs	1.000	0.000		1.000	0.000			0.984			0.000	
Prop RTs		0.000	1.000		0.000	1.000		0.000	1.000		0.333	
Peds Bikes	0			0			0			0		
Buses	0	0	0	0	0	0	0	0	0	0	0	
%InProtPhase	0.0			0.0								

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Arriv. Type	3	3	3	3	3	3	3	3	3	3	3	
Unit Ext.	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	
Ext of g	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	
Ped Min g	3.2			3.2			3.2			3.2		

PHASE DATA

Phase Combination	1	2	3	4			5	6	7	8
EB Left	A		A		NB	Left	A			
Thru			A			Thru	A			
Right			A			Right	A			
Peds						Peds				
WB Left	A	A	A		SB	Left		A		
Thru		A	A			Thru		A		
Right		A	A			Right		A		
Peds						Peds				
NB Right	A	A			EB	Right	A			
SB Right					WB	Right		A		
Green	5.0	4.0	29.0				30.0	8.0		
Yellow	3.0	3.0	4.5				4.5	4.5		
All Red	0.0	0.0	1.5				1.5	1.5		

Cycle Length: 100.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	5	640	95	195	745	5	570	5	395	5	10	5
PHF	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83
Adj flow	6	771	114	235	898	6	687	6	476	6	12	6
No. Lanes	1	2	1	1	2	1	1	1	1	1	1	0
Lane group	L	T	R	L	T	R	L	LT	R	L	TR	
Adj flow	6	771	114	235	898	6	344	349	476	6	18	
Prop LTs	1.000	0.000		1.000	0.000			0.984			0.000	
Prop RTs		0.000	1.000		0.000	1.000		0.000	1.000		0.333	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L	T	R	L	T	R	L	LT	R	L	TR	
So	1900	2000	1900	1900	2000	1900	1900	1900	1900	1900	1900	0
Lanes	1	2	1	1	2	1	1	1	1	1	1	
fW	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
fHV	0.980	0.870	0.980	0.980	0.926	0.980	1.000	1.000	0.990	0.980	0.980	
fG	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
fP	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
fBB	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
fA	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
fLU	1.000	0.952	1.000	1.000	0.952	1.000	1.000	1.000	1.000	1.000	1.000	
fRT		1.000	0.850		1.000	0.850		1.000	0.850		0.950	
fLT	0.950	1.000		0.950	1.000		0.950	0.953		0.950	1.000	
Sec.	0.232			0.125								
fLpb	1.000	1.000		1.000			1.000	1.000		1.000	1.000	
fRpb		1.000	1.000		1.000	1.000		1.000	1.000		1.000	
S	1770	3311	1583	1770	3526	1583	1805	1811	1599	1770	1770	
Sec.	432			233								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		6	1770	0.00	0.050	89	0.07
Perm		0	432	0.00	0.290	125	0.00
Left	L	6			0.34	214	0.03
Prot							
Perm							
Thru	T	771	3311	# 0.23	0.29	960	0.80
Right	R	114	1583	0.07	0.65	1029	0.11
Westbound							
Prot		212	1770	# 0.12	0.120	212	1.00
Perm		23	233	0.10	0.320	75	0.31
Left	L	235			0.44	287	0.82
Prot							
Perm							
Thru	T	898	3526	0.25	0.36	1269	0.71
Right	R	6	1583	0.00	0.44	697	0.01
Northbound							
Prot							
Perm							
Left	L	344	1805	0.19	0.30	542	0.63
Prot							
Perm							
Thru	LT	349	1811	# 0.19	0.30	543	0.64
Right	R	476	1599	0.30	0.42	672	0.71
Southbound							
Prot							
Perm							
Left	L	6	1770	0.00	0.08	142	0.04
Prot							
Perm							
Thru	TR	18	1770	# 0.01	0.08	142	0.13
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.56
Total lost time per cycle, L = 24.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.73

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor Del k	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound											
L	0.03	0.34	22.1	1.000	214	0.11	0.1	0.0	22.1	C	
T	0.80	0.29	32.9	1.000	960	0.35	5.0	0.0	37.9	D	33.8 C
R	0.11	0.65	6.6	1.000	1029	0.11	0.0	0.0	6.6	A	
Westbound											
L	0.82	0.44	21.6	1.000	287	0.36	16.9	0.0	38.4	D	
T	0.71	0.36	27.5	1.000	1269	0.27	1.8	0.0	29.3	C	31.1 C
R	0.01	0.44	15.7	1.000	697	0.11	0.0	0.0	15.7	B	
Northbound											
L	0.63	0.30	30.3	1.000	542	0.22	2.4	0.0	32.7	C	
LT	0.64	0.30	30.4	1.000	543	0.22	2.6	0.0	33.0	C	30.6 C
R	0.71	0.42	23.9	1.000	672	0.27	3.5	0.0	27.4	C	
Southbound											
L	0.04	0.08	42.5	1.000	142	0.11	0.1	0.0	42.6	D	

TR	0.13	0.08	42.8	1.000	142	0.11	0.4	0.0	43.2	D	43.0	D

Intersection delay = 31.8 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M		
Cycle length, C 100.0 sec				
Total actual green time for LT lane group, G (s)	34.0	44.0		
Effective permitted green time for LT lane group, g(s)	29.0	32.0		
Opposing effective green time, go (s)	36.0	29.0		
Number of lanes in LT lane group, N	1	1		
Number of lanes in opposing approach, No	2	2		
Adjusted LT flow rate, VLT (veh/h)	6	235		
Proportion of LT in LT lane group, PLT	1.000	1.000		
Proportion of LT in opposing flow, PLTo	0.00	0.00		
Adjusted opposing flow rate, Vo (veh/h)	898	771		
Lost time for LT lane group, tL	9.00	6.00		
Computation				
LT volume per cycle, LTC=VLTC/3600	0.17	6.53		
Opposing lane util. factor, fLUo	0.952	0.952	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	13.10	11.25		
gf=G[exp(- a * (LTC ** b)]-tl, gf<=g	0.0	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.64	0.71		
gq, (see Exhibit C16-4,5,6,7,8)	6.72	20.61		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	22.28	11.39		
n=Max(gq-gf)/2,0)	3.36	10.30		
PTHo=1-PLTo	1.00	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00		
EL1 (refer to Exhibit C16-3)	3.31	2.92		
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.14	0.13		
gdiff=max(gq-gf,0)	0.00	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.23	0.13		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.232	0.125		

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 100.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000	0.984	0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	0.952	0.952	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b)]-tl, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 100.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v	6	235		
v/c ratio from Capacity Worksheet, X	0.03	0.82		
Protected phase effective green interval, g (s)	5.0	12.0		
Opposing queue effective green interval, gq	6.72	20.61		
Unopposed green interval, gu	22.28	11.39		
Red time r=(C-g-gq-gu)	66.0	56.0		
Arrival rate, qa=v/(3600(max[X,1.0]))	0.00	0.07		
Protected ph. departure rate, Sp=s/3600	0.492	0.492		
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.16	0.18		
XPerm	0.01	1.01		
XProt	0.05	0.75		
Case	1	3		
Queue at beginning of green arrow, Qa	0.11	3.67		
Queue at beginning of unsaturated green, Qu	0.01	1.35		
Residual queue, Qr	0.00	0.02		
Uniform Delay, dI	22.1	21.6		

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Dur. Unmet Demand Q veh	Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. dl sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 31.8 sec/veh Intersection LOS C

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	T	R	L	T	R	L	LT	R	L	TR	
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Flow Rate	6	404	114	235	471	6	344	349	476	6	18	
So	1900	2000	1900	1900	2000	1900	1900	1900	1900	1900	1900	
No.Lanes	1	2	1	1	2	1	1	1	1	1	1	0
SL	629	1738	1583	652	1851	1583	1805	1811	1599	1770	1770	
LnCapacity	214	504	1029	287	666	697	542	543	672	142	142	
Flow Ratio	0.01	0.23	0.07	0.36	0.25	0.00	0.19	0.19	0.30	0.00	0.01	
v/c Ratio	0.03	0.80	0.11	0.82	0.71	0.01	0.63	0.64	0.71	0.04	0.13	
Grn Ratio	0.34	0.29	0.65	0.44	0.36	0.44	0.30	0.30	0.42	0.08	0.08	
I Factor		1.000			1.000			1.000			1.000	
AT or PVG	3	3	3	3	3	3	3	3	3	3	3	
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
PF2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Q1	0.1	10.4	1.2	4.1	11.2	0.1	8.3	8.4	10.9	0.2	0.5	
kB	0.3	0.5	0.7	0.3	0.6	0.6	0.5	0.5	0.6	0.2	0.2	
Q2	0.0	1.7	0.1	1.3	1.3	0.0	0.9	0.9	1.3	0.0	0.0	
Q Average	0.1	12.1	1.3	5.4	12.6	0.1	9.1	9.3	12.2	0.2	0.5	
Q Spacing	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	
Q Storage	0	0	0	0	0	0	0	0	0	0	0	
Q S Ratio												
70th Percentile Output:												
fB%	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	
BOQ	0.1	14.2	1.5	6.4	14.7	0.1	10.8	11.0	14.4	0.2	0.6	
QSRatio												
85th Percentile Output:												
fB%	1.6	1.5	1.6	1.6	1.5	1.6	1.5	1.5	1.5	1.6	1.6	
BOQ	0.2	18.2	2.0	8.3	18.8	0.2	13.9	14.1	18.4	0.3	0.8	
QSRatio												
90th Percentile Output:												
fB%	1.8	1.6	1.8	1.7	1.6	1.8	1.7	1.7	1.6	1.8	1.8	
BOQ	0.2	19.6	2.3	9.1	20.3	0.2	15.1	15.3	19.8	0.3	0.9	
QSRatio												
95th Percentile Output:												
fB%	2.1	1.8	2.1	1.9	1.8	2.1	1.9	1.9	1.8	2.1	2.1	
BOQ	0.2	21.9	2.7	10.4	22.6	0.2	17.0	17.3	22.1	0.3	1.0	
QSRatio												
98th Percentile Output:												
fB%	2.7	2.1	2.6	2.4	2.1	2.7	2.2	2.2	2.1	2.7	2.7	
BOQ	0.3	25.4	3.4	12.7	26.1	0.3	20.0	20.3	25.6	0.4	1.3	
QSRatio												

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: md
Agency:
Date: 12/10/2004
Period: pm
Project ID: 2017 total traffic - with improvements
E/W St: STH 158

Inter.: STH 158/104th
Area Type: All other areas
Jurisd: WisDOT
Year : 2017
N/S St: 104th Ave

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	2	1	1	2	1	1	1	1	1	1	0
LGConfig	L	T	R	L	T	R	L	LT	R	L	TR	
Volume	5	780	125	165	735	5	900	5	515	10	5	10
Lane Width	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A		A		NB Left	A			
Thru			A		Thru	A			
Right			A		Right	A			
Peds					Peds				
WB Left	A	A	A		SB Left		A		
Thru		A	A		Thru		A		
Right		A	A		Right		A		
Peds					Peds				
NB Right	A	A			EB Right	A			
SB Right					WB Right		A		
Green	4.0	4.0	33.0			40.0	5.0		
Yellow	3.0	3.0	4.5			4.5	4.5		
All Red	0.0	0.0	1.5			1.5	1.5		

Cycle Length: 110.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	170	1770	0.04	0.34	25.0	C		
T	1088	3627	0.93	0.30	51.2	D	44.7	D
R	1160	1615	0.14	0.72	4.9	A		
Westbound								
L	247	1787	0.87	0.43	52.4	D		
T	1306	3592	0.73	0.36	32.5	C	36.0	D
R	648	1583	0.01	0.41	19.3	B		
Northbound								
L	656	1805	0.89	0.36	47.4	D		
LT	658	1810	0.90	0.36	48.1	D	45.5	D
R	741	1599	0.90	0.46	41.6	D		
Southbound								
L	80	1770	0.16	0.05	51.4	D		
TR	76	1672	0.25	0.05	52.4	D	52.0	D

Intersection Delay = 42.7 (sec/veh) Intersection LOS = D

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 12/10/2004
Analysis Time Period: pm
Intersection: STH 158/104th
Area Type: All other areas
Jurisdiction: WisDOT
Analysis Year: 2017
Project ID: 2017 total traffic - with improvements
East/West Street: STH 158 North/South Street: 104th Ave

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	5	780	125	165	735	5	900	5	515	10	5	10
% Heavy Veh	2	5	0	1	6	2	0	0	1	2	2	2
PHF	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77
PK 15 Vol	2	253	41	54	239	2	292	2	167	3	2	3
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	2000	1900	1900	2000	1900	1900	1900	1900	1900	1900	
ParkExist												
NumPark												
No. Lanes	1	2	1	1	2	1	1	1	1	1	1	0
LGConfig	L	T	R	L	T	R	L	LT	R	L	TR	
Lane Width	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	
RTOR Vol			0			0			0			0
Adj Flow	6	1013	162	214	955	6	585	590	669	13	19	
%InSharedLn							50					
Prop LTs	1.000	0.000		1.000	0.000			0.991			0.000	
Prop RTs		0.000	1.000		0.000	1.000		0.000	1.000		0.684	
Peds	0			0			0			0		
Bikes												
Buses	0	0	0	0	0	0	0	0	0	0	0	
%InProtPhase	0.0			0.0								

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Arriv. Type	3	3	3	3	3	3	3	3	3	3	3	
Unit Ext.	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	
Ext of g	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	

Ped Min g	3.2	3.2	3.2	3.2

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A		A		NB Left	A			
Thru			A		Thru	A			
Right			A		Right	A			
Peds					Peds				
WB Left	A	A	A		SB Left		A		
Thru		A	A		Thru		A		
Right		A	A		Right		A		
Peds					Peds				
NB Right	A	A			EB Right	A			
SB Right					WB Right		A		
Green	4.0	4.0	33.0			40.0	5.0		
Yellow	3.0	3.0	4.5			4.5	4.5		
All Red	0.0	0.0	1.5			1.5	1.5		

Cycle Length: 110.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	5	780	125	165	735	5	900	5	515	10	5	10
PHF	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77
Adj flow	6	1013	162	214	955	6	1169	6	669	13	6	13
No. Lanes	1	2	1	1	2	1	1	1	1	1	1	0
Lane group	L	T	R	L	T	R	L	LT	R	L	TR	
Adj flow	6	1013	162	214	955	6	585	590	669	13	19	
Prop LTs	1.000	0.000		1.000	0.000			0.991			0.000	
Prop RTs		0.000	1.000		0.000	1.000		0.000	1.000		0.684	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound L	T	R	Westbound L	T	R	Northbound L	LT	R	Southbound L	TR	
So	1900	2000	1900	1900	2000	1900	1900	1900	1900	1900	1900	
Lanes	1	2	1	1	2	1	1	1	1	1	1	0
fW	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
fHV	0.980	0.952	1.000	0.990	0.943	0.980	1.000	1.000	0.990	0.980	0.980	
fG	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
fP	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
fBB	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
fA	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
fLU	1.000	0.952	1.000	1.000	0.952	1.000	1.000	1.000	1.000	1.000	1.000	
fRT		1.000	0.850		1.000	0.850		1.000	0.850		0.897	
fLT	0.950	1.000		0.950	1.000		0.950	0.953		0.950	1.000	
Sec.	0.190			0.111								
fLpb	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fRpb		1.000	1.000		1.000	1.000		1.000	1.000		1.000	
s	1770	3627	1615	1787	3592	1583	1805	1810	1599	1770	1672	
Sec.	354			209								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		6	1770	0.00	0.036	64	0.09
Perm		0	354	0.00	0.300	106	0.00
Left	L	6			0.34	170	0.04
Prot							
Perm							
Thru	T	1013	3627	# 0.28	0.30	1088	0.93
Right	R	162	1615	0.10	0.72	1160	0.14
Westbound							
Prot		179	1787	# 0.10	0.100	179	1.00
Perm		35	209	0.17	0.327	68	0.51
Left	L	214			0.43	247	0.87
Prot							
Perm							
Thru	T	955	3592	0.27	0.36	1306	0.73
Right	R	6	1583	0.00	0.41	648	0.01
Northbound							
Prot							
Perm							
Left	L	585	1805	0.32	0.36	656	0.89
Prot							
Perm							
Thru	LT	590	1810	# 0.33	0.36	658	0.90
Right	R	669	1599	0.42	0.46	741	0.90
Southbound							
Prot							
Perm							
Left	L	13	1770	0.01	0.05	80	0.16
Prot							
Perm							
Thru	TR	19	1672	# 0.01	0.05	76	0.25
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.72
Total lost time per cycle, L = 24.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.92

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group Delay	LOS	Approach Delay	LOS
Eastbound												
L	0.04	0.34	24.9	1.000	170	0.11	0.1	0.0	25.0	C		
T	0.93	0.30	37.4	1.000	1088	0.45	13.8	0.0	51.2	D	44.7	D
R	0.14	0.72	4.9	1.000	1160	0.11	0.1	0.0	4.9	A		
Westbound												
L	0.87	0.43	26.3	1.000	247	0.40	26.1	0.0	52.4	D		
T	0.73	0.36	30.3	1.000	1306	0.29	2.1	0.0	32.5	C	36.0	D
R	0.01	0.41	19.3	1.000	648	0.11	0.0	0.0	19.3	B		
Northbound												
L	0.89	0.36	33.0	1.000	656	0.42	14.5	0.0	47.4	D		
LT	0.90	0.36	33.0	1.000	658	0.42	15.0	0.0	48.1	D	45.5	D
R	0.90	0.46	27.2	1.000	741	0.42	14.4	0.0	41.6	D		
Southbound												
L	0.16	0.05	50.5	1.000	80	0.11	1.0	0.0	51.4	D		

TR	0.25	0.05	50.7	1.000	76	0.11	1.7	0.0	52.4	D	52.0	D

Intersection delay = 42.7 (sec/veh) Intersection LOS = D

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M		
Cycle length, C 110.0 sec				
Total actual green time for LT lane group, G (s)	37.0	47.0		
Effective permitted green time for LT lane group, g(s)	33.0	36.0		
Opposing effective green time, go (s)	40.0	33.0		
Number of lanes in LT lane group, N	1	1		
Number of lanes in opposing approach, No	2	2		
Adjusted LT flow rate, VLT (veh/h)	6	214		
Proportion of LT in LT lane group, PLT	1.000	1.000		
Proportion of LT in opposing flow, PLTo	0.00	0.00		
Adjusted opposing flow rate, Vo (veh/h)	955	1013		
Lost time for LT lane group, tL	9.00	6.00		
Computation				
LT volume per cycle, LTC=VLTC/3600	0.18	6.54		
Opposing lane util. factor, fLUo	0.952	0.952	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	15.33	16.26		
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g	0.0	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.64	0.70		
gq, (see Exhibit C16-4,5,6,7,8)	11.04	32.00		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	21.96	4.00		
n=Max(gq-gf)/2,0)	5.52	16.00		
PTHo=1-PLTo	1.00	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00		
EL1 (refer to Exhibit C16-3)	3.51	3.71		
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+P1)/g	0.12	0.11		
gdiff=max(gq-gf,0)	0.00	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.19	0.11		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.190	0.111		

For special case of single-lane approach opposed by multilane approach, see text.
* If P1>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 110.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000	0.991	0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	0.952	0.952	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+P1)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If P1>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 110.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v	6	214		
v/c ratio from Capacity Worksheet, X	0.04	0.87		
Protected phase effective green interval, g (s)	4.0	11.0		
Opposing queue effective green interval, gq	11.04	32.00		
Unopposed green interval, gu	21.96	4.00		
Red time r=(C-g-gq-gu)	73.0	63.0		
Arrival rate, qa=v/(3600(max[X,1.0]))	0.00	0.06		
Protected ph. departure rate, Sp=s/3600	0.492	0.496		
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.15	0.52		
XPerm	0.02	1.02		
XProt	0.07	0.81		
Case	1	3		
Queue at beginning of green arrow, Qa	0.12	3.80		
Queue at beginning of unsaturated green, Qu	0.02	1.90		
Residual queue, Qr	0.00	0.05		
Uniform Delay, d1	24.9	26.3		

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 42.7 sec/veh Intersection LOS D

BACK OF QUEUE WORKSHEET

LaneGroup	Eastbound L	Eastbound T	Eastbound R	Westbound L	Westbound T	Westbound R	Northbound L	Northbound LT	Northbound R	Southbound L	Southbound TR	
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Flow Rate	6	532	162	214	501	6	585	590	669	13	19	
So	1900	2000	1900	1900	2000	1900	1900	1900	1900	1900	1900	
No.Lanes	1	2	1	1	2	1	1	1	1	1	1	0
SL	507	1904	1615	578	1886	1583	1805	1810	1599	1770	1672	
LnCapacity	170	571	1160	247	685	648	656	658	741	80	76	
Flow Ratio	0.01	0.28	0.10	0.37	0.27	0.00	0.32	0.33	0.42	0.01	0.01	
v/c Ratio	0.04	0.93	0.14	0.87	0.73	0.01	0.89	0.90	0.90	0.16	0.25	
Grn Ratio	0.34	0.30	0.72	0.43	0.36	0.41	0.36	0.36	0.46	0.05	0.05	
I Factor		1.000			1.000			1.000			1.000	
AT or PVG	3	3	3	3	3	3	3	3	3	3	3	
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
PF2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Q1	0.1	15.8	1.6	4.1	13.3	0.1	16.8	17.0	18.9	0.4	0.6	
kB	0.3	0.6	0.9	0.3	0.6	0.6	0.6	0.6	0.7	0.2	0.2	
Q2	0.0	4.1	0.1	1.6	1.6	0.0	3.6	3.7	4.1	0.0	0.1	
Q Average	0.1	19.9	1.7	5.7	14.9	0.1	20.4	20.7	23.0	0.4	0.6	
Q Spacing	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	
Q Storage	0	0	0	0	0	0	0	0	0	0	0	
Q S Ratio												
70th Percentile Output:												
fB%	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	
BOQ	0.2	23.1	2.0	6.7	17.4	0.1	23.7	24.0	26.6	0.5	0.7	
QSRatio												
85th Percentile Output:												
fB%	1.6	1.5	1.6	1.5	1.5	1.6	1.5	1.5	1.4	1.6	1.6	
BOQ	0.2	29.0	2.7	8.8	22.0	0.2	29.6	30.0	33.1	0.7	1.0	
QSRatio												
90th Percentile Output:												
fB%	1.8	1.5	1.8	1.7	1.6	1.8	1.5	1.5	1.5	1.8	1.8	
BOQ	0.2	30.8	3.0	9.7	23.6	0.2	31.5	31.9	35.1	0.7	1.1	
QSRatio												
95th Percentile Output:												
fB%	2.1	1.7	2.0	1.9	1.8	2.1	1.7	1.7	1.7	2.1	2.1	
BOQ	0.3	33.8	3.5	11.0	26.2	0.2	34.5	35.0	38.3	0.9	1.3	
QSRatio												
98th Percentile Output:												
fB%	2.7	1.9	2.6	2.3	2.0	2.7	1.9	1.9	1.9	2.7	2.7	
BOQ	0.4	38.1	4.4	13.3	30.0	0.3	38.9	39.4	43.0	1.1	1.6	
QSRatio												

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: md
Agency:
Date: 1/3/2005
Period: am
Project ID: 2017 total traffic - with improvements
E/W St: sth 158

Inter.: sth 158/greyhound access
Area Type: All other areas
Jurisd: wisdot
Year : 2017
N/S St: greyhound access

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	1	2	0	2	0	1	0	0	0
LGConfig		T		L	T		L		R			
Volume		700		375	950		45		40			
Lane Width		12.0		12.0	12.0		12.0		12.0			
RTOR Vol									0			

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left					NB Left	A			
Thru		A			Thru				
Right					Right	A			
Peds					Peds				
WB Left	A	A			SB Left				
Thru	A	A			Thru				
Right					Right				
Peds					Peds				
NB Right	A				EB Right				
SB Right					WB Right				
Green	15.0	52.0				18.0			
Yellow	3.0	4.5				4.5			
All Red	0.0	1.5				1.5			

Cycle Length: 100.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
T	1722	3311	0.42	0.52	14.9	B	14.9	B
Westbound								
L	559	1805	0.69	0.70	11.3	B	7.7	A
T	2468	3526	0.40	0.70	6.3	A		
Northbound								
L	631	3505	0.07	0.18	34.1	C	27.1	C
R	630	1615	0.07	0.39	19.1	B		
Southbound								

Intersection Delay = 10.9 (sec/veh) Intersection LOS = B

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/3/2005
Analysis Time Period: am
Intersection: sth 158/greyhound access
Area Type: All other areas
Jurisdiction: wisdot
Analysis Year: 2017
Project ID: 2017 total traffic - with improvements
East/West Street: sth 158
North/South Street: greyhound access

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume		700		375	950		45		40			
% Heavy Veh		15		0	8		0		0			
PHF		0.97		0.97	0.97		0.97		0.97			
PK 15 Vol		180		97	245		12		10			
Hi Ln Vol								0				
% Grade		0			0							
Ideal Sat		2000		1900	2000		1900		1900			
ParkExist												
HumPark												
No. Lanes	0	2	0		1	2	0	2	0	1	0	0	0
LGConfig		T			L	T		L		R			
Lane Width		12.0			12.0	12.0		12.0		12.0			
RTOR Vol										0			
Adj Flow		722			387	979		46		41			
%InSharedLn													
Prop LTs		0.000			1.000	0.000							
Prop RTs		0.000				0.000				1.000			
Peds		0						0			0		
Bikes													
Buses		0			0	0		0		0			
%InProtPhase					0.0								

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0		0.0	0.0		0.0		0.0			
Arriv. Type		3		3	3		3		3			
Unit Ext.		3.0		3.0	3.0		3.0		3.0			
I Factor		1.000			1.000			1.000				
Lost Time		2.0		2.0	2.0		2.0		2.0			
Ext of g		2.0		2.0	2.0		2.0		2.0			
Ped Min g		3.2						3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left					NB Left	A			
Thru		A			Thru				
Right					Right	A			
Peds					Peds				
WB Left	A	A			SB Left				
Thru	A	A			Thru				
Right					Right				
Peds					Peds				
NB Right	A				EB Right				
SB Right					WB Right				
Green	15.0	52.0				18.0			
Yellow	3.0	4.5				4.5			
All Red	0.0	1.5				1.5			

Cycle Length: 100.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V		700		375	950		45		40			
PHF		0.97		0.97	0.97		0.97		0.97			
Adj flow		722		387	979		46		41			
No. Lanes	0	2	0	1	2	0	2	0	1	0	0	0
Lane group		T		L	T		L		R			
Adj flow		722		387	979		46		41			
Prop LTs		0.000		1.000	0.000							
Prop RTs		0.000			0.000				1.000			

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG		T		L	T		L		R			
So		2000		1900	2000		1900		1900			
Lanes	0	2	0	1	2	0	2	0	1	0	0	0
fW		1.000		1.000	1.000		1.000		1.000			
fHV		0.870		1.000	0.926		1.000		1.000			
fG		1.000		1.000	1.000		1.000		1.000			
fP		1.000		1.000	1.000		1.000		1.000			
fBB		1.000		1.000	1.000		1.000		1.000			
fA		1.000		1.000	1.000		1.000		1.000			
fLU		0.952		1.000	0.952		0.971		1.000			
fRT		1.000			1.000				0.850			
fLT		1.000		0.950	1.000		0.950					
Sec.				0.275								
fLpb		1.000		1.000	1.000		1.000					
fRpb		1.000			1.000				1.000			
S		3311		1805	3526		3505		1615			
Sec.				523								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	722	3311	0.22	0.52	1722	0.42
Right							
Westbound							
Prot		271	1805	# 0.15	0.150	271	1.00
Perm		116	523	# 0.22	0.550	288	0.40
Left	L	387			0.70	559	0.69
Prot							
Perm							
Thru	T	979	3526	0.28	0.70	2468	0.40
Right							
Northbound							
Prot							
Perm							
Left	L	46	3505	# 0.01	0.18	631	0.07
Prot							
Perm							
Thru							
Right	R	41	1615	0.03	0.39	630	0.07
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.39
Total lost time per cycle, L = 12.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.44

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Del Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
T	0.42	0.52	14.7	1.000	1722	0.11	0.2	0.0	14.9	B	14.9	B
Westbound												
L	0.69	0.70	7.6	1.000	559	0.26	3.7	0.0	11.3	B	7.7	A
T	0.40	0.70	6.2	1.000	2468	0.11	0.1	0.0	6.3	A		
Northbound												
L	0.07	0.18	34.1	1.000	631	0.11	0.0	0.0	34.1	C	27.1	C
R	0.07	0.39	19.1	1.000	630	0.11	0.0	0.0	19.1	B		
Southbound												

Intersection delay = 10.9 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach		M		
Cycle length, C 100.0 sec				
Total actual green time for LT lane group, G (s)		70.0		
Effective permitted green time for LT lane group, g(s)		55.0		
Opposing effective green time, go (s)		52.0		
Number of lanes in LT lane group, N		1		
Number of lanes in opposing approach, No		2		
Adjusted LT flow rate, VLT (veh/h)		387		
Proportion of LT in LT lane group, PLT		1.000		
Proportion of LT in opposing flow, PLTo		0.00		
Adjusted opposing flow rate, Vo (veh/h)		722		
Lost time for LT lane group, tL		6.00		
Computation				
LT volume per cycle, LTC=VLTC/3600		10.75		
Opposing lane util. factor, fLUo	0.952	0.952		
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		10.53		
gf=G[exp(- a * (LTC ** b)]-tl, gf<=g		0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.48		
gq, (see Exhibit C16-4,5,6,7,8)		12.81		
gu=g-gq if gq>=gf, or = g-gf if gq<gf		42.19		
n=Max(gq-gf)/2,0)		6.41		
PTHo=1-PLTo		1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00		
EL1 (refer to Exhibit C16-3)		2.79		
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.07		
gdiff=max(gq-gf,0)		0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.28		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.275		

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 100.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000		
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	0.952	0.952		
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b)]-tl, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 100.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v		387		
v/c ratio from Capacity Worksheet, X		0.69		
Protected phase effective green interval, g (s)		15.0		
Opposing queue effective green interval, gq		12.81		
Unopposed green interval, gu		42.19		
Red time r=(C-g-gq-gu)		30.0		
Arrival rate, qa=v/(3600(max[X,1.0]))		0.11		
Protected ph. departure rate, Sp=s/3600		0.501		
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)		0.19		
XPerm		0.74		
XProt		0.64		
Case		1		
Queue at beginning of green arrow, Qa		3.23		
Queue at beginning of unsaturated green, Qu		1.38		
Residual queue, Qr		0.00		
Uniform Delay, d1		7.6		

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Dur. Unmet Demand Q veh	Unmet Demand t hrs.	Uniform Delay Unadj. ds	Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 10.9 sec/veh Intersection LOS B

BACK OF QUEUE WORKSHEET

LaneGroup	Eastbound T	Westbound L	Westbound T	Northbound L	Northbound R	Southbound		
Init Queue	0.0	0.0	0.0	0.0	0.0			
Flow Rate	379	387	514	23	41			
So	2000	1900	2000	1900	1900			
No.Lanes	2	1	2	2	1	0	0	0
SL	1738	798	1851	1805	1615			
LnCapacity	904	559	1296	324	630			
Flow Ratio	0.22	0.48	0.28	0.01	0.03			
v/c Ratio	0.42	0.69	0.40	0.07	0.07			
Grn Ratio	0.52	0.70	0.70	0.18	0.39			
I Factor	1.000	1.000		1.000				
AT or PVG	3	3	3	3	3			
Pltn Ratio	1.00	1.00	1.00	1.00	1.00			
PF2	1.00	1.00	1.00	1.00	1.00			
Q1	6.5	3.6	5.9	0.5	0.7			
kB	0.7	0.5	0.9	0.4	0.6			
Q2	0.5	1.1	0.6	0.0	0.0			
Q Average	7.0	4.7	6.5	0.6	0.8			
Q Spacing	25.0	25.0	25.0	25.0	25.0			
Q Storage	0	0	0	0	0			
Q S Ratio								
70th Percentile Output:								
fB%	1.2	1.2	1.2	1.2	1.2			
BOQ	8.2	5.6	7.7	0.7	0.9			
QSRatio								
85th Percentile Output:								
fB%	1.5	1.6	1.5	1.6	1.6			
BOQ	10.7	7.3	10.0	0.9	1.2			
QSRatio								
90th Percentile Output:								
fB%	1.7	1.7	1.7	1.8	1.8			
BOQ	11.7	8.1	11.0	1.0	1.3			
QSRatio								
95th Percentile Output:								
fB%	1.9	2.0	1.9	2.1	2.1			
BOQ	13.3	9.2	12.5	1.2	1.6			
QSRatio								
98th Percentile Output:								
fB%	2.3	2.4	2.3	2.7	2.6			
BOQ	15.9	11.3	15.0	1.5	2.0			
QSRatio								

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: md
Agency:
Date: 1/3/2005
Period: pm
Project ID: 2017 total traffic - with improvements
E/W St: sth 158

Inter.: sth 158/greyhound access
Area Type: All other areas
Jurisd: wisdot
Year : 2017
N/S St: greyhound access

SIGNALIZED INTERSECTION SUMMARY

	Eastbound L	T	R	Westbound L	T	R	Northbound L	T	R	Southbound L	T	R
No. Lanes	0	2	0	1	2	0	2	0	1	0	0	0
LGConfig		T		L	T		L		R			
Volume		780		595	1070		170		130			
Lane Width		12.0		12.0	12.0		12.0		12.0			
RTOR Vol									0			

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left	A		
Thru		A			Thru			
Right					Right	A		
Peds					Peds			
WB Left	A	A			SB Left			
Thru	A	A			Thru			
Right					Right			
Peds					Peds			
NB Right	A				EB Right			
SB Right					WB Right			
Green	40.0	35.0			20.0			
Yellow	3.0	4.5			4.5			
All Red	0.0	1.5			1.5			

Cycle Length: 110.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	g/C	Lane Group Delay	LOS	Approach Delay	LOS
Eastbound								
T	1154	3627	0.73	0.32	35.6	D	35.6	D
Westbound								
L	732	1805	0.87	0.71	37.2	D		
T	2547	3592	0.45	0.71	7.0	A	17.8	B
Northbound								
L	637	3505	0.29	0.18	39.1	D		
R	969	1615	0.14	0.60	9.7	A	26.4	C
Southbound								

Intersection Delay = 23.8 (sec/veh) Intersection LOS = C

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/3/2005
Analysis Time Period: pm
Intersection: sth 158/greyhound access
Area Type: All other areas
Jurisdiction: wisdot
Analysis Year: 2017
Project ID: 2017 total traffic - with improvements
East/West Street: sth 158 North/South Street: greyhound access

VOLUME DATA

	Eastbound L	T	R	Westbound L	T	R	Northbound L	T	R	Southbound L	T	R
Volume		780		595	1070		170		130			
% Heavy Veh		5		0	6		0		0			
PHF		0.93		0.93	0.93		0.93		0.93			
PK 15 Vol		210		160	288		46		35			
Hi Ln Vol												
% Grade		0			0			0				
Ideal Sat		2000		1900	2000		1900		1900			
ParkExist												
NumPark												
No. Lanes	0	2	0	1	2	0	2	0	1	0	0	0
LGConfig		T		L	T		L		R			
Lane Width		12.0		12.0	12.0		12.0		12.0			
RTOR Vol									0			
Adj Flow		839		640	1151		183		140			
%InSharedLn												
Prop LTs		0.000		1.000	0.000							
Prop RTs	0.000				0.000				1.000			
Peds	0						0			0		
Bikes	0											
Buses		0		0	0		0		0			
%InProtPhase				0.0								

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound L	T	R	Westbound L	T	R	Northbound L	T	R	Southbound L	T	R
Init Unmet		0.0		0.0	0.0		0.0		0.0			
Arriv. Type		3		3	3		3		3			
Unit Ext.		3.0		3.0	3.0		3.0		3.0			
I Factor		1.000			1.000			1.000				
Lost Time		2.0		2.0	2.0		2.0		2.0			
Ext of g		2.0		2.0	2.0		2.0		2.0			
Ped Min g		3.2						3.2		3.2		

PHASE DATA

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left	A		
Thru		A			Thru			
Right					Right	A		
Peds					Peds			
WB Left	A	A			SB Left			
Thru	A	A			Thru			
Right					Right			
Peds					Peds			
NB Right	A				EB Right			
SB Right					WB Right			
Green	40.0	35.0			20.0			
Yellow	3.0	4.5			4.5			
All Red	0.0	1.5			1.5			

Cycle Length: 110.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound L	T	R	Westbound L	T	R	Northbound L	T	R	Southbound L	T	R
Volume, V		780		595	1070		170		130			
PHF		0.93		0.93	0.93		0.93		0.93			
Adj flow		839		640	1151		183		140			
No. Lanes	0	2	0	1	2	0	2	0	1	0	0	0
Lane group		T		L	T		L		R			
Adj flow		839		640	1151		183		140			
Prop LTs		0.000		1.000	0.000							
Prop RTs	0.000				0.000				1.000			

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG		T		L	T		L		R			
So		2000		1900	2000		1900		1900			
Lanes	0	2	0	1	2	0	2	0	1	0	0	0
fW		1.000		1.000	1.000		1.000		1.000			
fHV		0.952		1.000	0.943		1.000		1.000			
fG		1.000		1.000	1.000		1.000		1.000			
fP		1.000		1.000	1.000		1.000		1.000			
fBB		1.000		1.000	1.000		1.000		1.000			
fA		1.000		1.000	1.000		1.000		1.000			
fLU		0.952		1.000	0.952		0.971		1.000			
fRT		1.000			1.000				0.850			
fLT		1.000		0.950	1.000		0.950					
Sec.				0.115								
fLpb		1.000		1.000	1.000		1.000					
fRpb		1.000			1.000				1.000			
S		3627		1805	3592		3505		1615			
Sec.				219								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	839	3627	# 0.23	0.32	1154	0.73
Right							
Westbound							
Prot		640	1805	# 0.35	0.364	656	0.98
Perm		0	219	0.00	0.345	76	0.00
Left	L	640			0.71	732	0.87
Prot							
Perm							
Thru	T	1151	3592	0.32	0.71	2547	0.45
Right							
Northbound							
Prot							
Perm							
Left	L	183	3505	# 0.05	0.18	637	0.29
Prot							
Perm							
Thru							
Right	R	140	1615	0.09	0.60	969	0.14
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (V/S) = 0.64
Total lost time per cycle, L = 18.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.76

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group Delay	LOS	Approach Delay	LOS
Eastbound												
T	0.73	0.32	33.3	1.000	1154	0.29	2.3	0.0	35.6	D	35.6	D
Westbound												
L	0.87	0.71	25.8	1.000	732	0.40	11.4	0.0	37.2	D		
T	0.45	0.71	6.8	1.000	2547	0.11	0.1	0.0	7.0	A	17.8	B
Northbound												
L	0.29	0.18	38.8	1.000	637	0.11	0.3	0.0	39.1	D		
R	0.14	0.60	9.6	1.000	969	0.11	0.1	0.0	9.7	A	26.4	C
Southbound												

Intersection delay = 23.8 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach		M		
Cycle length, C 110.0 sec				
Total actual green time for LT lane group, G (s)		78.0		
Effective permitted green time for LT lane group, g(s)		38.0		
Opposing effective green time, go (s)		35.0		
Number of lanes in LT lane group, N		1		
Number of lanes in opposing approach, No		2		
Adjusted LT flow rate, VLT (veh/h)		640		
Proportion of LT in LT lane group, PLT		1.000		
Proportion of LT in opposing flow, PLTo		0.00		
Adjusted opposing flow rate, Vo (veh/h)		839		
Lost time for LT lane group, tL		6.00		
Computation				
LT volume per cycle, LTC=VLTC/3600		19.56		
Opposing lane util. factor, fLUo	0.952	0.952		
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		13.46		
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g		0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.68		
gq, (see Exhibit C16-4,5,6,7,8)		24.31		
gu=g-gq if gq>=gf, or = g-gf if gq<gf		13.69		
n=Max(gq-gf)/2,0)		12.16		
PTHo=1-PLTo		1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00		
EL1 (refer to Exhibit C16-3)		3.13		
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.11		
gdiff=max(gq-gf,0)		0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.12		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.115		

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 110.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT		0.000	0.000	
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo		0.952	0.952	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 110.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v		640		
v/c ratio from Capacity Worksheet, X		0.87		
Protected phase effective green interval, g (s)		40.0		
Opposing queue effective green interval, gq		24.31		
Unopposed green interval, gu		13.69		
Red time r=(C-g-gq-gu)		32.0		
Arrival rate, qa=v/(3600(max[X,1.0]))		0.18		
Protected ph. departure rate, Sp=s/3600		0.501		
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)		0.17		
XPerm		2.92		
XProt		0.64		
Case		3		
Queue at beginning of green arrow, Qa		10.13		
Queue at beginning of unsaturated green, Qu		4.32		
Residual queue, Qr		4.44		
Uniform Delay, d1		25.8		

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 23.8 sec/veh Intersection LOS C

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup		T		L	T		L		R			
Init Queue		0.0		0.0	0.0		0.0		0.0			
Flow Rate		440		640	604		94		140			
So		2000		1900	2000		1900		1900			
No.Lanes	0	2	0	1	2	0	2	0	1	0	0	0
SL		1904		1032	1886		1805		1615			
LnCapacity		606		732	1337		328		969			
Flow Ratio		0.23		0.62	0.32		0.05		0.09			
v/c Ratio		0.73		0.87	0.45		0.29		0.14			
Grn Ratio		0.32		0.71	0.71		0.18		0.60			
I Factor		1.000			1.000			1.000				
AT or PVG		3		3	3		3		3			
Pltn Ratio		1.00		1.00	1.00		1.00		1.00			
PF2		1.00		1.00	1.00		1.00		1.00			
Q1		11.9		8.3	7.9		2.5		1.9			
kB		0.6		0.6	0.9		0.4		0.8			
Q2		1.4		3.5	0.8		0.2		0.1			
Q Average		13.3		11.8	8.7		2.6		2.0			
Q Spacing		25.0		25.0	25.0		25.0		25.0			
Q Storage		0		0	0		0		0			
Q S Ratio												
70th Percentile Output:												
fB%		1.2		1.2	1.2		1.2		1.2			
BOQ		15.6		13.9	10.2		3.1		2.4			
QSRatio												
85th Percentile Output:												
fB%		1.5		1.5	1.5		1.6		1.6			
BOQ		19.9		17.7	13.2		4.2		3.2			
QSRatio												
90th Percentile Output:												
fB%		1.6		1.6	1.7		1.8		1.8			
BOQ		21.4		19.1	14.4		4.6		3.5			
QSRatio												
95th Percentile Output:												
fB%		1.8		1.8	1.9		2.0		2.0			
BOQ		23.8		21.4	16.2		5.3		4.1			
QSRatio												
98th Percentile Output:												
fB%		2.1		2.1	2.2		2.5		2.6			
BOQ		27.5		24.8	19.2		6.6		5.1			
QSRatio												

ERROR MESSAGES

No errors to report.

HCS2000: Unsignalized Intersections Release 4.1d

TWO-WAY STOP CONTROL SUMMARY

Analyst: md
Agency/Co.:
Date Performed: 12/15/2004
Analysis Time Period: am
Intersection: STH 158/Eastern Frontage Road
Jurisdiction: WisDOT
Units: U. S. Customary
Analysis Year: 2017
Project ID: 2017 site + background - with improvements
East/West Street: STH 158
North/South Street: Frontage Road
Intersection Orientation: EW
Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	1	1295	1	1	1105	10
Peak-Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate, HFR	1	1295	1	1	1105	10
Percent Heavy Vehicles	0	--	--	0	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						No
Lanes	1	2	0	1	2	1
Configuration	L	T	TR	L	T	R
Upstream Signal?		No			No	

Minor Street: Approach	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	50	10	55	10	1	10
Peak Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate, HFR	50	10	55	10	1	10
Percent Heavy Vehicles	0	0	0	0	0	0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No /			No /
Lanes	1	1	0	1	1	0
Configuration	L		TR	L		TR

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	L	L	L		TR	L		TR
v (vph)	1	1	50		65	10		11
C(m) (vph)	634	541	45		150	36		219
v/c	0.00	0.00	1.11		0.43	0.28		0.05
95% queue length	0.00	0.01	4.65		1.94	0.90		0.16
Control Delay	10.7	11.7	311.6		46.2	139.7		22.3
LOS	B	B	F		E	F		C
Approach Delay				161.6			78.2	
Approach LOS				F			F	

HCS2000: Unsignalized Intersections Release 4.1d

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TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 12/15/2004
Analysis Time Period: am
Intersection: STH 158/Eastern Frontage Road
Jurisdiction: WisDOT
Units: U. S. Customary
Analysis Year: 2017
Project ID: 2017 site + background - with improvements
East/West Street: STH 158
North/South Street: Frontage Road
Intersection Orientation: EW
Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	1	1295	1	1	1105	10
Peak-Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Peak-15 Minute Volume	0	324	0	0	276	2
Hourly Flow Rate, HFR	1	1295	1	1	1105	10
Percent Heavy Vehicles	0	--	--	0	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						No
Lanes	1	2	0	1	2	1
Configuration	L	T	TR	L	T	R
Upstream Signal?		No			No	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	50	10	55	10	1	10
Peak Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Peak-15 Minute Volume	12	2	14	2	0	2
Hourly Flow Rate, HFR	50	10	55	10	1	10
Percent Heavy Vehicles	0	0	0	0	0	0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No /			No /
RT Channelized?						
Lanes	1	1	0	1	1	0
Configuration	L		TR	L		TR

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn							
Through							
S5 Left-Turn							
Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1	4.1	7.5	6.5	6.9	7.5	6.5	6.9
t(c,hv)		2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
P(hv)		0	0	0	0	0	0	0	0
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Grade/100				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage	4.1	4.1	7.5	6.5	6.9	7.5	6.5	6.9
	2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20	2.20	3.50	4.00	3.30	3.50	4.00	3.30
t(f,HV)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(HV)	0	0	0	0	0	0	0	0
t(f)	2.2	2.2	3.5	4.0	3.3	3.5	4.0	3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2 V(t)	Movement 2 V(1,prot)	Movement 5 V(t)	Movement 5 V(1,prot)
V prog				
Total Saturation Flow Rate, s (vph)				
Arrival Type				
Effective Green, g (sec)				
Cycle Length, C (sec)				
Rp (from Exhibit 16-11)				
Proportion vehicles arriving on green P				
g(q1)				
g(q2)				
g(q)				

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2 V(t)	Movement 2 V(1,prot)	Movement 5 V(t)	Movement 5 V(1,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p		0.000		0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x	1115	1296	1852	2415	648	1761	2405	552
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process

	7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		3000		3000		3000		3000
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	648	552
Potential Capacity	418	483
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	418	483
Probability of Queue free St.	0.87	0.98

Step 2: LT from Major St.	4	1
Conflicting Flows	1296	1115
Potential Capacity	541	634
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	541	634
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows	2415	2405
Potential Capacity	33	34
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	33	34
Probability of Queue free St.	0.70	0.97

Step 4: LT from Minor St.	7	10
Conflicting Flows	1852	1761
Potential Capacity	47	55
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.97	0.69
Maj. L, Min T Adj. Imp Factor.	0.98	0.76
Cap. Adj. factor due to Impeding mvmnt	0.95	0.66
Movement Capacity	45	36

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	2415	2405
Potential Capacity	33	34
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	33	34
Result for 2 stage process:		
a		
y		
C t	33	34
Probability of Queue free St.	0.70	0.97

Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	1852	1761
Potential Capacity	47	55
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.97	0.69
Maj. L, Min T Adj. Imp Factor.	0.98	0.76
Cap. Adj. factor due to Impeding mvmnt	0.95	0.66
Movement Capacity	45	36
Results for Two-stage process:		
a		
y		
C t	45	36

Worksheet 8-Shared Lane Calculations

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (vph)	50	10	55	10	1	10
Movement Capacity (vph)	45	33	418	36	34	483
Shared Lane Capacity (vph)			150			219

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
C sep	45	33	418	36	34	483
Volume	50	10	55	10	1	10
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh			150			219
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	L	L	L		TR	L		TR
v (vph)	1	1	50		65	10		11
C(m) (vph)	634	541	45		150	36		219
v/c	0.00	0.00	1.11		0.43	0.28		0.05
95% queue length	0.00	0.01	4.65		1.94	0.90		0.16
Control Delay	10.7	11.7	311.6		46.2	139.7		22.3
LOS	B	B	F		E	F		C
Approach Delay				161.6			78.2	
Approach LOS				F			F	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4	10.7	11.7
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS2000: Unsignalized Intersections Release 4.1d

TWO-WAY STOP CONTROL SUMMARY

Analyst: md
Agency/Co.:
Date Performed: 12/15/2004
Analysis Time Period: pm
Intersection: STH 158/Eastern Frontage Road
Jurisdiction: WisDOT
Units: U. S. Customary
Analysis Year: 2017
Project ID: 2017 site + background - with improvements
East/West Street: STH 158
North/South Street: Frontage Road
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1 L	2 T	3 R	4 L	5 T	6 R
Volume	1	1645	1	1	1290	25
Peak-Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate, HFR	1	1645	1	1	1290	25
Percent Heavy Vehicles	0	--	--	0	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						No
Lanes	1 L	2 T	0 TR	1 L	2 T	1 R
Configuration					No	
Upstream Signal?		No				

Minor Street: Approach	Northbound			Southbound		
Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume	105	25	65	10	1	10
Peak Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate, HFR	105	25	65	10	1	10
Percent Heavy Vehicles	0	0	0	0	0	0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No /			No /
Lanes	1 L	1	0 TR	1 L	1	0 TR
Configuration						

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound		Southbound	
Movement	1	4	7	8	9	10	11	12
Lane Config	L	L	L		TR	L		TR
v (vph)	1	1	105		90	10		11
C(m) (vph)	533	398	20		48	0		122
v/c	0.00	0.00	5.25		1.88			0.09
95% queue length	0.01	0.01	13.53		9.00			0.29
Control Delay	11.8	14.1	2299		596.3			37.4
LOS	B	B	F		F	F		E
Approach Delay				1513				
Approach LOS				F				

HCS2000: Unsignalized Intersections Release 4.1d

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TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 12/15/2004
Analysis Time Period: pm
Intersection: STH 158/Eastern Frontage Road
Jurisdiction: WisDOT
Units: U. S. Customary
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East/West Street: STH 158
North/South Street: Frontage Road
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume	1	1645	1	1	1290	25
Peak-Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Peak-15 Minute Volume	0	411	0	0	322	6
Hourly Flow Rate, HFR	1	1645	1	1	1290	25
Percent Heavy Vehicles	0	--	--	0	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						No
Lanes	1 L	2 T	0 TR	1 L	2 T	1 R
Configuration		No			No	
Upstream Signal?						

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume	105	25	65	10	1	10
Peak Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Peak-15 Minute Volume	26	6	16	2	0	2
Hourly Flow Rate, HFR	105	25	65	10	1	10
Percent Heavy Vehicles	0	0	0	0	0	0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No /			No /
RT Channelized?						
Lanes	1 L	1	0 TR	1 L	1	0 TR
Configuration						

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn							
Through							
S5 Left-Turn							
Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1	4.1	7.5	6.5	6.9	7.5	6.5	6.9
t(c,hv)		2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
P(hv)		0	0	0	0	0	0	0	0
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Grade/100				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage	4.1	4.1	7.5	6.5	6.9	7.5	6.5	6.9
	2-stage								

Follow-Up Time Calculations Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20	2.20	3.50	4.00	3.30	3.50	4.00	3.30
t(f,HV)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(HV)	0	0	0	0	0	0	0	0
t(f)	2.2	2.2	3.5	4.0	3.3	3.5	4.0	3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2 V(t)	Movement 2 V(1,prot)	Movement 5 V(t)	Movement 5 V(1,prot)
V prog				
Total Saturation Flow Rate, s (vph)				
Arrival Type				
Effective Green, g (sec)				
Cycle Length, C (sec)				
Rp (from Exhibit 16-11)				
Proportion vehicles arriving on green P				
g(q1)				
g(q2)				
g(q)				

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2 V(t)	Movement 2 V(1,prot)	Movement 5 V(t)	Movement 5 V(1,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p		0.000		0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x	1315	1646	2296	2965	823	2128	2940	645
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		3000		3000		3000		3000
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	823	645
Potential Capacity	321	420
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	321	420
Probability of Queue free St.	0.80	0.98

Step 2: LT from Major St.	4	1
Conflicting Flows	1646	1315
Potential Capacity	398	533
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	398	533
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows	2965	2940
Potential Capacity	15	15
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	15	15
Probability of Queue free St.	0.00	0.93

Step 4: LT from Minor St.	7	10
Conflicting Flows	2296	2128
Potential Capacity	22	29
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.93	0.00
Maj. L, Min T Adj. Imp Factor.	0.95	0.00
Cap. Adj. factor due to Impeding mvmnt	0.92	0.00
Movement Capacity	20	0

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	2965	2940
Potential Capacity	15	15
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	15	15
Result for 2 stage process:		
a		
y		
C t	15	15
Probability of Queue free St.	0.00	0.93

Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	2296	2128
Potential Capacity	22	29
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.93	0.00
Maj. L, Min T Adj. Imp Factor.	0.95	0.00
Cap. Adj. factor due to Impeding mvmnt	0.92	0.00
Movement Capacity	20	0
Results for Two-stage process:		
a		
y		
C t	20	0

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	105	25	65	10	1	10
Movement Capacity (vph)	20	15	321	0	15	420
Shared Lane Capacity (vph)			48			122

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	20	15	321	0	15	420
Volume	105	25	65	10	1	10
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh			48			122
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	L	L	L		TR	L		TR
v (vph)	1	1	105		90	10		11
C(m) (vph)	533	398	20		48	0		122
v/c	0.00	0.00	5.25		1.88			0.09
95% queue length	0.01	0.01	13.53		9.00			0.29
Control Delay	11.8	14.1	2299		596.3			37.4
LOS	B	B	F		F	F		E
Approach Delay				1513				
Approach LOS				F				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4	11.8	14.1
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS2000: Unsignalized Intersections Release 4.1d

TWO-WAY STOP CONTROL SUMMARY

Analyst: md
Agency/Co.:
Date Performed: 12/15/2004
Analysis Time Period: am
Intersection: sth 158/i-94 nb interchange
Jurisdiction: wisdot
Units: U. S. Customary
Analysis Year: 2017
Project ID: 2017 site + background - with improvements
East/West Street: sth 158
North/South Street: i-94 nb interchange
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	25	840			625	540
Peak-Hour Factor, PHF	1.00	1.00			1.00	1.00
Hourly Flow Rate, HFR	25	840			625	540
Percent Heavy Vehicles	0	--	--		--	--
Median Type/Storage	Undivided		/			
RT Channelized?						No
Lanes	1	2			2	1
Configuration	L	T			T	R
Upstream Signal?		No			No	

Minor Street: Approach	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	1	1				
Peak Hour Factor, PHF	1.00	1.00				
Hourly Flow Rate, HFR	1	1				
Percent Heavy Vehicles	0	0				
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/			/
Lanes	0	1				
Configuration	LT					

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	L		LT					
v (vph)	25		2					
C(m) (vph)	607		82					
v/c	0.04		0.02					
95% queue length	0.13		0.07					
Control Delay	11.2		50.0-					
LOS	B		E					
Approach Delay				50.0-				
Approach LOS				E				

HCS2000: Unsignalized Intersections Release 4.1d

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TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 12/15/2004
Analysis Time Period: am
Intersection: sth 158/i-94 nb interchange
Jurisdiction: wisdot
Units: U. S. Customary
Analysis Year: 2017
Project ID: 2017 site + background - with improvements
East/West Street: sth 158
North/South Street: i-94 nb interchange
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	25	840			625	540
Peak-Hour Factor, PHF	1.00	1.00			1.00	1.00
Peak-15 Minute Volume	6	210			156	135
Hourly Flow Rate, HFR	25	840			625	540
Percent Heavy Vehicles	0	--	--		--	--
Median Type/Storage	Undivided		/			
RT Channelized?						No
Lanes	1	2			2	1
Configuration	L	T			T	R
Upstream Signal?		No			No	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	1	1				
Peak Hour Factor, PHF	1.00	1.00				
Peak-15 Minute Volume	0	0				
Hourly Flow Rate, HFR	1	1				
Percent Heavy Vehicles	0	0				
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/			/
RT Channelized?						
Lanes	0	1				
Configuration	LT					

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn							
Through							
S5 Left-Turn							
Through							

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p		0.000		0.000

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Computation 3-Platoon Event Periods

	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)	4.1		7.5	6.5				
t(c,hv)	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
P(hv)	0		0	0				
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Grade/100			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)	0.00		0.70	0.00				
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage	4.1		6.8	6.5				
2-stage								

Follow-Up Time Calculations

Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)	2.20		3.50	4.00				
t(f,HV)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(HV)	0		0	0				
t(f)	2.2		3.5	4.0				

Computation 4 and 5

Single-Stage Process

Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
V c,x	1165		1202	2055				
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process

	7	8	10	11

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movemert 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		3000		3000				
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 2: LT from Major St.	4	1
Conflicting Flows		1165
Potential Capacity		607
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		607
Probability of Queue free St.	1.00	0.96
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows	2055	
Potential Capacity	56	
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.96	0.96
Movement Capacity	54	
Probability of Queue free St.	0.98	1.00

Step 4: LT from Minor St.	7	10
Conflicting Flows	1202	
Potential Capacity	180	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.94
Maj. L, Min T Adj. Imp Factor.		0.95
Cap. Adj. factor due to Impeding mvmnt	0.96	0.95
Movement Capacity	173	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	2055	
Potential Capacity	56	
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.96	0.96
Movement Capacity	54	
Result for 2 stage process:		
a		
y		
C t	54	
Probability of Queue free St.	0.98	1.00

Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	1202	
Potential Capacity	180	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.94
Maj. L, Min T Adj. Imp Factor.		0.95
Cap. Adj. factor due to Impeding mvmnt	0.96	0.95
Movement Capacity	173	
Results for Two-stage process:		
a		
y		
C t	173	

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	1	1				
Movement Capacity (vph)	173	54				
Shared Lane Capacity (vph)	82					

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	173	54				
Volume	1	1				
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh	82					
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	L		LT					
v (vph)	25		2					
C(m) (vph)	607		82					
v/c	0.04		0.02					
95% queue length	0.13		0.07					
Control Delay	11.2		50.0-					
LOS	B		E					
Approach Delay				50.0-				
Approach LOS				E				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.96	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4	11.2	
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS2000: Unsignalized Intersections Release 4.1d

TWO-WAY STOP CONTROL SUMMARY

Analyst: md
Agency/Co.:
Date Performed: 12/15/2004
Analysis Time Period: pm
Intersection: sth 158/i-94 nb interchange
Jurisdiction: wisdot
Units: U. S. Customary
Analysis Year: 2017
Project ID: 2017 site + background - with improvements
East/West Street: sth 158
North/South Street: i-94 nb interchange
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	15	875			650	755
Peak-Hour Factor, PHF	1.00	1.00			1.00	1.00
Hourly Flow Rate, HFR	15	875			650	755
Percent Heavy Vehicles	0	--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?					No	
Lanes	1	2			2	1
Configuration	L	T			T	R
Upstream Signal?		No			No	

Minor Street: Approach	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	1	1				
Peak Hour Factor, PHF	1.00	1.00				
Hourly Flow Rate, HFR	1	1				
Percent Heavy Vehicles	0	0				
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/			/
Lanes	0	1				
Configuration		LT				

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	L		LT					
v (vph)	15		2					
C(m) (vph)	492		62					
v/c	0.03		0.03					
95% queue length	0.09		0.10					
Control Delay	12.5		65.0					
LOS	B		F					
Approach Delay				65.0				
Approach LOS				F				

HCS2000: Unsignalized Intersections Release 4.1d

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TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 12/15/2004
Analysis Time Period: pm
Intersection: sth 158/i-94 nb interchange
Jurisdiction: wisdot
Units: U. S. Customary
Analysis Year: 2017
Project ID: 2017 site + background - with improvements
East/West Street: sth 158
North/South Street: i-94 nb interchange
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	15	875			650	755
Peak-Hour Factor, PHF	1.00	1.00			1.00	1.00
Peak-15 Minute Volume	4	219			162	189
Hourly Flow Rate, HFR	15	875			650	755
Percent Heavy Vehicles	0	--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?					No	
Lanes	1	2			2	1
Configuration	L	T			T	R
Upstream Signal?		No			No	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	1	1				
Peak Hour Factor, PHF	1.00	1.00				
Peak-15 Minute Volume	0	0				
Hourly Flow Rate, HFR	1	1				
Percent Heavy Vehicles	0	0				
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/			/
RT Channelized?						
Lanes	0	1				
Configuration		LT				

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn							
Through							
S5 Left-Turn							
Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1	4	7	8	9	10	11	12
		L	L	L	T	R	L	T	R
t(c,base)		4.1		7.5	6.5				
t(c,hv)		2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
P(hv)		0		0	0				
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Grade/100				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00		0.70	0.00				
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage	4.1		6.8	6.5				
	2-stage								

Follow-Up Time Calculations

Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)	2.20		3.50	4.00				
t(f,HV)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(HV)	0		0	0				
t(f)	2.2		3.5	4.0				

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(1,prot)	V(t)	V(1,prot)
V prog				
Total Saturation Flow Rate, s (vph)				
Arrival Type				
Effective Green, g (sec)				
Cycle Length, C (sec)				
Rp (from Exhibit 16-11)				
Proportion vehicles arriving on green P				
g(q1)				
g(q2)				
g(q)				

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2		Movement 5	
	V(t)	V(1,prot)	V(t)	V(1,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p		0.000		0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5
Single-Stage Process

Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
V c,x	1405		1230	2310				
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		3000		3000				
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 2: LT from Major St.	4	1
Conflicting Flows		1405
Potential Capacity		492
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		492
Probability of Queue free St.	1.00	0.97
Maj L-Shared Prob Q free St.		
Step 3: TH from Minor St.	8	11
Conflicting Flows	2310	
Potential Capacity	39	
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.97	0.97
Movement Capacity	38	
Probability of Queue free St.	0.97	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows	1230	
Potential Capacity	173	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.94
Maj. L, Min T Adj. Imp Factor.		0.96
Cap. Adj. factor due to Impeding mvmnt	0.97	0.96
Movement Capacity	168	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	2310	
Potential Capacity	39	
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.97	0.97
Movement Capacity	38	
Result for 2 stage process:		
a		
y		
C t	38	
Probability of Queue free St.	0.97	1.00
Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	1230	
Potential Capacity	173	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.94
Maj. L, Min T Adj. Imp Factor.		0.96
Cap. Adj. factor due to Impeding mvmnt	0.97	0.96
Movement Capacity	168	
Results for Two-stage process:		
a		
y		
C t	168	

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	1	1				
Movement Capacity (vph)	168	38				
Shared Lane Capacity (vph)	62					

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	168	38				
Volume	1	1				
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh	62					
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	L		LT					
v (vph)	15		2					
C(m) (vph)	492		62					
v/c	0.03		0.03					
95% queue length	0.09		0.10					
Control Delay	12.5		65.0					
LOS	B		F					
Approach Delay				65.0				
Approach LOS				F				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.97	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4	12.5	
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS2000: Signalized Intersections Release 4.1e

Analyst: md
Agency:
Date: 12/15/2004
Period: am
Project ID: 2017 background + site
E/W St: sth 158

Inter.: sth 158/I-94 SB Interchange
Area Type: All other areas
Jurisd: WisDOT
Year : 2017

N/S St: I-94 SB Intechange

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	1	1	2	0	0	0	0	1	1	0
LGConfig		T	R	L	T					L	LTR	
Volume		125	15	530	95					740	2	40
Lane Width		12.0	12.0	12.0	12.0					12.0	12.0	
RTOR Vol			0								0	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left			
Thru		A			Thru			
Right		A			Right			
Peds					Peds			
WB Left	A	A			SB Left	A		
Thru	A	A			Thru	A		
Right					Right	A		
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	40.0	9.0			36.0			
Yellow	3.0	4.5			4.5			
All Red	0.0	1.5			1.5			

Cycle Length: 100.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
T	333	3697	0.40	0.09	43.7	D	43.6	D
R	141	1568	0.11	0.09	42.2	D		
Westbound								
L	775	1752	0.73	0.52	20.8	C		
T	1784	3431	0.06	0.52	11.9	B	19.4	B
Northbound								
Southbound								
L	585	1626	0.74	0.36	32.9	C		
LTR	585	1626	0.68	0.36	30.4	C	31.7	C

Intersection Delay = 27.8 (sec/veh) Intersection LOS = C

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 12/15/2004
Analysis Time Period: am
Intersection: sth 158/I-94 SB Interchange
Area Type: All other areas
Jurisdiction: WisDOT
Analysis Year: 2017
Project ID: 2017 background + site

East/West Street: sth 158
North/South Street: I-94 SB Intechange

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume		125	15	530	95					740	2	40
% Heavy Veh		3	3	3	11					11	3	3
PHF		0.94	0.94	0.94	0.94					0.94	0.94	0.94
PK 15 Vol		33	4	141	25					197	1	11
Hi Ln Vol												
% Grade		0			0						0	
Ideal Sat		2000	1900	1900	2000					1900	1900	
ParkExist												
NumPark												
No. Lanes	0	2	1		1	2	0	0	0		1	1	0
LGConfig		T	R	L	T					L	LTR	
Lane Width		12.0	12.0	12.0	12.0					12.0	12.0	
RTOR Vol			0									0
Adj Flow		133	16	564	101					433	399	
%InSharedLn										45		
Prop LTs		0.000		1.000	0.000						0.888	
Prop RTs	0.000	1.000		0.000						0.108		
Peds Bikes	0						0			0		
Buses	0	0		0	0					0	0	
%InProtPhase				0.0								

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0	0.0	0.0	0.0					0.0	0.0	
Arriv. Type		3	3	3	3					3	3	
Unit Ext.		3.0	3.0	3.0	3.0					3.0	3.0	
I Factor		1.000			1.000						1.000	
Lost Time		2.0	2.0	2.0	2.0					2.0	2.0	
Ext of g		2.0	2.0	2.0	2.0					2.0	2.0	
Ped Min g		3.2						3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left			
Thru		A			Thru			
Right		A			Right			
Peds					Peds			
WB Left	A	A			SB Left	A		
Thru	A	A			Thru	A		
Right					Right	A		
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	40.0	9.0			36.0			
Yellow	3.0	4.5			4.5			
All Red	0.0	1.5			1.5			

Cycle Length: 100.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V		125	15	530	95					740	2	40
PHF		0.94	0.94	0.94	0.94					0.94	0.94	0.94
Adj flow		133	16	564	101					787	2	43
No. Lanes	0	2	1		1	2	0	0	0		1	1	0
Lane group		T	R	L	T					L	LTR	
Adj flow		133	16	564	101					433	399	
Prop LTs		0.000		1.000	0.000						0.888	
Prop RTs	0.000	1.000		0.000						0.108		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound T	Eastbound R	Westbound L	Westbound T			Northbound			Southbound L	Southbound LTR	
So	2000	1900	1900	2000						1900	1900	
Lanes	2	1	1	2	0	0	0	0		1	1	0
fW	1.000	1.000	1.000	1.000						1.000	1.000	
fHV	0.971	0.971	0.971	0.901						0.901	0.908	
fG	1.000	1.000	1.000	1.000						1.000	1.000	
fP	1.000	1.000	1.000	1.000						1.000	1.000	
fBB	1.000	1.000	1.000	1.000						1.000	1.000	
fA	1.000	1.000	1.000	1.000						1.000	1.000	
fLU	0.952	1.000	1.000	0.952							0.984	
fRT	1.000	0.850		1.000						0.950	0.958	
fLT	1.000		0.950	1.000								
Sec.			0.333							1.000	1.000	
fLpb	1.000		1.000	1.000							1.000	
fRpb	1.000	1.000		1.000						1626	1626	
S	3697	1568	1752	3431								
Sec.			615									

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	133	3697	# 0.04	0.09	333	0.40
Right	R	16	1568	0.01	0.09	141	0.11
Westbound							
Prot		564	1752	# 0.32	0.400	701	0.80
Perm		0	615	0.00	0.120	74	0.00
Left	L	564			0.52	775	0.73
Prot							
Perm							
Thru	T	101	3431	0.03	0.52	1784	0.06
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Southbound							
Prot							
Perm							
Left	L	433	1626	# 0.27	0.36	585	0.74
Prot							
Perm							
Thru	LTR	399	1626	0.25	0.36	585	0.68
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.62
Total lost time per cycle, L = 18.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.76

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
T	0.40	0.09	42.9	1.000	333	0.11	0.8	0.0	43.7	D	43.6	D
R	0.11	0.09	41.8	1.000	141	0.11	0.4	0.0	42.2	D		
Westbound												
L	0.73	0.52	17.3	1.000	775	0.29	3.5	0.0	20.8	C		
T	0.06	0.52	11.9	1.000	1784	0.11	0.0	0.0	11.9	B	19.4	B
Northbound												
Southbound												
L	0.74	0.36	27.9	1.000	585	0.30	5.0	0.0	32.9	C		

LTR	0.68	0.36	27.1	1.000	585	0.25	3.3	0.0	30.4	C	31.7	C

Intersection delay = 27.8 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach		M		
Cycle length, C 100.0 sec				
Total actual green time for LT lane group, G (s)		52.0		
Effective permitted green time for LT lane group, g(s)		12.0		
Opposing effective green time, go (s)		9.0		
Number of lanes in LT lane group, N		1		
Number of lanes in opposing approach, No		2		
Adjusted LT flow rate, VLT (veh/h)		564		
Proportion of LT in LT lane group, PLT		1.000		
Proportion of LT in opposing flow, PLTo		0.00		
Adjusted opposing flow rate, Vo (veh/h)		133		
Lost time for LT lane group, tL		6.00		
Computation				
LT volume per cycle, LTC=VLTC/3600		15.67		
Opposing lane util. factor, fLUo	0.952	0.952	1.000	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		1.94		
gf=G[exp(- a * (LTC ** b)]-tl, gf<=g		0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.91		
gq, (see Exhibit C16-4,5,6,7,8)		6.00		
gu=g-gq if gq>=gf, or = g-gf if gq<gf		6.00		
n=Max(gq-gf)/2,0)		3.00		
PTHo=1-PLTo		1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00		
EL1 (refer to Exhibit C16-3)		1.58		
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+P1)/g		0.33		
gdiff=max(gq-gf,0)		0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.33		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.333		

For special case of single-lane approach opposed by multilane approach, see text.
* If P1>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 100.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000		0.888
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	0.952	0.952	1.000	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b)]-tl, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+P1)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If P1>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 100.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v		564		
v/c ratio from Capacity Worksheet, X		0.73		
Protected phase effective green interval, g (s)		40.0		
Opposing queue effective green interval, gq		6.00		
Unopposed green interval, gu		6.00		
Red time r=(C-g-gq-gu)		48.0		
Arrival rate, qa=v/(3600(max[X,1.0]))		0.16		
Protected ph. departure rate, Sp=s/3600		0.487		
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)		0.34		
XPerm		0.92		
XProt		0.71		
Case		1		
Queue at beginning of green arrow, Qa		7.52		
Queue at beginning of unsaturated green, Qu		0.94		
Residual queue, Qr		0.00		
Uniform Delay, d1		17.3		

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 27.8 sec/veh Intersection LOS C

BACK OF QUEUE WORKSHEET

LaneGroup	Eastbound T	Eastbound R	Westbound L	Westbound T	Northbound	Southbound L	Southbound LTR
Init Queue	0.0	0.0	0.0	0.0		0.0	0.0
Flow Rate	69	16	564	53		433	399
So	2000	1900	1900	2000		1900	1900
No.Lanes	0 2	1	1	2 0	0 0 0	1	1 0
SL	1941	1568	1490	1801		1626	1626
LnCapacity	174	141	775	936		585	585
Flow Ratio	0.04	0.01	0.38	0.03		0.27	0.25
v/c Ratio	0.40	0.11	0.73	0.06		0.74	0.68
Grn Ratio	0.09	0.09	0.52	0.52		0.36	0.36
I Factor	1.000			1.000			1.000
AT or PVG	3	3	3	3		3	3
Pltn Ratio	1.00	1.00	1.00	1.00		1.00	1.00
PF2	1.00	1.00	1.00	1.00		1.00	1.00
Q1	1.8	0.4	10.6	0.7		10.5	9.4
kB	0.3	0.2	0.6	0.7		0.5	0.5
Q2	0.2	0.0	1.6	0.0		1.4	1.1
Q Average	2.0	0.4	12.2	0.8		11.9	10.5
Q Spacing	25.0	25.0	25.0	25.0		25.0	25.0
Q Storage	0	0	0	0		0	0
Q S Ratio							
70th Percentile Output:							
fB%	1.2	1.2	1.2	1.2		1.2	1.2
BOQ	2.4	0.5	14.3	0.9		14.0	12.4
QSRatio							
85th Percentile Output:							
fB%	1.6	1.6	1.5	1.6		1.5	1.5
BOQ	3.1	0.7	18.3	1.2		17.9	15.9
QSRatio							
90th Percentile Output:							
fB%	1.8	1.8	1.6	1.8		1.6	1.6
BOQ	3.5	0.8	19.7	1.4		19.3	17.2
QSRatio							
95th Percentile Output:							
fB%	2.0	2.1	1.8	2.1		1.8	1.8
BOQ	4.0	0.9	22.0	1.6		21.5	19.3
QSRatio							
98th Percentile Output:							
fB%	2.6	2.7	2.1	2.6		2.1	2.1
BOQ	5.1	1.2	25.5	2.0		25.0	22.5
QSRatio							

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: md
Agency:
Date: 12/15/2004
Period: pm
Project ID: 2017 background + site
E/W St: sth 158

Inter.: sth 158/I-94 SB Interchange
Area Type: All other areas
Jurisd: WisDOT
Year : 2017

N/S St: I-94 SB Intechange

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	1	1	2	0	0	0	0	1	1	0
LGConfig		T	R	L	T					L	LTR	
Volume		90	15	495	155					805	5	85
Lane Width		12.0	12.0	12.0	12.0					12.0	12.0	
RTOR Vol			0								0	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left					NB Left				
Thru		A			Thru				
Right		A			Right				
Peds					Peds				
WB Left	A	A			SB Left	A			
Thru	A	A			Thru	A			
Right					Right	A			
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	35.0	17.0				43.0			
Yellow	3.0	4.5				4.5			
All Red	0.0	1.5				1.5			

Cycle Length: 110.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
T	571	3697	0.20	0.15	40.7	D	40.6	D
R	242	1568	0.08	0.15	39.9	D		
Westbound								
L	696	1719	0.89	0.50	35.4	D		
T	1849	3697	0.10	0.50	14.5	B	30.4	C
Northbound								
Southbound								
L	672	1719	0.82	0.39	38.3	D		
LTR	663	1697	0.85	0.39	41.0	D	39.6	D

Intersection Delay = 36.1 (sec/veh) Intersection LOS = D

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 12/15/2004
Analysis Time Period: pm
Intersection: sth 158/I-94 SB Interchange
Area Type: All other areas
Jurisdiction: WisDOT
Analysis Year: 2017
Project ID: 2017 background + site

East/West Street: sth 158
North/South Street: I-94 SB Intechange

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume		90	15	495	155					805	5	85
% Heavy Veh		3	3	5	3					5	3	3
PHF		0.80	0.80	0.80	0.80					0.80	0.80	0.80
PK 15 Vol		28	5	155	48					252	2	27
Hi Ln Vol												
% Grade		0			0						0	
Ideal Sat		2000	1900	1900	2000					1900	1900	
ParkExist												
NumPark												
No. Lanes	0	2	1		1	2	0	0	0		1	1	0
LGConfig		T	R	L	T					L	LTR	
Lane Width		12.0	12.0	12.0	12.0					12.0	12.0	
RTOR Vol			0									0
Adj Flow		112	19	619	194					553	565	
%InSharedLn										45		
Prop LTs		0.000		1.000	0.000						0.801	
Prop RTs		0.000	1.000		0.000					0.188		
Peds Bikes	0						0			0		
Buses		0	0	0	0					0	0	
%InProtPhase				0.0								

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0	0.0	0.0	0.0					0.0	0.0	
Arriv. Type		3	3	3	3					3	3	
Unit Ext.		3.0	3.0	3.0	3.0					3.0	3.0	
I Factor		1.000			1.000						1.000	
Lost Time		2.0	2.0	2.0	2.0					2.0	2.0	
Ext of g		2.0	2.0	2.0	2.0					2.0	2.0	
Ped Min g		3.2								3.2	3.2	

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left					NB Left				
Thru		A			Thru				
Right		A			Right				
Peds					Peds				
WB Left	A	A			SB Left	A			
Thru	A	A			Thru	A			
Right					Right	A			
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	35.0	17.0				43.0			
Yellow	3.0	4.5				4.5			
All Red	0.0	1.5				1.5			

Cycle Length: 110.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V		90	15	495	155					805	5	85
PHF		0.80	0.80	0.80	0.80					0.80	0.80	0.80
Adj flow		112	19	619	194					1006	6	106
No. Lanes	0	2	1		1	2	0	0	0		1	1	0
Lane group		T	R	L	T					L	LTR	
Adj flow		112	19	619	194					553	565	
Prop LTs		0.000		1.000	0.000						0.801	
Prop RTs		0.000	1.000		0.000					0.188		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound T	Eastbound R	Westbound L	Westbound T	Northbound			Southbound L	Southbound LTR	
So	2000	1900	1900	2000				1900	1900	
Lanes 0	2	1	1	2	0	0	0	1	1	0
fW	1.000	1.000	1.000	1.000				1.000	1.000	
fHV	0.971	0.971	0.952	0.971				0.952	0.956	
fG	1.000	1.000	1.000	1.000				1.000	1.000	
fP	1.000	1.000	1.000	1.000				1.000	1.000	
fBB	1.000	1.000	1.000	1.000				1.000	1.000	
fA	1.000	1.000	1.000	1.000				1.000	1.000	
fLU	0.952	1.000	1.000	0.952				1.000	1.000	
fRT	1.000	0.850		1.000					0.972	
fLT	1.000		0.950	1.000				0.950	0.961	
Sec.			0.453							
fLpb	1.000		1.000	1.000				1.000	1.000	
fRpb	1.000	1.000		1.000					1.000	
S	3697	1568	1719	3697				1719	1697	
Sec.			820							

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	112	3697	0.03	0.15	571	0.20
Right	R	19	1568	0.01	0.15	242	0.08
Westbound							
Prot		547	1719	# 0.32	0.318	547	1.00
Perm		72	820	# 0.09	0.182	149	0.48
Left	L	619			0.50	696	0.89
Prot							
Perm							
Thru	T	194	3697	0.05	0.50	1849	0.10
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Southbound							
Prot							
Perm							
Left	L	553	1719	0.32	0.39	672	0.82
Prot							
Perm							
Thru	LTR	565	1697	# 0.33	0.39	663	0.85
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.74
Total lost time per cycle, L = 12.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.83

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
T	0.20	0.15	40.5	1.000	571	0.11	0.2	0.0	40.7	D	40.6	D
R	0.08	0.15	39.8	1.000	242	0.11	0.1	0.0	39.9	D		
Westbound												
L	0.89	0.50	21.8	1.000	696	0.41	13.5	0.0	35.4	D		
T	0.10	0.50	14.5	1.000	1849	0.11	0.0	0.0	14.5	B	30.4	C
Northbound												
Southbound												
L	0.82	0.39	30.1	1.000	672	0.36	8.2	0.0	38.3	D		

LTR	0.85	0.39	30.6	1.000	663	0.38	10.4	0.0	41.0	D	39.6	D

Intersection delay = 36.1 (sec/veh) Intersection LOS = D

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach		M		
Cycle length, C 110.0 sec				
Total actual green time for LT lane group, G (s)		55.0		
Effective permitted green time for LT lane group, g(s)		20.0		
Opposing effective green time, go (s)		17.0		
Number of lanes in LT lane group, N		1		
Number of lanes in opposing approach, No		2		
Adjusted LT flow rate, VLT (veh/h)		619		
Proportion of LT in LT lane group, PLT		1.000		
Proportion of LT in opposing flow, PLTo		0.00		
Adjusted opposing flow rate, Vo (veh/h)		112		
Lost time for LT lane group, tL		6.00		
Computation				
LT volume per cycle, LTC=VLTC/3600		18.91		
Opposing lane util. factor, fLUo	0.952	0.952	1.000	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		1.80		
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g		0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.85		
gq, (see Exhibit C16-4,5,6,7,8)		6.00		
gu=g-gq if gq>=gf, or = g-gf if gq<gf		14.00		
n=Max(gq-gf)/2,0)		3.00		
PTHo=1-PLTo		1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00		
EL1 (refer to Exhibit C16-3)		1.54		
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.20		
gdiff=max(gq-gf,0)		0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.45		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.453		

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 110.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000		0.801
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	0.952	0.952	1.000	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 110.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v		619		
v/c ratio from Capacity Worksheet, X		0.89		
Protected phase effective green interval, g (s)		35.0		
Opposing queue effective green interval, gq		6.00		
Unopposed green interval, gu		14.00		
Red time r=(C-g-gq-gu)		55.0		
Arrival rate, qa=v/(3600(max[X,1.0]))		0.17		
Protected ph. departure rate, Sp=s/3600		0.478		
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)		0.33		
XPerm		0.75		
XProt		0.93		
Case		1		
Queue at beginning of green arrow, Qa		9.46		
Queue at beginning of unsaturated green, Qu		1.03		
Residual queue, Qr		0.00		
Uniform Delay, d1		21.8		

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Dur. Unmet Demand Q veh	Unmet Demand t hrs.	Uniform Delay Unadj. ds	Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 36.1 sec/veh Intersection LOS D

BACK OF QUEUE WORKSHEET

LaneGroup	Eastbound T	Eastbound R	Westbound L	Westbound T	Northbound	Southbound L	Southbound LTR
Init Queue	0.0	0.0	0.0	0.0		0.0	0.0
Flow Rate	58	19	619	101		553	565
So	2000	1900	1900	2000		1900	1900
No.Lanes	2	1	1	2	0 0 0	1	1 0
SL	1941	1568	1392	1941		1719	1697
LnCapacity	299	242	696	971		672	663
Flow Ratio	0.03	0.01	0.44	0.05		0.32	0.33
v/c Ratio	0.19	0.08	0.89	0.10		0.82	0.85
Grn Ratio	0.15	0.15	0.50	0.50		0.39	0.39
I Factor	1.000			1.000			1.000
AT or PVG	3	3	3	3		3	3
Pltn Ratio	1.00	1.00	1.00	1.00		1.00	1.00
PF2	1.00	1.00	1.00	1.00		1.00	1.00
Q1	1.5	0.5	13.2	1.6		15.2	15.8
kB	0.4	0.3	0.6	0.8		0.6	0.6
Q2	0.1	0.0	3.6	0.1		2.4	2.8
Q Average	1.6	0.5	16.8	1.7		17.6	18.6
Q Spacing	25.0	25.0	25.0	25.0		25.0	25.0
Q Storage	0	0	0	0		0	0
Q 5 Ratio							
70th Percentile Output:							
fB%	1.2	1.2	1.2	1.2		1.2	1.2
BOQ	2.0	0.6	19.6	2.1		20.5	21.6
QSRatio							
85th Percentile Output:							
fB%	1.6	1.6	1.5	1.6		1.5	1.5
BOQ	2.6	0.8	24.8	2.7		25.8	27.2
QSRatio							
90th Percentile Output:							
fB%	1.8	1.8	1.6	1.8		1.6	1.6
BOQ	2.9	0.9	26.5	3.0		27.6	29.0
QSRatio							
95th Percentile Output:							
fB%	2.0	2.1	1.7	2.0		1.7	1.7
BOQ	3.3	1.1	29.2	3.5		30.4	31.9
QSRatio							
98th Percentile Output:							
fB%	2.6	2.7	2.0	2.6		2.0	1.9
BOQ	4.2	1.4	33.2	4.4		34.5	36.1
QSRatio							

ERROR MESSAGES

No errors to report.

HCS2000: Unsignalized Intersections Release 4.1d

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ALL-WAY STOP CONTROL(AWSC) ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/5/2005
Analysis Time Period: am
Intersection: sth 158/western frontage road
Jurisdiction: wisdot
Units: U. S. Customary
Analysis Year: 2017
Project ID: 2017 site + background - with improvements
East/West Street: sth158
North/South Street: western frontage road

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	0	0	0	130	0	1	0	1	110	30	1	0

% Thrus Left Lane

	Eastbound L1	Eastbound L2	Westbound L1	Westbound L2	Northbound L1	Northbound L2	Southbound L1	Southbound L2
Configuration			LR		TR		LT	
PHF			1.00		1.00		1.00	
Flow Rate			131		111		31	
% Heavy Veh			0		0		0	
No. Lanes			1		1		1	
Opposing-Lanes			0		1		1	
Conflicting-lanes			1		1		1	
Geometry group			1		1		1	

Duration, T 0.25 hrs.

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound L1	Eastbound L2	Westbound L1	Westbound L2	Northbound L1	Northbound L2	Southbound L1	Southbound L2
Flow Rates:								
Total in Lane			131		111		31	
Left-Turn			130		0		30	
Right-Turn			1		110		0	
Prop. Left-Turns			1.0		0.0		1.0	
Prop. Right-Turns			0.0		1.0		0.0	
Prop. Heavy Vehicle			0.0		0.0		0.0	
Geometry Group			1		1		1	
Adjustments Exhibit 17-33:								
hLT-adj			0.2		0.2		0.2	
hRT-adj			-0.6		-0.6		-0.6	
hHV-adj			1.7		1.7		1.7	
hadj, computed			0.2		-0.6		0.2	

Worksheet 4 - Departure Headway and Service Time

	Eastbound L1	Eastbound L2	Westbound L1	Westbound L2	Northbound L1	Northbound L2	Southbound L1	Southbound L2
Flow rate			131		111		31	
hd, initial value	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20
x, initial			0.12		0.10		0.03	
hd, final value			4.38		3.65		4.51	
x, final value			0.16		0.11		0.04	
Move-up time, m			2.0		2.0		2.0	
Service Time			2.4		1.7		2.5	

Worksheet 5 - Capacity and Level of Service

	Eastbound L1	Eastbound L2	Westbound L1	Westbound L2	Northbound L1	Northbound L2	Southbound L1	Southbound L2
Flow Rate			131		111		31	
Service Time			2.4		1.7		2.5	
Utilization, x			0.16		0.11		0.04	
Dep. headway, hd			4.38		3.65		4.51	
Capacity			381		361		281	
Delay			8.21		7.11		7.69	
LOS			A		A		A	
Approach:								
Delay			8.21		7.11		7.69	
LOS			A		A		A	

Intersection Delay 7.71 Intersection LOS A

HCS2000: Unsignalized Intersections Release 4.1d

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ALL-WAY STOP CONTROL(AWSC) ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/5/2005
Analysis Time Period: pm
Intersection: sth 158/western frontage road
Jurisdiction: wisdot
Units: U. S. Customary
Analysis Year: 2017
Project ID: 2017 site + background - with improvements
East/West Street: sth158
North/South Street: western frontage road

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	0	0	0	240	0	1	0	1	85	20	1	0

% Thrus Left Lane

	Eastbound L1	Eastbound L2	Westbound L1	Westbound L2	Northbound L1	Northbound L2	Southbound L1	Southbound L2
Configuration			LR		TR		LT	
PHF			1.00		1.00		1.00	
Flow Rate			241		86		21	
% Heavy Veh			0		0		0	
No. Lanes			1		1		1	
Opposing-Lanes			0		1		1	
Conflicting-lanes			1		1		1	
Geometry group			1		1		1	

Duration, T 0.25 hrs.

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound L1	Eastbound L2	Westbound L1	Westbound L2	Northbound L1	Northbound L2	Southbound L1	Southbound L2
Flow Rates:								
Total in Lane			241		86		21	
Left-Turn			240		0		20	
Right-Turn			1		85		0	
Prop. Left-Turns			1.0		0.0		1.0	
Prop. Right-Turns			0.0		1.0		0.0	
Prop. Heavy Vehicle			0.0		0.0		0.0	
Geometry Group			1		1		1	
Adjustments Exhibit 17-33:								
hLT-adj			0.2		0.2		0.2	
hRT-adj			-0.6		-0.6		-0.6	
hHV-adj			1.7		1.7		1.7	
hadj, computed			0.2		-0.6		0.2	

Worksheet 4 - Departure Headway and Service Time

	Eastbound L1	Eastbound L2	Westbound L1	Westbound L2	Northbound L1	Northbound L2	Southbound L1	Southbound L2
Flow rate			241		86		21	
hd, initial value	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20
x, initial			0.21		0.08		0.02	
hd, final value			4.33		3.90		4.75	
x, final value			0.29		0.09		0.03	
Move-up time, m			2.0		2.0		2.0	
Service Time			2.3		1.9		2.7	

Worksheet 5 - Capacity and Level of Service

	Eastbound L1	Eastbound L2	Westbound L1	Westbound L2	Northbound L1	Northbound L2	Southbound L1	Southbound L2
Flow Rate			241		86		21	
Service Time			2.3		1.9		2.7	
Utilization, x			0.29		0.09		0.03	
Dep. headway, hd			4.33		3.90		4.75	
Capacity			491		336		271	
Delay			9.08		7.30		7.88	
LOS			A		A		A	
Approach:								
Delay			9.08		7.30		7.88	
LOS			A		A		A	

Intersection Delay 8.57 Intersection LOS A

HCS2000: Signalized Intersections Release 4.1e

Analyst: md
Agency:
Date: 1/4/2005
Period: am
Project ID: 2017 total traffic - with improvements
E/W St: cth k

Inter.: cth k/104th ave
Area Type: All other areas
Jurisd: kenosha county
Year : 2017
N/S St: 104th ave

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	1	1	0	1	1	0	1	1	0
LGConfig	L	TR		L	TR		L	TR		L	TR	
Volume	15	185	40	155	130	130	5	225	95	20	265	25
Lane Width	12.0	12.0		12.0	12.0		12.0	12.0		12.0	12.0	
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A	A			NB Left	A	A		
Thru		A			Thru		A		
Right		A			Right		A		
Peds					Peds				
WB Left	A	A			SB Left	A	A		
Thru		A			Thru		A		
Right		A			Right		A		
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	7.0	35.0				7.0	33.0		
Yellow	3.0	4.5				3.0	4.5		
All Red	0.0	1.5				0.0	1.5		

Cycle Length: 100.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	369	1770	0.05	0.45	16.4	B		
TR	635	1813	0.45	0.35	25.6	C	25.0	C
Westbound								
L	405	1770	0.48	0.45	18.8	B		
TR	603	1723	0.55	0.35	27.2	C	24.1	C
Northbound								
L	314	1770	0.02	0.43	17.8	B		
TR	587	1780	0.69	0.33	32.5	C	32.3	C
Southbound								
L	286	1770	0.09	0.43	18.6	B		
TR	607	1838	0.60	0.33	29.8	C	29.0	C

Intersection Delay = 27.5 (sec/veh) Intersection LOS = C

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/4/2005
Analysis Time Period: am
Intersection: cth k/104th ave
Area Type: All other areas
Jurisdiction: kenosha county
Analysis Year: 2017
Project ID: 2017 total traffic - with improvements
East/West Street: cth k North/South Street: 104th ave

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	15	185	40	155	130	130	5	225	95	20	265	25
% Heavy Veh	2	2	2	2	2	2	2	2	2	2	2	2
PHF	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79
PK 15 Vol	5	59	13	49	41	41	2	71	30	6	84	8
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900		1900	1900		1900	1900		1900	1900	
ParkExist												
NumPark												
No. Lanes	1	1	0	1	1	0	1	1	0	1	1	0
LGConfig	L	TR		L	TR		L	TR		L	TR	
Lane Width	12.0	12.0		12.0	12.0		12.0	12.0		12.0	12.0	
RTOR Vol			0			0			0			0
Adj Flow	19	285		196	330		6	405		25	367	
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.179			0.500			0.296			0.087	
Peds Bikes	0			0			0			0		
Buses	0	0		0	0		0	0		0	0	
%InProtPhase	0.0			0.0			0.0			0.0		

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Arriv. Type	3	3		3	3		3	3		3	3	
Unit Ext.	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Ext of g	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	

Ped Min g	3.2	3.2	3.2	3.2

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A	A			NB Left	A	A		
Thru		A			Thru		A		
Right		A			Right		A		
Peds					Peds				
WB Left	A	A			SB Left	A	A		
Thru		A			Thru		A		
Right		A			Right		A		
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	7.0	35.0				7.0	33.0		
Yellow	3.0	4.5				3.0	4.5		
All Red	0.0	1.5				0.0	1.5		

Cycle Length: 100.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	15	185	40	155	130	130	5	225	95	20	265	25
PHF	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79
Adj flow	19	234	51	196	165	165	6	285	120	25	335	32
No. Lanes	1	1	0	1	1	0	1	1	0	1	1	0
Lane group	L	TR		L	TR		L	TR		L	TR	
Adj flow	19	285		196	330		6	405		25	367	
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.179			0.500			0.296			0.087	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L	TR		L	TR		L	TR		L	TR	
So	1900	1900		1900	1900		1900	1900		1900	1900	
Lanes	1	1	0	1	1	0	1	1	0	1	1	0
fW	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fHV	0.980	0.980		0.980	0.980		0.980	0.980		0.980	0.980	
fG	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fP	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fBB	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fA	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fLU	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fRT		0.973			0.925			0.956			0.987	
fLT	0.950	1.000		0.950	1.000		0.950	1.000		0.950	1.000	
Sec.	0.346			0.397			0.284			0.241		
fLpb	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fRpb		1.000			1.000			1.000			1.000	
S	1770	1813		1770	1723		1770	1780		1770	1838	
Sec.	644			739			529			449		

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		19	1770	0.01	0.070	124	0.15
Perm		0	644	0.00	0.380	245	0.00
Left	L	19			0.45	369	0.05
Prot							
Perm							
Thru	TR	285	1813	0.16	0.35	635	0.45
Right							
Westbound							
Prot		124	1770	# 0.07	0.070	124	1.00
Perm		72	739	0.10	0.380	281	0.26
Left	L	196			0.45	405	0.48
Prot							
Perm							
Thru	TR	330	1723	# 0.19	0.35	603	0.55
Right							
Northbound							
Prot		6	1770	0.00	0.070	124	0.05
Perm		0	529	0.00	0.360	190	0.00
Left	L	6			0.43	314	0.02
Prot							
Perm							
Thru	TR	405	1780	# 0.23	0.33	587	0.69
Right							
Southbound							
Prot		25	1770	# 0.01	0.070	124	0.20
Perm		0	449	0.00	0.360	162	0.00
Left	L	25			0.43	286	0.09
Prot							
Perm							
Thru	TR	367	1838	0.20	0.33	607	0.60
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.50
Total lost time per cycle, L = 24.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.66

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	0.05	0.45	16.4	1.000	369	0.11	0.1	0.0	16.4	B		
TR	0.45	0.35	25.1	1.000	635	0.11	0.5	0.0	25.6	C	25.0	C
Westbound												
L	0.48	0.45	17.9	1.000	405	0.11	0.9	0.0	18.8	B		
TR	0.55	0.35	26.1	1.000	603	0.15	1.1	0.0	27.2	C	24.1	C
Northbound												
L	0.02	0.43	17.8	1.000	314	0.11	0.0	0.0	17.8	B		
TR	0.69	0.33	29.1	1.000	587	0.26	3.4	0.0	32.5	C	32.3	C
Southbound												
L	0.09	0.43	18.4	1.000	286	0.11	0.1	0.0	18.6	B		

TR	0.60	0.33	28.0	1.000	607	0.19	1.7	0.0	29.8	C	29.0	C

Intersection delay = 27.5 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M	M	M
Cycle length, C 100.0 sec				
Total actual green time for LT lane group, G (s)	45.0	45.0	43.0	43.0
Effective permitted green time for LT lane group, g(s)	38.0	38.0	36.0	36.0
Opposing effective green time, go (s)	35.0	35.0	33.0	33.0
Number of lanes in LT lane group, N	1	1	1	1
Number of lanes in opposing approach, No	1	1	1	1
Adjusted LT flow rate, VLT (veh/h)	19	196	6	25
Proportion of LT in LT lane group, PLT	1.000	1.000	1.000	1.000
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	330	285	367	405
Lost time for LT lane group, tL	6.00	6.00	6.00	6.00
Computation				
LT volume per cycle, LTC=VLTC/3600	0.53	5.44	0.17	0.69
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	9.17	7.92	10.19	11.25
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	0.0	0.0	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.65	0.65	0.67	0.67
gq, (see Exhibit C16-4,5,6,7,8)	14.59	12.23	17.16	19.45
gu=g-gq if gq>=gf, or = g-gf if gq<gf	23.41	25.77	18.84	16.55
n=Max(gq-gf)/2,0)	7.30	6.11	8.58	9.73
PTHo=1-PLTo	1.00	1.00	1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00	1.00	1.00
EL1 (refer to Exhibit C16-3)	1.78	1.71	1.84	1.91
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.11	0.11	0.11	0.11
gdiff=max(gq-gf,0)	0.00	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.35	0.40	0.28	0.24
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.346	0.397	0.284	0.241

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 100.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000	0.000	0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 100.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v	19	196	6	25
v/c ratio from Capacity Worksheet, X	0.05	0.48	0.02	0.09
Protected phase effective green interval, g (s)	7.0	7.0	7.0	7.0
Opposing queue effective green interval, gq	14.59	12.23	17.16	19.45
Unopposed green interval, gu	23.41	25.77	18.84	16.55
Red time r=(C-g-gq-gu)	55.0	55.0	57.0	57.0
Arrival rate, qa=v/(3600(max[X,1.0]))	0.01	0.05	0.00	0.01
Protected ph. departure rate, Sp=s/3600	0.492	0.492	0.492	0.492
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.29	0.30	0.28	0.27
XPerm	0.03	0.27	0.01	0.06
XProt	0.10	0.98	0.03	0.13
Case	1	1	1	1
Queue at beginning of green arrow, Qa	0.29	2.99	0.10	0.40
Queue at beginning of unsaturated green, Qu	0.08	0.67	0.03	0.14
Residual queue, Qr	0.00	0.00	0.00	0.00
Uniform Delay, d1	16.4	17.9	17.8	18.4

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Dur. Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 27.5 sec/veh Intersection LOS C

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	L	TR	L	TR	L	TR	L	TR
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	19	285	196	330	6	405	25	367
So	1900	1900	1900	1900	1900	1900	1900	1900
No.Lanes	1	1 0	1	1 0	1	1 0	1	1 0
SL	819	1813	899	1723	731	1780	664	1838
LnCapacity	369	635	405	603	314	587	286	607
Flow Ratio	0.02	0.16	0.22	0.19	0.01	0.23	0.04	0.20
v/c Ratio	0.05	0.45	0.48	0.55	0.02	0.69	0.09	0.60
Grn Ratio	0.45	0.35	0.45	0.35	0.43	0.33	0.43	0.33
I Factor		1.000		1.000		1.000		1.000
AT or PVG	3	3	3	3	3	3	3	3
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Q1	0.3	6.1	3.1	7.4	0.1	9.8	0.4	8.5
kB	0.4	0.6	0.4	0.5	0.4	0.5	0.3	0.5
Q2	0.0	0.5	0.4	0.6	0.0	1.1	0.0	0.8
Q Average	0.3	6.6	3.5	8.0	0.1	10.9	0.4	9.3
Q Spacing	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0
Q Storage	0	0	0	0	0	0	0	0
Q S Ratio								
70th Percentile Output:								
fB%	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
BOQ	0.4	7.8	4.2	9.5	0.1	12.8	0.5	11.0
QSRatio								
85th Percentile Output:								
fB%	1.6	1.5	1.6	1.5	1.6	1.5	1.6	1.5
BOQ	0.5	10.1	5.5	12.3	0.2	16.4	0.7	14.2
QSRatio								
90th Percentile Output:								
fB%	1.8	1.7	1.7	1.7	1.8	1.6	1.8	1.7
BOQ	0.6	11.1	6.1	13.4	0.2	17.8	0.8	15.4
QSRatio								
95th Percentile Output:								
fB%	2.1	1.9	2.0	1.9	2.1	1.8	2.1	1.9
BOQ	0.7	12.6	7.0	15.1	0.2	19.9	0.9	17.4
QSRatio								
98th Percentile Output:								
fB%	2.7	2.3	2.5	2.2	2.7	2.1	2.7	2.2
BOQ	0.8	15.1	8.6	17.9	0.3	23.2	1.2	20.4
QSRatio								

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: md
Agency:
Date: 1/4/2005
Period: pm
Project ID: 2017 total traffic - with improvements
E/W St: cth k

Inter.: cth k/104th ave
Area Type: All other areas
Jurisd: kenosha county
Year : 2017
N/S St: 104th ave

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	1	1	0	1	1	0	1	1	0
LGConfig	L	TR		L	TR		L	TR		L	TR	
Volume	15	250	25	170	205	170	20	290	110	70	185	30
Lane Width	12.0	12.0		12.0	12.0		12.0	12.0		12.0	12.0	
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A	A			NB Left	A	A		
Thru		A			Thru		A		
Right		A			Right		A		
Peds					Peds				
WB Left	A	A			SB Left	A	A		
Thru		A			Thru		A		
Right		A			Right		A		
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	6.0	40.0				8.0	38.0		
Yellow	3.0	4.5				3.0	4.5		
All Red	0.0	1.5				0.0	1.5		

Cycle Length: 110.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	293	1770	0.05	0.45	19.1	B		
TR	668	1838	0.45	0.36	27.1	C	26.7	C
Westbound								
L	379	1770	0.49	0.45	25.6	C		
TR	631	1736	0.65	0.36	31.6	C	29.8	C
Northbound								
L	441	1770	0.05	0.45	17.7	B		
TR	617	1786	0.71	0.35	35.2	D	34.3	C
Southbound								
L	281	1770	0.27	0.45	20.9	C		
TR	630	1824	0.37	0.35	27.4	C	25.8	C

Intersection Delay = 29.7 (sec/veh) Intersection LOS = C

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/4/2005
Analysis Time Period: pm
Intersection: cth k/104th ave
Area Type: All other areas
Jurisdiction: kenosha county
Analysis Year: 2017
Project ID: 2017 total traffic - with improvements
East/West Street: cth k
North/South Street: 104th ave

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	15	250	25	170	205	170	20	290	110	70	185	30
% Heavy Veh	2	2	2	2	2	2	2	2	2	2	2	2
PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
PK 15 Vol	4	69	7	47	56	47	5	80	30	19	51	8
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900		1900	1900		1900	1900		1900	1900	
ParkExist												
NumPark												
No. Lanes	1	1	0	1	1	0	1	1	0	1	1	0
LGConfig	L	TR		L	TR		L	TR		L	TR	
Lane Width	12.0	12.0		12.0	12.0		12.0	12.0		12.0	12.0	
RTOR Vol			0			0			0			0
Adj Flow	16	302		187	412		22	440		77	236	
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs	0.089			0.454			0.275			0.140		
Peds Bikes	0			0			0			0		
Buses	0	0		0	0		0	0		0	0	
%InProtPhase	0.0			0.0			0.0			0.0		

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Arriv. Type	3	3		3	3		3	3		3	3	
Unit Ext.	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Ext of g	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Ped Min g	3.2			3.2			3.2			3.2		

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A	A			NB Left	A	A		
Thru		A			Thru		A		
Right		A			Right		A		
Peds					Peds				
WB Left	A	A			SB Left	A	A		
Thru		A			Thru		A		
Right		A			Right		A		
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	6.0	40.0				8.0	38.0		
Yellow	3.0	4.5				3.0	4.5		
All Red	0.0	1.5				0.0	1.5		

Cycle Length: 110.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	15	250	25	170	205	170	20	290	110	70	185	30
PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Adj flow	16	275	27	187	225	187	22	319	121	77	203	33
No. Lanes	1	1	0	1	1	0	1	1	0	1	1	0
Lane group	L	TR		L	TR		L	TR		L	TR	
Adj flow	16	302		187	412		22	440		77	236	
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs	0.089			0.454			0.275			0.140		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L	TR		L	TR		L	TR		L	TR	
So	1900	1900		1900	1900		1900	1900		1900	1900	
Lanes	1	1	0	1	1	0	1	1	0	1	1	0
fW	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fHV	0.980	0.980		0.980	0.980		0.980	0.980		0.980	0.980	
fG	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fP	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fBB	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fA	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fLU	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fRT		0.987			0.932			0.959			0.979	
fLT	0.950	1.000		0.950	1.000		0.950	1.000		0.950	1.000	
Sec.	0.269			0.387			0.450			0.219		
fLpb	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fRpb		1.000			1.000			1.000			1.000	
S	1770	1838		1770	1736		1770	1786		1770	1824	
Sec.	501			721			838			408		

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		16	1770	0.01	0.055	97	0.16
Perm		0	501	0.00	0.391	196	0.00
Left	L	16			0.45	293	0.05
Prot							
Perm							
Thru	TR	302	1838	0.16	0.36	668	0.45
Right							
Westbound							
Prot		97	1770	# 0.05	0.055	97	1.00
Perm		90	721	0.12	0.391	282	0.32
Left	L	187			0.45	379	0.49
Prot							
Perm							
Thru	TR	412	1736	# 0.24	0.36	631	0.65
Right							
Northbound							
Prot		22	1770	0.01	0.073	129	0.17
Perm		0	838	0.00	0.373	312	0.00
Left	L	22			0.45	441	0.05
Prot							
Perm							
Thru	TR	440	1786	# 0.25	0.35	617	0.71
Right							
Southbound							
Prot		77	1770	# 0.04	0.073	129	0.60
Perm		0	408	0.00	0.373	152	0.00
Left	L	77			0.45	281	0.27
Prot							
Perm							
Thru	TR	236	1824	0.13	0.35	630	0.37
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.58
Total lost time per cycle, L = 24.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.74

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	0.05	0.45	19.1	1.000	293	0.11	0.1	0.0	19.1	B		
TR	0.45	0.36	26.7	1.000	668	0.11	0.5	0.0	27.1	C	26.7	C
Westbound												
L	0.49	0.45	24.6	1.000	379	0.11	1.0	0.0	25.6	C		
TR	0.65	0.36	29.2	1.000	631	0.23	2.4	0.0	31.6	C	29.8	C
Northbound												
L	0.05	0.45	17.7	1.000	441	0.11	0.0	0.0	17.7	B		
TR	0.71	0.35	31.3	1.000	617	0.28	3.9	0.0	35.2	D	34.3	C
Southbound												
L	0.27	0.45	20.4	1.000	281	0.11	0.5	0.0	20.9	C		

TR	0.37	0.35	27.1	1.000	630	0.11	0.4	0.0	27.4	C	25.8	C

Intersection delay = 29.7 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M	M	M
Cycle length, C 110.0 sec				
Total actual green time for LT lane group, G (s)	49.0	49.0	49.0	49.0
Effective permitted green time for LT lane group, g(s)	43.0	43.0	41.0	41.0
Opposing effective green time, go (s)	40.0	40.0	38.0	38.0
Number of lanes in LT lane group, N	1	1	1	1
Number of lanes in opposing approach, No	1	1	1	1
Adjusted LT flow rate, VLT (veh/h)	16	187	22	77
Proportion of LT in LT lane group, PLT	1.000	1.000	1.000	1.000
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	412	302	236	440
Lost time for LT lane group, tL	6.00	6.00	6.00	6.00
Computation				
LT volume per cycle, LTC=VLTC/3600	0.49	5.71	0.67	2.35
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	12.59	9.23	7.21	13.44
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g	0.0	0.0	0.0	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.64	0.64	0.65	0.65
gq, (see Exhibit C16-4,5,6,7,8)	20.78	14.11	10.86	23.29
gu=g-gq if gq>=gf, or = g-gf if gq<gf	22.22	28.89	30.14	17.71
n=Max(gq-gf)/2,0)	10.39	7.06	5.43	11.65
PTHo=1-PLTo	1.00	1.00	1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00	1.00	1.00
EL1 (refer to Exhibit C16-3)	1.92	1.74	1.63	1.97
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.09	0.09	0.10	0.10
gdiff=max(gq-gf,0)	0.00	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.27	0.39	0.45	0.22
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.269	0.387	0.430	0.219

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 110.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000	0.000	0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 110.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v	16	187	22	77
v/c ratio from Capacity Worksheet, X	0.05	0.49	0.05	0.27
Protected phase effective green interval, g (s)	6.0	6.0	8.0	8.0
Opposing queue effective green interval, gq	20.78	14.11	10.86	23.29
Unopposed green interval, gu	22.22	28.89	30.14	17.71
Red time r=(C-g-gq-gu)	61.0	61.0	61.0	61.0
Arrival rate, qa=v/(3600(max[X,1.0]))	0.00	0.05	0.01	0.02
Protected ph. departure rate, Sp=s/3600	0.492	0.492	0.492	0.492
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.27	0.30	0.32	0.26
XPerm	0.03	0.26	0.03	0.19
XProt	0.10	1.18	0.11	0.38
Case	1	2	1	1
Queue at beginning of green arrow, Qa	0.27	3.17	0.37	1.30
Queue at beginning of unsaturated green, Qu	0.09	2.42	0.07	0.50
Residual queue, Qr	0.00	0.53	0.00	0.00
Uniform Delay, dl	19.1	24.6	17.7	20.4

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Dur. Unmet Demand Q veh	Unmet Demand t hrs.	Uniform Delay Unadj. ds	Adj. dl sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 29.7 sec/veh Intersection LOS C

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	L	TR	L	TR	L	TR	L	TR
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	16	302	187	412	22	440	77	236
So	1900	1900	1900	1900	1900	1900	1900	1900
No.Lanes	1	1 0	1	1 0	1	1 0	1	1 0
SL	656	1838	849	1736	990	1786	630	1824
LnCapacity	293	668	379	631	441	617	281	630
Flow Ratio	0.02	0.16	0.22	0.24	0.02	0.25	0.12	0.13
v/c Ratio	0.05	0.45	0.49	0.65	0.05	0.71	0.27	0.37
Grn Ratio	0.45	0.36	0.45	0.36	0.45	0.35	0.45	0.35
I Factor		1.000		1.000		1.000		1.000
AT or PVG	3	3	3	3	3	3	3	3
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Q1	0.3	7.0	3.3	10.5	0.4	11.7	1.3	5.4
kB	0.4	0.6	0.4	0.6	0.5	0.6	0.4	0.6
Q2	0.0	0.5	0.4	1.1	0.0	1.4	0.1	0.4
Q Average	0.3	7.5	3.7	11.6	0.4	13.0	1.5	5.8
Q Spacing	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0
Q Storage	0	0	0	0	0	0	0	0
Q S Ratio								
70th Percentile Output:								
fB%	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
BOQ	0.4	8.9	4.4	13.6	0.5	15.3	1.8	6.8
QSRatio								
85th Percentile Output:								
fB%	1.6	1.5	1.6	1.5	1.6	1.5	1.6	1.5
BOQ	0.5	11.5	5.7	17.4	0.6	19.5	2.3	8.9
QSRatio								
90th Percentile Output:								
fB%	1.8	1.7	1.7	1.6	1.8	1.6	1.8	1.7
BOQ	0.5	12.6	6.4	18.8	0.7	21.0	2.6	9.8
QSRatio								
95th Percentile Output:								
fB%	2.1	1.9	2.0	1.8	2.1	1.8	2.1	1.9
BOQ	0.6	14.3	7.3	21.0	0.8	23.4	3.0	11.2
QSRatio								
98th Percentile Output:								
fB%	2.7	2.3	2.5	2.1	2.7	2.1	2.6	2.3
BOQ	0.8	17.0	9.0	24.4	1.1	27.0	3.8	13.5
QSRatio								

ERROR MESSAGES

No errors to report.

HCS2000: Unsignalized Intersections Release 4.1d

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ALL-WAY STOP CONTROL(AWSC) ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/4/2005
Analysis Time Period: am
Intersection: cth k/eastern frontage road
Jurisdiction: kenosha county
Units: U. S. Customary
Analysis Year: 2007
Project ID: 2017 site + background - with improvements
East/West Street: cth k
North/South Street: eastern frontage road

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	15	145	30	50	105	5	5	95	95	1	1	1

% Thrus Left Lane

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	LTR		LTR		LTR		LTR	
PHF	1.00		1.00		1.00		1.00	
Flow Rate	190		160		195		3	
% Heavy Veh	0		0		0		0	
No. Lanes	1		1		1		1	
Opposing-Lanes	1		1		1		1	
Conflicting-lanes	1		1		1		1	
Geometry group	1		1		1		1	

Duration, T 0.25 hrs.

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	190		160		195		3	
Left-Turn	15		50		5		1	
Right-Turn	30		5		95		1	
Prop. Left-Turns	0.1		0.3		0.0		0.3	
Prop. Right-Turns	0.2		0.0		0.5		0.3	
Prop. Heavy Vehicle	0.0		0.0		0.0		0.0	
Geometry Group	1		1		1		1	
Adjustments Exhibit 17-33:								
hLT-adj	0.2		0.2		0.2		0.2	
hRT-adj	-0.6		-0.6		-0.6		-0.6	
hHV-adj	1.7		1.7		1.7		1.7	
hadj, computed	-0.1		0.0		-0.3		-0.1	

Worksheet 4 - Departure Headway and Service Time

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow rate	190		160		195		3	
hd, initial value	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20
x, initial	0.17		0.14		0.17		0.00	
hd, final value	4.49		4.64		4.44		4.85	
x, final value	0.24		0.21		0.24		0.00	
Move-up time, m	2.0		2.0		2.0		2.0	
Service Time	2.5		2.6		2.4		2.8	

Worksheet 5 - Capacity and Level of Service

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rate	190		160		195		3	
Service Time	2.5		2.6		2.4		2.8	
Utilization, x	0.24		0.21		0.24		0.00	
Dep. headway, hd	4.49		4.64		4.44		4.85	
Capacity	440		410		445		253	
Delay	8.87		8.84		8.84		7.87	
LOS	A		A		A		A	
Approach:								
Delay	8.87		8.84		8.84		7.87	
LOS	A		A		A		A	

Intersection Delay 8.85 Intersection LOS A

HCS2000: Unsignalized Intersections Release 4.1d

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ALL-WAY STOP CONTROL(AWSC) ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/4/2005
Analysis Time Period: pm
Intersection: cth k/eastern frontage road
Jurisdiction: kenosha county
Units: U. S. Customary
Analysis Year: 2007
Project ID: 2017 site + background - with improvements
East/West Street: cth k
North/South Street: eastern frontage road

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	30	170	70	70	160	25	20	140	105	10	5	10

% Thrus Left Lane

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	LTR		LTR		LTR		LTR	
PHF	1.00		1.00		1.00		1.00	
Flow Rate	270		255		265		25	
% Heavy Veh	0		0		0		0	
No. Lanes	1		1		1		1	
Opposing-Lanes	1		1		1		1	
Conflicting-lanes	1		1		1		1	
Geometry group	1		1		1		1	

Duration, T 0.25 hrs.

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	270		255		265		25	
Left-Turn	30		70		20		10	
Right-Turn	70		25		105		10	
Prop. Left-Turns	0.1		0.3		0.1		0.4	
Prop. Right-Turns	0.3		0.1		0.4		0.4	
Prop. Heavy Vehicle	0.0		0.0		0.0		0.0	
Geometry Group	1		1		1		1	
Adjustments Exhibit 17-33:								
hLT-adj	0.2		0.2		0.2		0.2	
hRT-adj	-0.6		-0.6		-0.6		-0.6	
hHV-adj	1.7		1.7		1.7		1.7	
hadj, computed	-0.1		-0.0		-0.2		-0.2	

Worksheet 4 - Departure Headway and Service Time

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow rate	270		255		265		25	
hd, initial value	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20
x, initial	0.24		0.23		0.24		0.02	
hd, final value	4.92		5.06		5.04		5.53	
x, final value	0.37		0.36		0.37		0.04	
Move-up time, m	2.0		2.0		2.0		2.0	
Service Time	2.9		3.1		3.0		3.5	

Worksheet 5 - Capacity and Level of Service

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rate	270		255		265		25	
Service Time	2.9		3.1		3.0		3.5	
Utilization, x	0.37		0.36		0.37		0.04	
Dep. headway, hd	4.92		5.06		5.04		5.53	
Capacity	520		505		515		275	
Delay	10.76		10.85		10.99		8.75	
LOS	B		B		B		A	
Approach:								
Delay	10.76		10.85		10.99		8.75	
LOS	B		B		B		A	

Intersection Delay 10.80 Intersection LOS B

HCS2000: Signalized Intersections Release 4.1e

Analyst: md
Agency:
Date: 1/3/2005
Period: am
Project ID: 2017 total traffic - with improvements
E/W St: Southern Access Drive

Inter.: 104th Ave/Southern Access Driv
Area Type: All other areas
Jurisd: Kenosha
Year : 2017
N/S St: 104th Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	2	0	0	0	0	0	1	1	0	0	1	1
LGConfig	L						L	T			T	R
Volume	590						1	360		190	5	
Lane Width	12.0						12.0	12.0		12.0	12.0	
RTOR Vol											0	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A				NB Left	A	A		
Thru					Thru	A	A		
Right					Right				
Peds					Peds				
WB Left					SB Left				
Thru					Thru		A		
Right					Right		A		
Peds					Peds				
NB Right					EB Right				
SB Right	A				WB Right				
Green	39.0					5.0	41.0		
Yellow	4.5					3.0	4.5		
All Red	1.5					0.0	1.5		

Cycle Length: 100.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	1367	3505	0.51	0.39	23.5	C	23.5	C
Westbound								
Northbound								
L	488	1805	0.00	0.49	13.4	B		
T	961	1961	0.44	0.49	16.9	B	16.9	B
Southbound								
T	804	1961	0.28	0.41	19.8	B	19.3	B
R	1389	1615	0.00	0.86	1.0	A		

Intersection Delay = 20.7 (sec/veh) Intersection LOS = C

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/3/2005
Analysis Time Period: am
Intersection: 104th Ave/Southern Access Driv
Area Type: All other areas
Jurisdiction: Kenosha
Analysis Year: 2017
Project ID: 2017 total traffic - with improvements.
East/West Street: Southern Access Drive North/South Street: 104th Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	590						1	360			190	5
% Heavy Veh	0						0	2			2	0
PHF	0.85						0.85	0.85			0.85	0.85
PK 15 Vol	174						1	106			56	2
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat	1900						1900	2000			2000	1900
ParkExist												
NumPark												
No. Lanes	2	0	0	0	0	0	1	1	0	0	1	1
LGConfig	L						L	T			T	R
Lane Width	12.0						12.0	12.0			12.0	12.0
RTOR Vol											0	
Adj Flow	694						1	424			224	6
%InSharedLn												
Prop LTs							1.000	0.000			0.000	
Prop RTs							0.000				0.000	1.000
Peds Bikes				0							0	
Buses	0						0	0			0	0
%InProtPhase							0.0					

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0						0.0	0.0			0.0	0.0
Arriv. Type	3						3	3			3	3
Unit Ext.	3.0						3.0	3.0			3.0	3.0
I Factor		1.000						1.000			1.000	
Lost Time	2.0						2.0	2.0			2.0	2.0
Ext of g	2.0						2.0	2.0			2.0	2.0
Ped Min g					3.2						3.2	

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A				NB Left	A	A		
Thru					Thru	A	A		
Right					Right				
Peds					Peds				
WB Left					SB Left				
Thru					Thru		A		
Right					Right		A		
Peds					Peds				
NB Right					EB Right				
SB Right	A				WB Right				
Green	39.0					5.0	41.0		
Yellow	4.5					3.0	4.5		
All Red	1.5					0.0	1.5		

Cycle Length: 100.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	590						1	360			190	5
PHF	0.85						0.85	0.85			0.85	0.85
Adj flow	694						1	424			224	6
No. Lanes	2	0	0	0	0	0	1	1	0	0	1	1
Lane group	L						L	T			T	R
Adj flow	694						1	424			224	6
Prop LTs							1.000	0.000			0.000	
Prop RTs							0.000				0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L						L	T			T	R
So	1900						1900	2000			2000	1900
Lanes	2	0	0	0	0	0	1	1	0	0	1	1
fW	1.000						1.000	1.000			1.000	1.000
fHV	1.000						1.000	0.980			0.980	1.000
fG	1.000						1.000	1.000			1.000	1.000
fP	1.000						1.000	1.000			1.000	1.000
fBB	1.000						1.000	1.000			1.000	1.000
fA	1.000						1.000	1.000			1.000	1.000
fLU	0.971						1.000	1.000			1.000	1.000
fRT								1.000			1.000	0.850
fLT	0.950						0.950	1.000			1.000	
Sec.							0.476					
fLpb	1.000						1.000	1.000			1.000	
fRpb								1.000			1.000	1.000
S	3505						1805	1961			1961	1615
Sec.							904					

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	694	3505	# 0.20	0.39	1367	0.51
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot		1	1805	0.00	0.050	90	0.01
Perm		0	904	0.00	0.440	398	0.00
Left	L	1			0.49	488	0.00
Prot							
Perm							
Thru	T	424	1961	# 0.22	0.49	961	0.44
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	224	1961	0.11	0.41	804	0.28
Right	R	6	1615	0.00	0.86	1389	0.00

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.41
Total lost time per cycle, L = 12.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.47

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	0.51	0.39	23.2	1.000	1367	0.12	0.3	0.0	23.5	C	23.5	C
Westbound												
Northbound												
L	0.00	0.49	13.4	1.000	488	0.11	0.0	0.0	13.4	B		
T	0.44	0.49	16.6	1.000	961	0.11	0.3	0.0	16.9	B	16.9	B
Southbound												

T	0.28	0.41	19.6	1.000	804	0.11	0.2	0.0	19.8	B	19.3	B
R	0.00	0.86	1.0	1.000	1389	0.11	0.0	0.0	1.0	A		

Intersection delay = 20.7 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach			M	
Cycle length, C 100.0 sec				
Total actual green time for LT lane group, G (s)			49.0	
Effective permitted green time for LT lane group, g(s)			44.0	
Opposing effective green time, go (s)			41.0	
Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			1	
Adjusted LT flow rate, VLT (veh/h)			1	
Proportion of LT in LT lane group, PLT			1.000	
Proportion of LT in opposing flow, PLTo			0.00	
Adjusted opposing flow rate, Vo (veh/h)			224	
Lost time for LT lane group, tL			6.00	
Computation				
LT volume per cycle, LTC=VLTC/3600			0.03	
Opposing lane util. factor, fLUo			1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			6.22	
gf=G[exp(- a * (LTC ** b)]-tl, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.59	
gq, (see Exhibit C16-4,5,6,7,8)			8.39	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			35.61	
n=Max(gq-gf)/2,0)			4.19	
PTHo=1-PLTo			1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	
EL1 (refer to Exhibit C16-3)			1.70	
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g			0.09	
gdiff=max(gq-gf,0)			0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.48	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.476	

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 100.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT			0.000	0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo			1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b)]-tl, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 100.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v			1	
v/c ratio from Capacity Worksheet, X			0.00	
Protected phase effective green interval, g (s)			5.0	
Opposing queue effective green interval, gq			8.39	
Unopposed green interval, gu			35.61	
Red time r=(C-g-gq-gu)			51.0	
Arrival rate, qa=v/(3600(max(X,1.0]])			0.00	
Protected ph. departure rate, Sp=s/3600			0.501	
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)			0.31	
XPerm			0.00	
XProt			0.01	
Case			1	
Queue at beginning of green arrow, Qa			0.01	
Queue at beginning of unsaturated green, Qu			0.00	
Residual queue, Qr			0.00	
Uniform Delay, d1			13.4	

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Dur. Unmet Demand Q veh	Unmet Demand t hrs.	Uniform Delay Unadj. ds	Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 20.7 sec/veh Intersection LOS C

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L						L	T		T	R	
Init Queue	0.0						0.0	0.0		0.0	0.0	
Flow Rate	357						1	424		224	6	
So	1900						1900	2000		2000	1900	
No.Lanes	2	0	0	0	0	0	1	1	0	1	1	0
SL	1805						996	1961		1961	1615	
LnCapacity	703						488	961		804	1389	
Flow Ratio	0.20						0.00	0.22		0.11	0.00	
v/c Ratio	0.51						0.00	0.44		0.28	0.00	
Grn Ratio	0.39						0.49	0.49		0.41	0.86	
I Factor		1.000						1.000		1.000		
AT or PVG	3						3	3		3	3	
Pltn Ratio	1.00						1.00	1.00		1.00	1.00	
PF2	1.00						1.00	1.00		1.00	1.00	
Q1	7.5						0.0	7.7		4.1	0.0	
kB	0.6						0.5	0.7		0.6	0.9	
Q2	0.0						0.0	0.6		0.2	0.0	
Q Average	8.1						0.0	8.2		4.4	0.0	
Q Spacing	25.0						25.0	25.0		25.0	25.0	
Q Storage	0						0	0		0	0	
Q S Ratio												
70th Percentile Output:												
fB%	1.2						1.2	1.2		1.2	1.2	
BOQ	9.6						0.0	9.7		5.2	0.0	
QSRatio												
85th Percentile Output:												
fB%	1.5						1.6	1.5		1.6	1.6	
BOQ	12.5						0.0	12.6		6.8	0.0	
QSRatio												
90th Percentile Output:												
fB%	1.7						1.8	1.7		1.7	1.8	
BOQ	13.6						0.0	13.7		7.6	0.0	
QSRatio												
95th Percentile Output:												
fB%	1.9						2.1	1.9		2.0	2.1	
BOQ	15.3						0.0	15.5		8.7	0.1	
QSRatio												
98th Percentile Output:												
fB%	2.2						2.7	2.2		2.4	2.7	
BOQ	18.2						0.0	18.4		10.6	0.1	
QSRatio												

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: md
Agency:
Date: 1/3/2005
Period: pm
Project ID: 2017 total traffic - with improvements
E/W St: Southern Access Drive

Inter.: 104th Ave/Southern Access Driv
Area Type: All other areas
Jurisd: Kenosha
Year : 2017
N/S St: 104th Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	2	0	0	0	0	0	1	1	0	0	1	1
LGConfig	L						L	T			T	R
Volume	935						1	475			285	5
Lane Width	12.0						12.0	12.0			12.0	12.0
RTOR Vol												0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left		A			NB Left	A	A		
Thru					Thru	A	A		
Right					Right				
Peds					Peds				
WB Left					SB Left				
Thru					Thru		A		
Right					Right		A		
Peds					Peds				
NB Right					EB Right				
SB Right		A			WB Right				
Green		43.0				5.0	47.0		
Yellow		4.5				3.0	4.5		
All Red		1.5				0.0	1.5		

Cycle Length: 110.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	1370	3505	0.80	0.39	33.3	C	33.3	C
Westbound								
Northbound								
L	408	1805	0.00	0.50	14.7	B		
T	981	1961	0.57	0.50	20.0+	C	20.0+	C
Southbound								
T	838	1961	0.40	0.43	22.1	C	21.7	C
R	1409	1615	0.00	0.87	0.9	A		

Intersection Delay = 27.6 (sec/veh) Intersection LOS = C

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/3/2005
Analysis Time Period: pm
Intersection: 104th Ave/Southern Access Driv
Area Type: All other areas
Jurisdiction: Kenosha
Analysis Year: 2017
Project ID: 2017 total traffic - with improvements
East/West Street: Southern Access Drive
North/South Street: 104th Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	935						1	475			285	5
% Heavy Veh	0						0	2			2	0
PHF	0.85						0.85	0.85			0.85	0.85
PK 15 Vol	275						1	140			84	2
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat	1900						1900	2000			2000	1900
ParkExist												
NumPark												
No. Lanes	2	0	0	0	0	0	1	1	0	0	1	1
LGConfig	L						L	T			T	R
Lane Width	12.0						12.0	12.0			12.0	12.0
RTOR Vol												0
Adj Flow	1100						1	559			335	6
%InSharedLn							1.000	0.000			0.000	
Prop LTs							0.000				0.000	1.000
Prop RTs											0	
Peds Bikes				0							0	0
Buses	0						0	0				
%InProtPhase							0.0					

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0						0.0	0.0			0.0	0.0
Arriv. Type	3						3	3			3	3
Unit Ext.	3.0						3.0	3.0			3.0	3.0
I Factor		1.000						1.000			1.000	
Lost Time	2.0						2.0	2.0			2.0	2.0
Ext of g	2.0						2.0	2.0			2.0	2.0

Ped Min g		3.2				3.2		

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left		A			NB Left	A	A		
Thru					Thru	A	A		
Right					Right				
Peds					Peds				
WB Left					SB Left				
Thru					Thru		A		
Right					Right		A		
Peds					Peds				
NB Right					EB Right				
SB Right		A			WB Right				
Green		43.0				5.0	47.0		
Yellow		4.5				3.0	4.5		
All Red		1.5				0.0	1.5		

Cycle Length: 110.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	935						1	475			285	5
PHF	0.85						0.85	0.85			0.85	0.85
Adj flow	1100						1	559			335	6
No. Lanes	2	0	0	0	0	0	1	1	0	0	1	1
Lane group	L						L	T			T	R
Adj flow	1100						1	559			335	6
Prop LTs							1.000	0.000			0.000	
Prop RTs								0.000			0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L						L	T			T	R
So	1900						1900	2000			2000	1900
Lanes	2	0	0	0	0	0	1	1	0	0	1	1
fW	1.000						1.000	1.000			1.000	1.000
fHV	1.000						1.000	0.980			0.980	1.000
fG	1.000						1.000	1.000			1.000	1.000
fP	1.000						1.000	1.000			1.000	1.000
fBB	1.000						1.000	1.000			1.000	1.000
fA	1.000						1.000	1.000			1.000	1.000
fLU	0.971						1.000	1.000			1.000	1.000
fRT								1.000			1.000	0.850
fLT	0.950						0.950	1.000			1.000	
Sec.							0.378					
fLpb	1.000						1.000	1.000			1.000	
fRpb								1.000			1.000	1.000
S	3505						1805	1961			1961	1615
Sec.							718					

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	1100	3505	# 0.31	0.39	1370	0.80
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot		1	1805	0.00	0.045	82	0.01
Perm		0	718	0.00	0.455	326	0.00
Left	L	1			0.50	408	0.00
Prot							
Perm							
Thru	T	559	1961	# 0.29	0.50	981	0.57
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	335	1961	0.17	0.43	838	0.40
Right	R	6	1615	0.00	0.87	1409	0.00

Sum of flow ratios for critical lane groups, Yc = Sum (V/s) = 0.60
Total lost time per cycle, L = 12.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.67

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	0.80	0.39	29.7	1.000	1370	0.35	3.6	0.0	33.3	C	33.3	C
Westbound												
Northbound												
L	0.00	0.50	14.7	1.000	408	0.11	0.0	0.0	14.7	B		
T	0.57	0.50	19.2	1.000	981	0.16	0.8	0.0	20.0+	C	20.0+	C
Southbound												

T	0.40	0.43	21.8	1.000	838	0.11	0.3	0.0	22.1	C	21.7	C
R	0.00	0.87	0.9	1.000	1409	0.11	0.0	0.0	0.9	A		

Intersection delay = 27.6 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach			M	
Cycle length, C 110.0 sec				
Total actual green time for LT lane group, G (s)			55.0	
Effective permitted green time for LT lane group, g(s)			50.0	
Opposing effective green time, go (s)			47.0	
Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			1	
Adjusted LT flow rate, VLT (veh/h)			1	
Proportion of LT in LT lane group, PLT			1.000	
Proportion of LT in opposing flow, PLTo			0.00	
Adjusted opposing flow rate, Vo (veh/h)			335	
Lost time for LT lane group, tL			6.00	
Computation				
LT volume per cycle, LTC=VLTC/3600			0.03	
Opposing lane util. factor, fLUo			1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			10.24	
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.57	
gq, (see Exhibit C16-4,5,6,7,8)			14.41	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			35.59	
n=Max(gq-gf)/2,0)			7.20	
PTHo=1-PLTo			1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	
EL1 (refer to Exhibit C16-3)			1.88	
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g			0.08	
gdiff=max(gq-gf,0)			0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.38	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.378	

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 110.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT			0.000	0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo			1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 110.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v			1	
v/c ratio from Capacity Worksheet, X			0.00	
Protected phase effective green interval, g (s)			5.0	
Opposing queue effective green interval, gq			14.41	
Unopposed green interval, gu			35.59	
Red time r=(C-g-gq-gu)			55.0	
Arrival rate, qa=v/(3600(max[X,1.0])]			0.00	
Protected ph. departure rate, Sp=s/3600			0.501	
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)			0.28	
XPerm			0.00	
XProt			0.01	
Case			1	
Queue at beginning of green arrow, Qa			0.02	
Queue at beginning of unsaturated green, Qu			0.00	
Residual queue, Qr			0.00	
Uniform Delay, d1			14.7	

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 27.6 sec/veh Intersection LOS C

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L						L	T		T	R	
Init Queue	0.0						0.0	0.0		0.0	0.0	
Flow Rate	566						1	559		335	6	
So	1900						1900	2000		2000	1900	
No.Lanes	2	0	0	0	0	0	1	1	0	0 1	1	
SL	1805						817	1961		1961	1615	
LnCapacity	705						408	981		838	1409	
Flow Ratio	0.31						0.00	0.29		0.17	0.00	
v/c Ratio	0.80						0.00	0.57		0.40	0.00	
Grn Ratio	0.39						0.50	0.50		0.43	0.87	
I Factor		1.000						1.000		1.000		
AT or PVG	3						3	3		3	3	
Pltn Ratio	1.00						1.00	1.00		1.00	1.00	
PF2	1.00						1.00	1.00		1.00	1.00	
Q1	15.4						0.0	11.9		7.1	0.0	
kB	0.6						0.5	0.8		0.7	1.0	
Q2	2.3						0.0	1.0		0.5	0.0	
Q Average	17.6						0.0	12.9		7.5	0.0	
Q Spacing	25.0						25.0	25.0		25.0	25.0	
Q Storage	0						0	0		0	0	
Q S Ratio												
70th Percentile Output:												
fB%	1.2						1.2	1.2		1.2	1.2	
BOQ	20.5						0.0	15.2		8.9	0.0	
QSRatio												
85th Percentile Output:												
fB%	1.5						1.6	1.5		1.5	1.6	
BOQ	25.9						0.0	19.3		11.6	0.0	
QSRatio												
90th Percentile Output:												
fB%	1.6						1.8	1.6		1.7	1.8	
BOQ	27.6						0.0	20.8		12.6	0.0	
QSRatio												
95th Percentile Output:												
fB%	1.7						2.1	1.8		1.9	2.1	
BOQ	30.4						0.0	23.2		14.3	0.1	
QSRatio												
98th Percentile Output:												
fB%	2.0						2.7	2.1		2.3	2.7	
BOQ	34.5						0.0	26.8		17.0	0.1	
QSRatio												

ERROR MESSAGES

No errors to report.

2017 SITE+BACKGROUND TRAFFIC CAPACITY ANALYSIS – WITHOUT IMPROVEMENTS

HCS2000: Signalized Intersections Release 4.1e

Analyst: md
Agency:
Date: 1/4/2005
Period: am
Project ID: 2017 site+background - no improvements
E/W St: sth 158

Inter.: sth 158/cth h
Area Type: All other areas
Jurisd: wisdot
Year : 2017
N/S St: cth h

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	1	1	0	0	1	0	0	1	0
LGConfig	L	TR		L	TR			LTR			LTR	
Volume	95	760	20	75	880	30	5	185	75	65	305	120
Lane Width	12.0	12.0		12.0	12.0			12.0			12.0	
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A	A			NB Left	A			
Thru		A			Thru	A			
Right		A			Right	A			
Peds					Peds				
WB Left	A	A			SB Left	A			
Thru		A			Thru	A			
Right		A			Right	A			
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	6.0	40.0				29.0			
Yellow	3.0	4.5				4.5			
All Red	0.0	1.5				1.5			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	205	1805	0.52	0.54	21.2	C		
TR	841	1893	1.03	0.44	63.9	E	59.2	E
Westbound								
L	205	1805	0.40	0.54	19.9	B		
TR	840	1891	1.20	0.44	127.9	F	119.7	F
Northbound								
LTR	583	1808	0.51	0.32	25.4	C	25.4	C
Southbound								
LTR	519	1610	1.05	0.32	83.2	F	83.2	F

Intersection Delay = 83.1 (sec/veh) Intersection LOS = F

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/4/2005
Analysis Time Period: am
Intersection: sth 158/cth h
Area Type: All other areas
Jurisdiction: wisdot
Analysis Year: 2017
Project ID: 2017 site+background - no improvements
East/West Street: sth 158 North/South Street: cth h

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	95	760	20	75	880	30	5	185	75	65	305	120
% Heavy Veh	0	0	0	0	0	0	0	0	0	0	0	0
PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
PK 15 Vol	26	211	6	21	244	8	2	51	21	18	85	33
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900		1900	1900			1900			1900	
ParkExist												
NumPark												
No. Lanes	1	1	0	1	1	0	0	1	0	0	1	0
LGConfig	L	TR		L	TR			LTR			LTR	
Lane Width	12.0	12.0		12.0	12.0			12.0			12.0	
RTOR Vol			0			0			0			0
Adj Flow	106	866		83	1011			295			544	
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000			0.020			0.132	
Prop RTs		0.025			0.033			0.281			0.244	
Peds Bikes	0			0			0			0		
Buses	0	0		0	0			0			0	
%InProtPhase	0.0			0.0								

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0	0.0			0.0			0.0	
Arriv. Type	3	3		3	3			3			3	
Unit Ext.	3.0	3.0		3.0	3.0			3.0			3.0	
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0		2.0	2.0			2.0			2.0	
Ext of g	2.0	2.0		2.0	2.0			2.0			2.0	

Ped Min g	3.2	3.2	3.2	3.2

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A	A			NB Left	A			
Thru		A			Thru	A			
Right		A			Right	A			
Peds					Peds				
WB Left	A	A			SB Left	A			
Thru		A			Thru	A			
Right		A			Right	A			
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	6.0	40.0				29.0			
Yellow	3.0	4.5				4.5			
All Red	0.0	1.5				1.5			

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	95	760	20	75	880	30	5	185	75	65	305	120
PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj flow	106	844	22	83	978	33	6	206	83	72	339	133
No. Lanes	1	1	0	1	1	0	0	1	0	0	1	0
Lane group	L	TR		L	TR			LTR			LTR	
Adj flow	106	866		83	1011			295			544	
Prop LTs	1.000	0.000		1.000	0.000			0.020			0.132	
Prop RTs		0.025			0.033			0.281			0.244	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L	TR		L	TR		LTR			LTR		
So	1900	1900		1900	1900		1900			1900		
Lanes	1	1	0	1	1	0	0	1	0	0	1	0
fW	1.000	1.000		1.000	1.000			1.000			1.000	
fHV	1.000	1.000		1.000	1.000			1.000			1.000	
fG	1.000	1.000		1.000	1.000			1.000			1.000	
fP	1.000	1.000		1.000	1.000			1.000			1.000	
fBB	1.000	1.000		1.000	1.000			1.000			1.000	
fA	1.000	1.000		1.000	1.000			1.000			1.000	
fLU	1.000	1.000		1.000	1.000			1.000			1.000	
fRT		0.996			0.995			0.962			0.967	
fLT	0.950	1.000		0.950	1.000			0.989			0.876	
Sec.	0.093			0.093								
fLpb	1.000	1.000		1.000	1.000			1.000			1.000	
fRpb		1.000			1.000			1.000			1.000	
S	1805	1893		1805	1891			1808			1610	
Sec.	177			177								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		106	1805	# 0.06	0.067	120	0.88
Perm		0	177	0.00	0.478	85	0.00
Left	L	106			0.54	205	0.52
Prot							
Perm							
Thru	TR	866	1893	# 0.44	0.44	841	1.03
Right							
Westbound							
Prot		83	1805	0.05	0.067	120	0.69
Perm		0	177	0.00	0.478	85	0.00
Left	L	83			0.54	205	0.40
Prot							
Perm							
Thru	TR	1011	1891	0.44	0.44	840	1.20
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	295	1808	0.16	0.32	583	0.51
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	544	1610	# 0.34	0.32	519	1.05
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.84
Total lost time per cycle, L = 18.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.05

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	0.52	0.54	18.9	1.000	205	0.12	2.3	0.0	21.2	C		
TR	1.03	0.44	25.0	1.000	841	0.50	38.9	0.0	63.9	E	59.2	E
Westbound												
L	0.40	0.54	18.6	1.000	205	0.11	1.3	0.0	19.9	B		
TR	1.20	0.44	25.0	1.000	840	0.50	102.9	0.0	127.9	F	119.7	F
Northbound												
LTR	0.51	0.32	24.7	1.000	583	0.11	0.7	0.0	25.4	C	25.4	C
Southbound												

LTR	1.05	0.32	30.5	1.000	519	0.50	52.7	0.0	83.2	F	83.2	F

Intersection delay = 83.1 (sec/veh) Intersection LOS = F

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M		
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	49.0	49.0		
Effective permitted green time for LT lane group, g(s)	43.0	43.0		
Opposing effective green time, go (s)	40.0	40.0		
Number of lanes in LT lane group, N	1	1		
Number of lanes in opposing approach, No	1	1		
Adjusted LT flow rate, VLT (veh/h)	106	83		
Proportion of LT in LT lane group, PLT	1.000	1.000		
Proportion of LT in opposing flow, PLTo	0.00	0.00		
Adjusted opposing flow rate, Vo (veh/h)	1011	866		
Lost time for LT lane group, tL	6.00	6.00		
Computation				
LT volume per cycle, LTC=VLTC/3600	2.65	2.08		
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	25.27	21.65		
gf=G[exp(- a * (LTC ** b)]-tl, gf<=g	0.0	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.56	0.56		
gq, (see Exhibit C16-4,5,6,7,8)	39.00	39.00		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	4.00	4.00		
n=Max(gq-gf)/2,0)	19.50	19.50		
PTHo=1-PLTo	1.00	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00		
EL1 (refer to Exhibit C16-3)	3.35	2.93		
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.09	0.09		
gdiff=max(gq-gf,0)	0.00	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.09	0.09		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.093	0.093		

For special case of single-lane approach opposed by multilane approach.
see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto
left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach
or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach			S	S
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)			29.)	29.0
Effective permitted green time for LT lane group, g(s)			29.)	29.0
Opposing effective green time, go (s)			29.)	29.0
Number of lanes in LT lane group, N			1	1
Number of lanes in opposing approach, No			1	1
Adjusted LT flow rate, VLT (veh/h)			6	72
Proportion of LT in LT lane group, PLT	0.000	0.000	0.020	0.132
Proportion of LT in opposing flow, PLTo			0.13	0.02
Adjusted opposing flow rate, Vo (veh/h)			544	295
Lost time for LT lane group, tL			6.00	6.00
Computation				
LT volume per cycle, LTC=VLTC/3600			0.15	1.80
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			13.60	7.38
gf=G[exp(- a * (LTC ** b)]-tl, gf<=g			16.3	2.4
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.68	0.68
gq, (see Exhibit C16-4,5,6,7,8)			17.91	9.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf			11.09	20.00
n=Max(gq-gf)/2,0)			0.78	3.32
PTHo=1-PLTo			0.87	0.98
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			0.02	0.13
EL1 (refer to Exhibit C16-3)			2.40	1.87
EL2=Max((1-Ptho**n)/Plto, 1.0)			1.00	3.24
fmin=2(1+PL)/g or fmin=2(1+Pl)/g			0.07	0.08
gdiff=max(gq-gf,0)			1.56	6.64
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.99	0.88
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.989	0.876

For special case of single-lane approach opposed by multilane approach,
see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto
left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach
or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 90.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v	106	83		
v/c ratio from Capacity Worksheet, X	0.52	0.40		
Protected phase effective green interval, g (s)	6.0	6.0		
Opposing queue effective green interval, gq	39.00	39.00		
Unopposed green interval, gu	4.00	4.00		
Red time r=(C-g-gq-gu)	41.0	41.0		
Arrival rate, qa=v/(3600(max[X,1.0]))	0.03	0.02		
Protected ph. departure rate, Sp=s/3600	0.501	0.501		
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.53	0.53		
XPerm	0.60	0.47		
XProt	0.46	0.36		
Case	1	1		
Queue at beginning of green arrow, Qa	1.21	0.95		
Queue at beginning of unsaturated green, Qu	1.15	0.90		
Residual queue, Qr	0.00	0.00		
Uniform Delay, d1	18.9	18.6		

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Dur. Unmet Demand Q veh	Unmet Demand t hrs.	Uniform Delay Unadj. ds	Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 83.1 sec/veh Intersection LOS F

BACK OF QUEUE WORKSHEET

LaneGroup	Eastbound L	Eastbound TR	Westbound L	Westbound TR	Northbound LTR	Southbound LTR
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	106	866	83	1011	295	544
So	1900	1900	1900	1900	1900	1900
No.Lanes	1	1 0	1	1 0	0 1 0	0 1 0
SL	376	1893	376	1891	1808	1610
LnCapacity	205	841	205	840	583	519
Flow Ratio	0.28	0.46	0.22	0.53	0.16	0.34
v/c Ratio	0.52	1.03	0.40	1.20	0.51	1.05
Grn Ratio	0.54	0.44	0.54	0.44	0.32	0.32
I Factor		1.000		1.000	1.000	1.000
AT or PVG	3	3	3	3	3	3
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00	1.00	1.00	1.00	1.00	1.00
Q1	1.3	21.6	1.0	25.3	6.0	13.6
kB	0.3	0.6	0.3	0.6	0.5	0.5
Q2	0.3	9.9	0.2	24.6	0.5	7.4
Q Average	1.5	31.6	1.2	49.8	6.5	21.0
Q Spacing	25.0	25.0	25.0	25.0	25.0	25.0
Q Storage	0	0	0	0	0	0
Q S Ratio						
70th Percentile Output:						
fB%	1.2	1.1	1.2	1.1	1.2	1.2
BOQ	1.8	36.2	1.4	56.3	7.7	24.3
QSRatio						
85th Percentile Output:						
fB%	1.6	1.4	1.6	1.4	1.5	1.4
BOQ	2.4	44.3	1.8	67.6	10.0	30.4
QSRatio						
90th Percentile Output:						
fB%	1.8	1.5	1.8	1.4	1.7	1.5
BOQ	2.7	46.8	2.0	71.4	10.9	32.3
QSRatio						
95th Percentile Output:						
fB%	2.1	1.6	2.1	1.5	1.9	1.7
BOQ	3.1	50.6	2.4	76.6	12.4	35.4
QSRatio						
98th Percentile Output:						
fB%	2.6	1.8	2.6	1.7	2.3	1.9
BOQ	4.0	56.4	3.0	85.8	14.9	39.9
QSRatio						

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: md
Agency:
Date: 1/4/2005
Period: pm
Project ID: 2017 site+background - no improvements
E/W St: sth 158

Inter.: sth 158/cth h
Area Type: All other areas
Jurisd: wisdot
Year : 2017
N/S St: cth h

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	1	1	0	0	1	0	0	1	0
LGConfig	L	TR		L	TR			LTR			LTR	
Volume	205	1060	25	45	760	70	10	365	60	65	325	75
Lane Width	12.0	12.0		12.0	12.0			12.0			12.0	
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A	A			NB Left	A			
Thru		A			Thru	A			
Right		A			Right	A			
Peds					Peds				
WB Left	A	A			SB Left	A			
Thru		A			Thru	A			
Right		A			Right	A			
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	6.0	42.0				27.0			
Yellow	3.0	4.5				4.5			
All Red	0.0	1.5				1.5			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	205	1805	1.11	0.57	120.0	F		
TR	883	1893	1.37	0.47	195.9	F	183.8	F
Westbound								
L	205	1805	0.24	0.57	18.9	B		
TR	875	1876	1.05	0.47	69.6	E	67.0	E
Northbound								
LTR	551	1835	0.88	0.30	44.9	D	44.9	D
Southbound								
LTR	387	1290	1.33	0.30	198.2	F	198.2	F

Intersection Delay = 132.9 (sec/veh) Intersection LOS = F

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/4/2005
Analysis Time Period: pm
Intersection: sth 158/cth h
Area Type: All other areas
Jurisdiction: wisdot
Analysis Year: 2017
Project ID: 2017 site+background - no improvements
East/West Street: sth 158 North/South Street: cth h

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	205	1060	25	45	760	70	10	365	60	65	325	75
% Heavy Veh	0	0	0	0	0	0	0	0	0	0	0	0
PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
PK 15 Vol	57	294	7	13	211	19	3	101	17	18	90	21
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900		1900	1900			1900			1900	
ParkExist												
NumPark												
No. Lanes	1	1	0	1	1	0	0	1	0	0	1	0
LGConfig	L	TR		L	TR			LTR			LTR	
Lane Width	12.0	12.0		12.0	12.0			12.0			12.0	
RTOR Vol			0			0			0			0
Adj Flow	228	1206		50	922			484			516	
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000			0.023			0.140	
Prop RTs		0.023			0.085		0.138			0.161		
Peds		0			0			0			0	
Bikes							0			0		
Buses	0	0		0	0							
%InProtPhase	0.0			0.0								

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0	0.0			0.0			0.0	
Arriv. Type	3	3		3	3			3			3	
Unit Ext.	3.0	3.0		3.0	3.0			3.0			3.0	
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0		2.0	2.0			2.0			2.0	
Ext of g	2.0	2.0		2.0	2.0			2.0			2.0	
Ped Min g	3.2			3.2			3.2			3.2		

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A	A			NB Left	A			
Thru		A			Thru	A			
Right		A			Right	A			
Peds					Peds				
WB Left	A	A			SB Left	A			
Thru		A			Thru	A			
Right		A			Right	A			
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	6.0	42.0				27.0			
Yellow	3.0	4.5				4.5			
All Red	0.0	1.5				1.5			

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	205	1060	25	45	760	70	10	365	60	65	325	75
PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj flow	228	1178	28	50	844	78	11	406	67	72	361	83
No. Lanes	1	1	0	1	1	0	0	1	0	0	1	0
Lane group	L	TR		L	TR			LTR			LTR	
Adj flow	228	1206		50	922			484			516	
Prop LTs	1.000	0.000		1.000	0.000			0.023			0.140	
Prop RTs		0.023			0.085		0.138			0.161		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L	TR		L	TR			LTR			LTR	
So	1900	1900		1900	1900			1900			1900	
Lanes	1	1	0	1	1	0	0	1	0	0	1	0
fW	1.000	1.000		1.000	1.000			1.000			1.000	
fHV	1.000	1.000		1.000	1.000			1.000			1.000	
fG	1.000	1.000		1.000	1.000			1.000			1.000	
fP	1.000	1.000		1.000	1.000			1.000			1.000	
fBB	1.000	1.000		1.000	1.000			1.000			1.000	
fA	1.000	1.000		1.000	1.000			1.000			1.000	
fLU	1.000	1.000		1.000	1.000			1.000			1.000	
fRT		0.997			0.987			0.981			0.978	
fLT	0.950	1.000		0.950	1.000			0.984			0.694	
Sec.	0.089			0.089								
fLpb	1.000	1.000		1.000	1.000			1.000			1.000	
fRpb		1.000			1.000			1.000			1.000	
S	1805	1893		1805	1876			1835			1290	
Sec.	169			169								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		120	1805	# 0.07	0.067	120	1.00
Perm		108	169	# 0.64	0.500	85	1.27
Left	L	228			0.57	205	1.11
Prot							
Perm							
Thru	TR	1206	1893	0.47	0.47	883	1.37
Right							
Westbound							
Prot		50	1805	0.03	0.067	120	0.42
Perm		0	169	0.00	0.500	85	0.00
Left	L	50			0.57	205	0.24
Prot							
Perm							
Thru	TR	922	1876	0.47	0.47	875	1.05
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	484	1835	0.26	0.30	551	0.88
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	516	1290	# 0.40	0.30	387	1.33
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 1.11
Total lost time per cycle, L = 12.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.28

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	1.11	0.57	23.9	1.000	205	0.50	96.2	0.0	120.0	F		
TR	1.37	0.47	24.0	1.000	883	0.50	171.9	0.0	195.9	F	183.8	F
Westbound												
L	0.24	0.57	18.3	1.000	205	0.11	0.6	0.0	18.9	B		
TR	1.05	0.47	24.0	1.000	875	0.50	45.6	0.0	69.6	E	67.0	E
Northbound												
LTR	0.88	0.30	29.9	1.000	551	0.41	15.0	0.0	44.9	D	44.9	D
Southbound												

LTR	1.33	0.30	31.5	1.000	387	0.50	166.7	0.0	198.2	F	198.2 F

Intersection delay = 132.9 (sec/veh) Intersection LOS = F

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M		
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	51.0	51.0		
Effective permitted green time for LT lane group, g(s)	45.0	45.0		
Opposing effective green time, go (s)	42.0	42.0		
Number of lanes in LT lane group, N	1	1		
Number of lanes in opposing approach, No	1	1		
Adjusted LT flow rate, VLT (veh/h)	228	50		
Proportion of LT in LT lane group, PLT	1.000	1.000		
Proportion of LT in opposing flow, PLTo	0.00	0.00		
Adjusted opposing flow rate, Vo (veh/h)	922	1206		
Lost time for LT lane group, tL	6.00	6.00		
Computation				
LT volume per cycle, LTC=VLTC/3600	5.70	1.25		
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	23.05	30.15		
gf=G[exp(- a * (LTC ** b)]-tl, gf<=g	0.0	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.53	0.53		
gq, (see Exhibit C16-4,5,6,7,8)	41.00	41.00		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	4.00	4.00		
n=Max(gq-gf)/2,0)	20.50	20.50		
PTHo=1-PLTo	1.00	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00		
EL1 (refer to Exhibit C16-3)	3.09	4.04		
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.09	0.09		
gdiff=max(gq-gf,0)	0.00	0.00		
fm=[gf/g)+[gu/g)/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.09	0.09		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.089	0.089		

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach			S	S
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)			27.0	27.0
Effective permitted green time for LT lane group, g(s)			27.0	27.0
Opposing effective green time, go (s)			27.0	27.0
Number of lanes in LT lane group, N			1	1
Number of lanes in opposing approach, No			1	1
Adjusted LT flow rate, VLT (veh/h)			11	72
Proportion of LT in LT lane group, PLT	0.000	0.000	0.023	0.140
Proportion of LT in opposing flow, PLTo			0.14	0.02
Adjusted opposing flow rate, Vo (veh/h)			516	484
Lost time for LT lane group, tL			6.00	6.00
Computation				
LT volume per cycle, LTC=VLTC/3600			0.28	1.80
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			12.90	12.10
gf=G[exp(- a * (LTC ** b)]-tl, gf<=g			12.4	1.8
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.70	0.70
gq, (see Exhibit C16-4,5,6,7,8)			17.76	16.63
gu=g-gq if gq>=gf, or = g-gf if gq<gf			9.24	10.37
n=Max(gq-gf)/2,0)			2.67	7.43
PTHo=1-PLTo			0.86	0.98
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			0.02	0.14
EL1 (refer to Exhibit C16-3)			2.34	2.26
EL2=Max((1-Ptho**n)/Plto, 1.0)			2.37	6.91
fmin=2(1+PL)/g or fmin=2(1+Pl)/g			0.08	0.08
gdiff=max(gq-gf,0)			5.33	14.86
fm=[gf/g)+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.98	0.69
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.984	0.694

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 90.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v	228	50		
v/c ratio from Capacity Worksheet, X	1.11	0.24		
Protected phase effective green interval, g (s)	6.0	6.0		
Opposing queue effective green interval, gq	41.00	41.00		
Unopposed green interval, gu	4.00	4.00		
Red time r=(C-g-gq-gu)	39.0	39.0		
Arrival rate, qa=v/(3600(max[X,1.0]))	0.06	0.01		
Protected ph. departure rate, Sp=s/3600	0.501	0.501		
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.53	0.53		
XPerm	1.21	0.30		
XProt	0.85	0.21		
Case	3	1		
Queue at beginning of green arrow, Qa	2.67	0.54		
Queue at beginning of unsaturated green, Qu	2.33	0.57		
Residual queue, Qr	0.45	0.00		
Uniform Delay, d1	23.9	18.3		

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Dur. Unmet Demand Q veh	Unmet Demand t hrs.	Uniform Delay Unadj. ds	Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 132.9 sec/veh Intersection LOS F

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound	Southbound
LaneGroup	L	TR	L	TR	LTR	LTR
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	228	1206	50	922	484	516
So	1900	1900	1900	1900	1900	1900
No.Lanes	1	1 0	1	1 0	0 1 0	0 1 0
SL	361	1893	361	1876	1835	1290
LnCapacity	205	883	205	875	551	387
Flow Ratio	0.63	0.64	0.14	0.49	0.26	0.40
v/c Ratio	1.11	1.37	0.24	1.05	0.88	1.33
Grn Ratio	0.57	0.47	0.57	0.47	0.30	0.30
I Factor		1.000		1.000	1.000	1.000
AT or PVG	3	3	3	3	3	3
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00	1.00	1.00	1.00	1.00	1.00
Q1	2.6	30.1	0.6	23.0	11.5	12.9
kB	0.3	0.6	0.3	0.6	0.5	0.4
Q2	4.5	42.6	0.1	12.0	2.6	17.6
Q Average	7.2	72.8	0.6	35.0	14.1	30.5
Q Spacing	25.0	25.0	25.0	25.0	25.0	25.0
Q Storage	0	0	0	0	0	0
Q S Ratio						
70th Percentile Output:						
fB%	1.2	1.1	1.2	1.1	1.2	1.1
BOQ	8.5	81.2	0.8	40.0	16.6	34.9
QSRatio						
85th Percentile Output:						
fB%	1.5	1.3	1.6	1.4	1.5	1.4
BOQ	11.0	96.6	1.0	48.8	21.0	42.9
QSRatio						
90th Percentile Output:						
fB%	1.7	1.4	1.8	1.5	1.6	1.5
BOQ	12.1	103	1.1	51.5	22.6	45.3
QSRatio						
95th Percentile Output:						
fB%	1.9	1.5	2.1	1.6	1.8	1.6
BOQ	13.7	110	1.3	55.6	25.1	49.1
QSRatio						
98th Percentile Output:						
fB%	2.3	1.7	2.7	1.8	2.0	1.8
BOQ	16.4	124	1.7	61.9	28.8	54.7
QSRatio						

ERROR MESSAGES

No errors to report.

HCS2000: Unsignalized Intersections Release 4.1d

TWO-WAY STOP CONTROL SUMMARY

Analyst: md
Agency/Co.:
Date Performed: 11/12/2004
Analysis Time Period: am
Intersection: sth 158/104th avenue
Jurisdiction: wisdot
Units: U. S. Customary
Analysis Year: 2017
Project ID: 2017 site+background - no improvements
East/West Street: sth 158
North/South Street: 104th Avenue
Intersection Orientation: EW
Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1 L	2 T	3 R	4 L	5 T	6 R
Volume	5	640	95	195	745	5
Peak-Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate, HFR	5	640	95	195	745	5
Percent Heavy Vehicles	0	--	--	0	--	--
Median Type/Storage	Undivided			/		
RT Channelized?			No			No
Lanes	1 L	2 T	1 R	1 L	2 T	1 R
Configuration		No			No	
Upstream Signal?						

Minor Street: Approach	Northbound			Southbound		
Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume	570	5	280	5	10	5
Peak Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate, HFR	570	5	280	5	10	5
Percent Heavy Vehicles	0	0	0	0	0	0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No /			No /
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	L	L		LTR			LTR	
v (vph)	5	195		855			20	
C(m) (vph)	868	879		99			65	
v/c	0.01	0.22		8.64			0.31	
95% queue length	0.02	0.85		97.78			1.11	
Control Delay	9.2	10.3		3518			83.3	
LOS	A	B		F			F	
Approach Delay				3518			83.3	
Approach LOS				F			F	

HCS2000: Unsignalized Intersections Release 4.1d

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TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 11/12/2004
Analysis Time Period: am
Intersection: sth 158/104th avenue
Jurisdiction: wisdot
Units: U. S. Customary
Analysis Year: 2017
Project ID: 2017 site+background - no improvements
East/West Street: sth 158
North/South Street: 104th Avenue
Intersection Orientation: EW
Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume	5	640	95	195	745	5
Peak-Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Peak-15 Minute Volume	1	160	24	49	186	1
Hourly Flow Rate, HFR	5	640	95	195	745	5
Percent Heavy Vehicles	0	--	--	0	--	--
Median Type/Storage	Undivided			/		
RT Channelized?			No			No
Lanes	1 L	2 T	1 R	1 L	2 T	1 R
Configuration		No			No	
Upstream Signal?						

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume	570	5	280	5	10	5
Peak Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Peak-15 Minute Volume	142	1	70	1	2	1
Hourly Flow Rate, HFR	570	5	280	5	10	5
Percent Heavy Vehicles	0	0	0	0	0	0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No /			No /
RT Channelized?						
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

		Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
32	Left-Turn							
	Through							
35	Left-Turn							
	Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1	4.1	7.5	6.5	6.9	7.5	6.5	6.9
t(c,hv)		2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
P(hv)		0	0	0	0	0	0	0	0
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Grade/100				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage	4.1	4.1	7.5	6.5	6.9	7.5	6.5	6.9
	2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20	2.20	3.50	4.00	3.30	3.50	4.00	3.30
t(f,HV)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(HV)	0	0	0	0	0	0	0	0
t(f)	2.2	2.2	3.5	4.0	3.3	3.5	4.0	3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2 V(t)	Movement 2 V(1,prot)	Movement 5 V(t)	Movement 5 V(1,prot)
V prog				
Total Saturation Flow Rate, s (vph)				
Arrival Type				
Effective Green, g (sec)				
Cycle Length, C (sec)				
Rp (from Exhibit 16-11)				
Proportion vehicles arriving on green P				
g(q1)				
g(q2)				
g(q)				

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2 V(t)	Movement 2 V(1,prot)	Movement 5 V(t)	Movement 5 V(1,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p		0.000		0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x	750	735	1417	1790	320	1467	1880	372
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		3000		3000		3000		3000
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	320	372
Potential Capacity	682	631
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	682	631
Probability of Queue free St.	0.59	0.99

Step 2: LT from Major St.	4	1
Conflicting Flows	735	750
Potential Capacity	879	868
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	879	868
Probability of Queue free St.	0.78	0.99
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows	1790	1880
Potential Capacity	82	72
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.77	0.77
Movement Capacity	63	56
Probability of Queue free St.	0.92	0.82

Step 4: LT from Minor St.	7	10
Conflicting Flows	1417	1467
Potential Capacity	99	91
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.64	0.71
Maj. L, Min T Adj. Imp Factor.	0.72	0.78
Cap. Adj. factor due to Impeding mvmnt	0.71	0.46
Movement Capacity	70	42

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	1790	1880
Potential Capacity	82	72
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.77	0.77
Movement Capacity	63	56
Result for 2 stage process:		
a		
y		
C t	63	56
Probability of Queue free St.	0.92	0.82

Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	1417	1467
Potential Capacity	99	91
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.64	0.71
Maj. L, Min T Adj. Imp Factor.	0.72	0.78
Cap. Adj. factor due to Impeding mvmnt	0.71	0.46
Movement Capacity	70	42
Results for Two-stage process:		
a		
y		
C t	70	42

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	570	5	280	5	10	5
Movement Capacity (vph)	70	63	682	42	56	631
Shared Lane Capacity (vph)		99			65	

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	70	63	682	42	56	631
Volume	570	5	280	5	10	5
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh		99			65	
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	L	L		LTR			LTR	
v (vph)	5	195		855			20	
C(m) (vph)	868	879		99			65	
v/c	0.01	0.22		8.64			0.31	
95% queue length	0.02	0.85		97.78			1.11	
Control Delay	9.2	10.3		3518			83.3	
LOS	A	B		F			F	
Approach Delay				3518			83.3	
Approach LOS				F			F	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.99	0.78
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4	9.2	10.3
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS2000: Unsignalized Intersections Release 4.1d

TWO-WAY STOP CONTROL SUMMARY

Analyst: md
Agency/Co.:
Date Performed: 11/12/2004
Analysis Time Period: pm
Intersection: sth 158/104th avenue
Jurisdiction: wisdot
Units: U. S. Customary
Analysis Year: 2017
Project ID: 2017 site+background - no improvements
East/West Street: sth 158
North/South Street: 104th Avenue
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	5	780	125	15	735	5
Peak-Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate, HFR	5	780	125	15	735	5
Percent Heavy Vehicles	0	--	--	0	--	--
Median Type/Storage	Undivided			/		
RT Channelized?			No			No
Lanes	1	2	1	1	2	1
Configuration	L	T	R	L	T	R
Upstream Signal?		No			No	

Minor Street: Approach	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	900	5	470	15	5	15
Peak Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate, HFR	900	5	470	15	5	15
Percent Heavy Vehicles	0	0	0	0	0	0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No /			No /
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	L	L		LTR			LTR	
v (vph)	5	15		1375			35	
C(m) (vph)	876	760		181			68	
v/c	0.01	0.02		7.60			0.51	
95% queue length	0.02	0.06		152.63			2.11	
Control Delay	9.1	9.8		3016			104.3	
LOS	A	A		F			F	
Approach Delay				3016			104.3	
Approach LOS				F			F	

HCS2000: Unsignalized Intersections Release 4.1d

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TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 11/12/2004
Analysis Time Period: pm
Intersection: sth 158/104th avenue
Jurisdiction: wisdot
Units: U. S. Customary
Analysis Year: 2017
Project ID: 2017 site+background - no improvements
East/West Street: sth 158
North/South Street: 104th Avenue
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	5	780	125	15	735	5
Peak-Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Peak-15 Minute Volume	1	195	31	4	184	1
Hourly Flow Rate, HFR	5	780	125	15	735	5
Percent Heavy Vehicles	0	--	--	0	--	--
Median Type/Storage	Undivided			/		
RT Channelized?			No			No
Lanes	1	2	1	1	2	1
Configuration	L	T	R	L	T	R
Upstream Signal?		No			No	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	900	5	470	15	5	15
Peak Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Peak-15 Minute Volume	225	1	118	4	1	4
Hourly Flow Rate, HFR	900	5	470	15	5	15
Percent Heavy Vehicles	0	0	0	0	0	0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No /			No /
RT Channelized?						
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn							
Through							
S5 Left-Turn							
Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1	4	7	8	9	10	11	12
		L	L	L	T	R	L	T	R
t(c,base)		4.1	4.1	7.5	6.5	6.9	7.5	6.5	6.9
t(c,hv)		2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
P(hv)		0	0	0	0	0	0	0	0
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Grade/100				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage	4.1	4.1	7.5	6.5	6.9	7.5	6.5	6.9
	2-stage								

Follow-Up Time Calculations

Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)	2.20	2.20	3.50	4.00	3.30	3.50	4.00	3.30
t(f,HV)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(HV)	0	0	0	0	0	0	0	0
t(f)	2.2	2.2	3.5	4.0	3.3	3.5	4.0	3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(1,prot)	V(t)	V(1,prot)
V prog				
Total Saturation Flow Rate, s (vph)				
Arrival Type				
Effective Green, g (sec)				
Cycle Length, C (sec)				
Rp (from Exhibit 16-11)				
Proportion vehicles arriving on green P				
g(q1)				
g(q2)				
g(q)				

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2		Movement 5	
	V(t)	V(1,prot)	V(t)	V(1,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p		0.000		0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5
Single-Stage Process

Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
V c,x	740	905	1190	1560	390	1167	1680	368
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process

	7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		3000		3000		3000		3000
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	390	368
Potential Capacity	614	635
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	614	635
Probability of Queue free St.	0.23	0.98

Step 2: LT from Major St.	4	1
Conflicting Flows	905	740
Potential Capacity	760	876
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	760	876
Probability of Queue free St.	0.98	0.99
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows	1560	1680
Potential Capacity	113	96
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.97	0.97
Movement Capacity	110	94
Probability of Queue free St.	0.95	0.95

Step 4: LT from Minor St.	7	10
Conflicting Flows	1190	1167
Potential Capacity	145	151
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.92	0.93
Maj. L, Min T Adj. Imp Factor.	0.94	0.95
Cap. Adj. factor due to Impeding mvmnt	0.92	0.22
Movement Capacity	133	34

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	1560	1680
Potential Capacity	113	96
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.97	0.97
Movement Capacity	110	94
Result for 2 stage process:		
a		
y		
C t	110	94
Probability of Queue free St.	0.95	0.95

Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	1190	1167
Potential Capacity	145	151
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.92	0.93
Maj. L, Min T Adj. Imp Factor.	0.94	0.95
Cap. Adj. factor due to Impeding mvmnt	0.92	0.22
Movement Capacity	133	34
Results for Two-stage process:		
a		
y		
C t	133	34

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	900	5	470	15	5	15
Movement Capacity (vph)	133	110	614	34	94	635
Shared Lane Capacity (vph)		181			68	

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	133	110	614	34	94	635
Volume	900	5	470	15	5	15
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh		181			68	
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	L	L		LTR			LTR	
v (vph)	5	15		1375			35	
C(m) (vph)	876	760		181			68	
v/c	0.01	0.02		7.60			0.51	
95% queue length	0.02	0.06		152.63			2.11	
Control Delay	9.1	9.8		3016			104.3	
LOS	A	A		F			F	
Approach Delay				3016			104.3	
Approach LOS				F			F	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.99	0.98
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4	9.1	9.8
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS2000: Signalized Intersections Release 4.1e

Analyst: md
Agency:
Date: 1/3/2005
Period: am
Project ID: 2017 site+background - no improvements
E/W St: sth 158

Inter.: sth 158/greyhound access
Area Type: All other areas
Jurisd: wisdot
Year : 2017
N/S St: greyhound access

SIGNALIZED INTERSECTION SUMMARY

	Eastbound L	Eastbound T	Eastbound R	Westbound L	Westbound T	Westbound R	Northbound L	Northbound T	Northbound R	Southbound L	Southbound T	Southbound R
No. Lanes	0	2	0	1	2	0	2	0	1	0	0	0
LGConfig		T		L	T		L		R			
Volume		700		375	945		45		40			
Lane Width		12.0		12.0	12.0		12.0		12.0			
RTOR Vol									0			

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left					NB Left	A			
Thru		A			Thru				
Right					Right	A			
Peds					Peds				
WB Left	A	A			SB Left				
Thru	A	A			Thru				
Right					Right				
Peds					Peds				
NB Right	A				EB Right				
SB Right					WB Right				
Green	15.0	52.0				18.0			
Yellow	3.0	4.5				4.5			
All Red	0.0	1.5				1.5			

Cycle Length: 100.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
T	1881	3618	0.41	0.52	14.8	B	14.8	B
Westbound								
L	549	1805	0.76	0.70	14.6	B		
T	2533	3618	0.41	0.70	6.5	A	8.8	A
Northbound								
L	631	3505	0.08	0.18	34.2	C	27.1	C
R	630	1615	0.07	0.39	19.2	B		
Southbound								

Intersection Delay = 11.5 (sec/veh) Intersection LOS = B

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/3/2005
Analysis Time Period: am
Intersection: sth 158/greyhound access
Area Type: All other areas
Jurisdiction: wisdot
Analysis Year: 2017
Project ID: 2017 site+background - no improvements
East/West Street: sth 158
North/South Street: greyhound access

VOLUME DATA

	Eastbound L	Eastbound T	Eastbound R	Westbound L	Westbound T	Westbound R	Northbound L	Northbound T	Northbound R	Southbound L	Southbound T	Southbound R
Volume		700		375	945		45		40			
% Heavy Veh		0		0	0		0		0			
PHF		0.90		0.90	0.90		0.90		0.90			
PK 15 Vol		194		104	263		13		11			
Hi Ln Vol												
% Grade		0			0			0				
Ideal Sat		1900		1900	1900		1900		1900			
ParkExist												
NumPark												
No. Lanes	0	2	0		1	2	0	2	0	1	0	0	0
LGConfig		T		L	T			L		R			
Lane Width		12.0		12.0	12.0			12.0		12.0			
RTOR Vol										0			
Adj Flow		778		417	1050			50		44			
%InSharedLn													
Prop LTs		0.000		1.000	0.000							
Prop RTs	0.000				0.000					1.000		
Peds Bikes	0							0			0	
Buses		0		0	0		0			0		
%InProtPhase				0.0								

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound L	Eastbound T	Eastbound R	Westbound L	Westbound T	Westbound R	Northbound L	Northbound T	Northbound R	Southbound L	Southbound T	Southbound R
Init Unmet		0.0		0.0	0.0		0.0		0.0			
Arriv. Type		3		3	3		3		3			
Unit Ext.		3.0		3.0	3.0		3.0		3.0			
I Factor		1.000			1.000			1.000				
Lost Time		2.0		2.0	2.0		2.0		2.0			
Ext of g		2.0		2.0	2.0		2.0		2.0			
Ped Min g		3.2						3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left					NB Left	A			
Thru		A			Thru				
Right					Right	A			
Peds					Peds				
WB Left	A	A			SB Left				
Thru	A	A			Thru				
Right					Right				
Peds					Peds				
NB Right	A				EB Right				
SB Right					WB Right				
Green	15.0	52.0				18.0			
Yellow	3.0	4.5				4.5			
All Red	0.0	1.5				1.5			

Cycle Length: 100.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound L	Eastbound T	Eastbound R	Westbound L	Westbound T	Westbound R	Northbound L	Northbound T	Northbound R	Southbound L	Southbound T	Southbound R
Volume, V		700		375	945		45		40			
PHF		0.90		0.90	0.90		0.90		0.90			
Adj flow		778		417	1050		50		44			
No. Lanes	0	2	0		1	2	0	2	0	1	0	0	0
Lane group		T		L	T		L		R			
Adj flow		778		417	1050		50		44			
Prop LTs		0.000		1.000	0.000							
Prop RTs	0.000				0.000					1.000		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound T	Westbound L	Westbound T	Northbound L	Northbound R	Southbound
So	1900	1900	1900	1900	1900	
Lanes 0	2 0	1	2 0	2 0	1 0	0 0
fW	1.000	1.000	1.000	1.000	1.000	
fHV	1.000	1.000	1.000	1.000	1.000	
fG	1.000	1.000	1.000	1.000	1.000	
fP	1.000	1.000	1.000	1.000	1.000	
fBB	1.000	1.000	1.000	1.000	1.000	
fA	1.000	1.000	1.000	1.000	1.000	
fLU	0.952	1.000	0.952	0.971	1.000	
fRT	1.000		1.000		0.850	
fLT	1.000	0.950	1.000	0.950		
Sec.		0.266				
fLpb	1.000	1.000	1.000	1.000		
fRpb	1.000		1.000		1.000	
S	3618	1805	3618	3505	1615	
Sec.		505				

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	778	3618	0.22	0.52	1881	0.41
Right							
Westbound							
Prot		271	1805	# 0.15	0.150	271	1.00
Perm		146	505	# 0.29	0.550	278	0.53
Left	L	417			0.70	549	0.76
Prot							
Perm							
Thru	T	1050	3618	0.29	0.70	2533	0.41
Right							
Northbound							
Prot							
Perm							
Left	L	50	3505	# 0.01	0.18	631	0.08
Prot							
Perm							
Thru							
Right	R	44	1615	0.03	0.39	630	0.07
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.45
Total lost time per cycle, L = 12.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.52

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
T	0.41	0.52	14.7	1.000	1881	0.11	0.1	0.0	14.8	B	14.8	B
Westbound												
L	0.76	0.70	8.4	1.000	549	0.31	6.1	0.0	14.6	B		
T	0.41	0.70	6.3	1.000	2533	0.11	0.1	0.0	6.5	A	8.8	A
Northbound												
L	0.08	0.18	34.1	1.000	631	0.11	0.1	0.0	34.2	C		
R	0.07	0.39	19.1	1.000	630	0.11	0.0	0.0	19.2	B	27.1	C
Southbound												

Intersection delay = 11.5 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach		M		
Cycle length, C 100.0 sec				
Total actual green time for LT lane group, G (s)		70.0		
Effective permitted green time for LT lane group, g(s)		55.0		
Opposing effective green time, go (s)		52.0		
Number of lanes in LT lane group, N		1		
Number of lanes in opposing approach, No		2		
Adjusted LT flow rate, VLT (veh/h)		417		
Proportion of LT in LT lane group, PLT		1.000		
Proportion of LT in opposing flow, PLTo		0.00		
Adjusted opposing flow rate, Vo (veh/h)		778		
Lost time for LT lane group, tL		6.00		
Computation				
LT volume per cycle, LTC=VLTC/3600		11.58		
Opposing lane util. factor, fLUo	0.952	0.952		
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		11.35		
gf=G[exp(- a * (LTC ** b)]-tl, gf<=g		0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.48		
gq, (see Exhibit C16-4,5,6,7,8)		14.10		
gu=g-gq if gq>=gf, or = g-gf if gq<gf		40.90		
n=Max(gq-gf)/2,0)		7.05		
PTHo=1-PLTo		1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00		
EL1 (refer to Exhibit C16-3)		2.80		
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.07		
gdiff=max(gq-gf,0)		0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.27		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.266		

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 100.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT		0.000	0.000	
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo		0.952	0.952	
Opposing flow, Volc=VoC/(3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b)]-tl, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 100.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v		417		
v/c ratio from Capacity Worksheet, X		0.76		
Protected phase effective green interval, g (s)		15.0		
Opposing queue effective green interval, gq		14.10		
Unopposed green interval, gu		40.90		
Red time r=(C-g-gq-gu)		30.0		
Arrival rate, qa=v/(3600(max[X,1.0]))		0.12		
Protected ph. departure rate, Sp=s/3600		0.501		
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)		0.19		
XPerm		0.83		
XProt		0.69		
Case		1		
Queue at beginning of green arrow, Qa		3.48		
Queue at beginning of unsaturated green, Qu		1.63		
Residual queue, Qr		0.00		
Uniform Delay, d1		8.4		

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Dur. Unmet Demand Q veh	Unmet Demand t hrs.	Uniform Delay Unadj. ds	Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 11.5 sec/veh Intersection LOS B

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	T		L	T	L	R		
Init Queue	0.0		0.0	0.0	0.0	0.0		
Flow Rate	408		417	551	25	44		
So	1900		1900	1900	1900	1900		
No.Lanes	2	0	1	2 0	2 0	1	0 0	0
SL	1900		784	1900	1805	1615		
LnCapacity	987		549	1330	324	630		
Flow Ratio	0.21		0.53	0.29	0.01	0.03		
v/c Ratio	0.41		0.76	0.41	0.08	0.07		
Grn Ratio	0.52		0.70	0.70	0.18	0.39		
I Factor	1.000			1.000	1.000			
AT or PVG	3		3	3	3	3		
Pltn Ratio	1.00		1.00	1.00	1.00	1.00		
PF2	1.00		1.00	1.00	1.00	1.00		
Q1	6.9		3.9	6.5	0.6	0.8		
kB	0.7		0.5	0.9	0.4	0.6		
Q2	0.5		1.5	0.6	0.0	0.0		
Q Average	7.4		5.4	7.1	0.6	0.8		
Q Spacing	25.0		25.0	25.0	25.0	25.0		
Q Storage	0		0	0	0	0		
Q S Ratio								
70th Percentile Output:								
fB%	1.2		1.2	1.2	1.2	1.2		
BOQ	8.8		6.4	8.4	0.7	1.0		
QSRatio								
85th Percentile Output:								
fB%	1.5		1.6	1.5	1.6	1.6		
BOQ	11.4		8.4	10.9	1.0	1.3		
QSRatio								
90th Percentile Output:								
fB%	1.7		1.7	1.7	1.8	1.8		
BOQ	12.5		9.2	11.9	1.1	1.4		
QSRatio								
95th Percentile Output:								
fB%	1.9		1.9	1.9	2.1	2.1		
BOQ	14.1		10.5	13.5	1.3	1.7		
QSRatio								
98th Percentile Output:								
fB%	2.3		2.4	2.3	2.7	2.6		
BOQ	16.8		12.8	16.1	1.6	2.1		
QSRatio								

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: md
Agency:
Date: 1/3/2005
Period: pm
Project ID: 2017 site+background - no improvements
E/W St: sth 158

Inter.: sth 158/greyhound access
Area Type: All other areas
Jurisd: wisdot
Year : 2017
N/S St: greyhound access

SIGNALIZED INTERSECTION SUMMARY

	Eastbound L	T	R	Westbound L	T	R	Northbound L	T	R	Southbound L	T	R
No. Lanes	0	2	0	1	2	0	2	0	1	0	0	0
LGConfig		T		L	T		L		R			
Volume		780		595	1055		170		130			
Lane Width		12.0		12.0	12.0		12.0		12.0			
RTOR Vol									0			

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left					NB Left	A			
Thru		A			Thru				
Right					Right	A			
Peds					Peds				
WB Left	A	A			SB Left				
Thru	A	A			Thru				
Right					Right				
Peds					Peds				
NB Right	A				EB Right				
SB Right					WB Right				
Green	40.0	39.0				16.0			
Yellow	3.0	4.5				4.5			
All Red	0.0	1.5				1.5			

Cycle Length: 110.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	g/C	Lane Group Delay	LOS	Approach Delay	LOS
Eastbound								
T	1283	3618	0.68	0.35	31.6	C	31.6	C
Westbound								
L	758	1805	0.87	0.75	34.9	C		
T	2697	3618	0.43	0.75	5.4	A	16.0	B
Northbound								
L	510	3505	0.37	0.15	42.9	D	29.4	C
R	910	1615	0.16	0.56	11.6	B		
Southbound								

Intersection Delay = 21.9 (sec/veh) Intersection LOS = C

HCS2000: Signalized Intersections Release 4.1e

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Suite 202

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E-Mail: mdelavergne@landstrategiesinc.com

OPERATIONAL ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/3/2005
Analysis Time Period: pm
Intersection: sth 158/greyhound access
Area Type: All other areas
Jurisdiction: wisdot
Analysis Year: 2017
Project ID: 2017 site+background - no improvements

East/West Street: sth 158
North/South Street: greyhound access

VOLUME DATA

	Eastbound L	T	R	Westbound L	T	R	Northbound L	T	R	Southbound L	T	R
Volume		780		595	1055		170		130			
% Heavy Veh		0		0	0		0		0			
PHF		0.90		0.90	0.90		0.90		0.90			
PK 15 Vol		217		165	293		47		36			
Hi Ln Vol												
% Grade		0			0			0				
Ideal Sat		1900		1900	1900		1900		1900			
ParkExist												
NumPark												
No. Lanes	0	2	0	1	2	0	2	0	1	0	0	0
LGConfig		T		L	T		L		R			
Lane Width		12.0		12.0	12.0		12.0		12.0			
RTOR Vol									0			
Adj Flow		867		661	1172		189		144			
%InSharedLn												
Prop LTs		0.000		1.000	0.000							
Prop RTs		0.000			0.000				1.000			
Peds Bikes		0						0			0	
Buses		0		0	0		0		0			
%InProtPhase				0.0								

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound L	T	R	Westbound L	T	R	Northbound L	T	R	Southbound L	T	R
Init Unmet		0.0		0.0	0.0		0.0		0.0			
Arriv. Type		3		3	3		3		3			
Unit Ext.		3.0		3.0	3.0		3.0		3.0			
I Factor		1.000			1.000			1.000				
Lost Time		2.0		2.0	2.0		2.0		2.0			
Ext of g		2.0		2.0	2.0		2.0		2.0			
Ped Min g		3.2					3.2		3.2			

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left					NB Left	A			
Thru		A			Thru				
Right					Right	A			
Peds					Peds				
WB Left	A	A			SB Left				
Thru	A	A			Thru				
Right					Right				
Peds					Peds				
NB Right	A				EB Right				
SB Right					WB Right				
Green	40.0	39.0				16.0			
Yellow	3.0	4.5				4.5			
All Red	0.0	1.5				1.5			

Cycle Length: 110.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound L	T	R	Westbound L	T	R	Northbound L	T	R	Southbound L	T	R
Volume, V		780		595	1055		170		130			
PHF		0.90		0.90	0.90		0.90		0.90			
Adj flow		867		661	1172		189		144			
No. Lanes	0	2	0	1	2	0	2	0	1	0	0	0
Lane group		T		L	T		L		R			
Adj flow		867		661	1172		189		144			
Prop LTs		0.000		1.000	0.000							
Prop RTs		0.000			0.000				1.000			

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound T			Westbound L	T		Northbound L		R	Southbound		
LG												
So	1900			1900	1900		1900		1900			
Lanes	0	2	0	1	2	0	2	0	1	0	0	0
fW		1.000		1.000	1.000		1.000		1.000			
fHV		1.000		1.000	1.000		1.000		1.000			
fG		1.000		1.000	1.000		1.000		1.000			
fP		1.000		1.000	1.000		1.000		1.000			
fBB		1.000		1.000	1.000		1.000		1.000			
fA		1.000		1.000	1.000		1.000		1.000			
fLU		0.952		1.000	0.952		0.971		1.000			
fRT		1.000			1.000				0.850			
fLT		1.000		0.950	1.000		0.950					
Sec.				0.140								
fLpb		1.000		1.000	1.000		1.000					
fRpb		1.000			1.000				1.000			
S		3618		1805	3618		3505		1615			
Sec.				266								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	867	3618	# 0.24	0.35	1283	0.68
Right							
Westbound							
Prot		656	1805	# 0.36	0.364	656	1.00
Perm		5	266	0.02	0.382	102	0.05
Left	L	661			0.75	758	0.87
Prot							
Perm							
Thru	T	1172	3618	0.32	0.75	2697	0.43
Right							
Northbound							
Prot							
Perm							
Left	L	189	3505	# 0.05	0.15	510	0.37
Prot							
Perm							
Thru							
Right	R	144	1615	0.09	0.56	910	0.16
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.66
Total lost time per cycle, L = 18.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.79

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group Delay	LOS	Approach Delay	LOS
Eastbound												
T	0.68	0.35	30.1	1.000	1283	0.25	1.4	0.0	31.6	C	31.6	C
Westbound												
L	0.87	0.75	24.0	1.000	758	0.40	10.9	0.0	34.9	C		
T	0.43	0.75	5.3	1.000	2697	0.11	0.1	0.0	5.4	A	16.0	B
Northbound												
L	0.37	0.15	42.5	1.000	510	0.11	0.5	0.0	42.9	D	29.4	C
R	0.16	0.56	11.5	1.000	910	0.11	0.1	0.0	11.6	B		
Southbound												

Intersection delay = 21.9 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach		M		
Cycle length, C 110.0 sec				
Total actual green time for LT lane group, G (s)		82.0		
Effective permitted green time for LT lane group, g(s)		42.0		
Opposing effective green time, go (s)		39.0		
Number of lanes in LT lane group, N		1		
Number of lanes in opposing approach, No		2		
Adjusted LT flow rate, VLT (veh/h)		661		
Proportion of LT in LT lane group, PLT		1.000		
Proportion of LT in opposing flow, PLTo		0.00		
Adjusted opposing flow rate, Vo (veh/h)		867		
Lost time for LT lane group, tL		6.00		
Computation				
LT volume per cycle, LTC=VLTC/3600		20.20		
Opposing lane util. factor, fLUo	0.952	0.952		
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		13.91		
gf=G[exp(- a * (LTC ** b)]-tl, gf<=g		0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.65		
gq, (see Exhibit C16-4,5,6,7,8)		24.04		
gu=g-gq if gq>=gf, or = g-gf if gq<gf		17.96		
n=Max(gq-gf)/2,0)		12.02		
PTHo=1-PLTo		1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00		
EL1 (refer to Exhibit C16-3)		3.05		
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.10		
gdiff=max(gq-gf,0)		0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.14		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.140		

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 110.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000		
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	0.952	0.952		
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b)]-tl, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 110.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v		661		
v/c ratio from Capacity Worksheet, X		0.87		
Protected phase effective green interval, g (s)		40.0		
Opposing queue effective green interval, gq		24.04		
Unopposed green interval, gu		17.96		
Red time r=(C-g-gq-gu)		28.0		
Arrival rate, qa=v/(3600(max[X,1.0]))		0.18		
Protected ph. departure rate, Sp=s/3600		0.501		
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)		0.17		
XPerm		2.48		
XProt		0.62		
Case		3		
Queue at beginning of green arrow, Qa		9.75		
Queue at beginning of unsaturated green, Qu		4.41		
Residual queue, Qr		4.61		
Uniform Delay, d1		24.0		

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 21.9 sec/veh Intersection LOS C

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	T		L	T	L	R		
Init Queue	0.0		0.0	0.0	0.0	0.0		
Flow Rate	455		661	615	97	144		
So	1900		1900	1900	1900	1900		
No.Lanes	2	0	1	2 0	2 0	1	0 0	0
SL	1900		1017	1900	1805	1615		
LnCapacity	673		758	1416	262	910		
Flow Ratio	0.24		0.65	0.32	0.05	0.09		
v/c Ratio	0.68		0.87	0.43	0.37	0.16		
Grn Ratio	0.35		0.75	0.75	0.15	0.56		
I Factor	1.000			1.000	1.000			
AT or PVG	3		3	3	3	3		
Pltn Ratio	1.00		1.00	1.00	1.00	1.00		
PF2	1.00		1.00	1.00	1.00	1.00		
Q1	11.8		7.5	7.1	2.7	2.1		
kB	0.6		0.7	1.0	0.3	0.7		
Q2	1.2		3.5	0.7	0.2	0.1		
Q Average	13.0		11.0	7.8	2.9	2.2		
Q Spacing	25.0		25.0	25.0	25.0	25.0		
Q Storage	0		0	0	0	0		
Q S Ratio								
70th Percentile Output:								
fB%	1.2		1.2	1.2	1.2	1.2		
BOQ	15.3		13.0	9.2	3.4	2.7		
QSRatio								
85th Percentile Output:								
fB%	1.5		1.5	1.5	1.6	1.6		
BOQ	19.5		16.6	12.0	4.5	3.5		
QSRatio								
90th Percentile Output:								
fB%	1.6		1.6	1.7	1.7	1.8		
BOQ	21.0		18.0	13.0	5.0	3.9		
QSRatio								
95th Percentile Output:								
fB%	1.8		1.8	1.9	2.0	2.0		
BOQ	23.3		20.1	14.7	5.8	4.6		
QSRatio								
98th Percentile Output:								
fB%	2.1		2.1	2.2	2.5	2.5		
BOQ	26.9		23.4	17.5	7.2	5.7		
QSRatio								

ERROR MESSAGES

No errors to report.

HCS2000: Unsignalized Intersections Release 4.1d

TWO-WAY STOP CONTROL SUMMARY

Analyst: md
Agency/Co.:
Date Performed: 12/15/2004
Analysis Time Period: am
Intersection: STH 158/Eastern Frontage Road
Jurisdiction: WisDOT
Units: U. S. Customary
Analysis Year: 2017
Project ID: 2017 site + background - no improvements
East/West Street: STH 158
North/South Street: Frontage Road
Intersection Orientation: EW
Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1 L	2 T	3 R	4 L	5 T	6 R
Volume	1	1295	1	1	1105	10
Peak-Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate, HFR	1	1295	1	1	1105	10
Percent Heavy Vehicles	0	--	--	0	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						No
Lanes	1	2	0	1	2	1
Configuration	L	T	TR	L	T	R
Upstream Signal?		No			No	

Minor Street: Approach	Northbound			Southbound		
Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume	50	10	55	10	1	10
Peak Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate, HFR	50	10	55	10	1	10
Percent Heavy Vehicles	0	0	0	0	0	0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No /			No /
Lanes	1	1	0	1	1	0
Configuration	L		TR	L		TR

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	L	L	L		TR	L		TR
v (vph)	1	1	50		65	10		11
C(m) (vph)	634	541	45		150	36		219
v/c	0.00	0.00	1.11		0.43	0.28		0.05
95% queue length	0.00	0.01	4.65		1.94	0.90		0.16
Control Delay	10.7	11.7	311.6		46.2	139.7		22.3
LOS	B	B	F		E	F		C
Approach Delay				161.6			78.2	
Approach LOS				F			F	

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

		Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2	Left-Turn							
	Through							
S5	Left-Turn							
	Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1	4.1	7.5	6.5	6.9	7.5	6.5	6.9
t(c,hv)		2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
P(hv)		0	0	0	0	0	0	0	0
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Grade/100				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage	4.1	4.1	7.5	6.5	6.9	7.5	6.5	6.9
	2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20	2.20	3.50	4.00	3.30	3.50	4.00	3.30
t(f,HV)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(HV)	0	0	0	0	0	0	0	0
t(f)	2.2	2.2	3.5	4.0	3.3	3.5	4.0	3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2 V(t)	Movement 2 V(1,prot)	Movement 5 V(t)	Movement 5 V(1,prot)
V prog				

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HCS2000: Unsignalized Intersections Release 4.1d

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 12/15/2004
Analysis Time Period: am
Intersection: STH 158/Eastern Frontage Road
Jurisdiction: WisDOT
Units: U. S. Customary
Analysis Year: 2017
Project ID: 2017 site + background - no improvements
East/West Street: STH 158
North/South Street: Frontage Road
Intersection Orientation: EW
Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume	1	1295	1	1	1105	10
Peak-Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Peak-15 Minute Volume	0	324	0	0	276	2
Hourly Flow Rate, HFR	1	1295	1	1	1105	10
Percent Heavy Vehicles	0	--	--	0	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						No
Lanes	1	2	0	1	2	1
Configuration	L	T	TR	L	T	R
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume	50	10	55	10	1	10
Peak Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Peak-15 Minute Volume	12	2	14	2	0	2
Hourly Flow Rate, HFR	50	10	55	10	1	10
Percent Heavy Vehicles	0	0	0	0	0	0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No /			No /
RT Channelized?						
Lanes	1	1	0	1	1	0
Configuration	L		TR	L		TR

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Total Saturation Flow Rate, s (vph)		
Arrival Type		
Effective Green, g (sec)		
Cycle Length, C (sec)		
Rp (from Exhibit 16-11)		
Proportion vehicles arriving on green P		
g(q1)		
g(q2)		
g(q)		

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2 V(t)	Movement 2 V(1,prot)	Movement 5 V(t)	Movement 5 V(1,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p		0.000		0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5
Single-Stage Process

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x	1115	1296	1852	2415	648	1761	2405	552
s								
Px								
V c,u,x								

C r,x	
C plat,x	

Two-Stage Process

	7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		3000		3000		3000		3000
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	648	552
Potential Capacity	418	483
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	418	483
Probability of Queue free St.	0.87	0.98

Step 2: LT from Major St.	4	1
Conflicting Flows	1296	1115
Potential Capacity	541	634
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	541	634
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows	2415	2405
Potential Capacity	33	34
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	33	34
Probability of Queue free St.	0.70	0.97

Step 4: LT from Minor St.	7	10
Conflicting Flows	1852	1761
Potential Capacity	47	55
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.97	0.69
Maj. L, Min T Adj. Imp Factor.	0.98	0.76
Cap. Adj. factor due to Impeding mvmnt	0.95	0.66
Movement Capacity	45	36

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	2415	2405
Potential Capacity	33	34
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	33	34
Result for 2 stage process:		
a		
y		
C t	33	34
Probability of Queue free St.	0.70	0.97

Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	1852	1761
Potential Capacity	47	55
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.97	0.69
Maj. L, Min T Adj. Imp Factor.	0.98	0.76
Cap. Adj. factor due to Impeding mvmnt	0.95	0.66
Movement Capacity	45	36
Results for Two-stage process:		
a		
y		
C t	45	36

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	50	10	55	10	1	10
Movement Capacity (vph)	45	33	418	36	34	483
Shared Lane Capacity (vph)			150			219

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	45	33	418	36	34	483
Volume	50	10	55	10	1	10
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh			150			219
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	L	L	L		TR	L		TR
v (vph)	1	1	50		65	10		11
C(m) (vph)	634	541	45		150	36		219
v/c	0.00	0.00	1.11		0.43	0.28		0.05
95% queue length	0.00	0.01	4.65		1.94	0.90		0.16
Control Delay	10.7	11.7	311.6		46.2	139.7		22.3
LOS	B	B	F		E	F		C
Approach Delay				161.6			78.2	
Approach LOS				F			F	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4	10.7	11.7
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS2000: Unsignalized Intersections Release 4.1d

TWO-WAY STOP CONTROL SUMMARY

Analyst: md
Agency/Co.:
Date Performed: 12/15/2004
Analysis Time Period: pm
Intersection: STH 158/Eastern Frontage Road
Jurisdiction: WisDOT
Units: U. S. Customary
Analysis Year: 2017
Project ID: 2017 site + background - no improvements
East/West Street: STH 158
North/South Street: Frontage Road
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1 L	2 T	3 R	4 L	5 T	6 R
Volume	1	1645	1	1	1290	25
Peak-Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate, HFR	1	1645	1	1	1290	25
Percent Heavy Vehicles	0	--	--	0	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						No
Lanes	1 L	2 T	0 TR	1 L	2 T	1 R
Configuration						
Upstream Signal?		No			No	

Minor Street: Approach	Northbound			Southbound		
Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume	105	25	65	10	1	10
Peak Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Hourly Flow Rate, HFR	105	25	65	10	1	10
Percent Heavy Vehicles	0	0	0	0	0	0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No /			No /
Lanes	1 L	1	0 TR	1 L	1	0 TR
Configuration						

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	L	L	L		TR	L		TR
v (vph)	1	1	105		90	10		11
C(m) (vph)	533	398	20		48	0		122
v/c	0.00	0.00	5.25		1.88			0.09
95% queue length	0.01	0.01	13.53		9.00			0.29
Control Delay	11.8	14.1	2299		596.3			37.4
LOS	B	B	F		F	F		E
Approach Delay				1513				
Approach LOS				F				

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TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 12/15/2004
Analysis Time Period: pm
Intersection: STH 158/Eastern Frontage Road
Jurisdiction: WisDOT
Units: U. S. Customary
Analysis Year: 2017
Project ID: 2017 site + background - no improvements
East/West Street: STH 158
North/South Street: Frontage Road
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume	1	1645	1	1	1290	25
Peak-Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Peak-15 Minute Volume	0	411	0	0	322	6
Hourly Flow Rate, HFR	1	1645	1	1	1290	25
Percent Heavy Vehicles	0	--	--	0	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						No
Lanes	1 L	2 T	0 TR	1 L	2 T	1 R
Configuration						
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume	105	25	65	10	1	10
Peak Hour Factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Peak-15 Minute Volume	26	6	16	2	0	2
Hourly Flow Rate, HFR	105	25	65	10	1	10
Percent Heavy Vehicles	0	0	0	0	0	0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No /			No /
RT Channelized?						
Lanes	1 L	1	0 TR	1 L	1	0 TR
Configuration						

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn							
Through							
S5 Left-Turn							
Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1	4.1	7.5	6.5	6.9	7.5	6.5	6.9
t(c,hv)		2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
P(hv)		0	0	0	0	0	0	0	0
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Grade/100				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage	4.1	4.1	7.5	6.5	6.9	7.5	6.5	6.9
	2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20	2.20	3.50	4.00	3.30	3.50	4.00	3.30
t(f,HV)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(HV)	0	0	0	0	0	0	0	0
t(f)	2.2	2.2	3.5	4.0	3.3	3.5	4.0	3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2 V(t)	Movement 2 V(1,prot)	Movement 5 V(t)	Movement 5 V(1,prot)
V prog				
Total Saturation Flow Rate, s (vph)				
Arrival Type				
Effective Green, g (sec)				
Cycle Length, C (sec)				
Rp (from Exhibit 16-11)				
Proportion vehicles arriving on green P				
g(q1)				
g(q2)				
g(q)				

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2 V(t)	Movement 2 V(1,prot)	Movement 5 V(t)	Movement 5 V(1,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p		0.000		0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5
Single-Stage Process

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x	1315	1646	2296	2965	823	2128	2940	645
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process

	7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		3000		3000		3000		3000
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	823	645
Potential Capacity	321	420
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	321	420
Probability of Queue free St.	0.80	0.98

Step 2: LT from Major St.	4	1
Conflicting Flows	1646	1315
Potential Capacity	398	533
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	398	533
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows	2965	2940
Potential Capacity	15	15
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	15	15
Probability of Queue free St.	0.00	0.93

Step 4: LT from Minor St.	7	10
Conflicting Flows	2296	2128
Potential Capacity	22	29
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.93	0.00
Maj. L, Min T Adj. Imp Factor.	0.95	0.00
Cap. Adj. factor due to Impeding mvmnt	0.92	0.00
Movement Capacity	20	0

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	2965	2940
Potential Capacity	15	15
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	15	15
Result for 2 stage process:		
a		
y		
C t	15	15
Probability of Queue free St.	0.00	0.93

Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	2296	2128
Potential Capacity	22	29
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.93	0.00
Maj. L, Min T Adj. Imp Factor.	0.95	0.00
Cap. Adj. factor due to Impeding mvmnt	0.92	0.00
Movement Capacity	20	0
Results for Two-stage process:		
a		
y		
C t	20	0

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	105	25	65	10	1	10
Movement Capacity (vph)	20	15	321	0	15	420
Shared Lane Capacity (vph)			48			122

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	20	15	321	0	15	420
Volume	105	25	65	10	1	10
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh			48			122
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	L	L	L		TR	L		TR
v (vph)	1	1	105		90	10		11
C(m) (vph)	533	398	20		48	0		122
v/c	0.00	0.00	5.25		1.88			0.09
95% queue length	0.01	0.01	13.53		9.00			0.29
Control Delay	11.8	14.1	2299		596.3			37.4
LOS	B	B	F		F	F		E
Approach Delay				1513				
Approach LOS				F				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4	11.8	14.1
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS2000: Unsignalized Intersections Release 4.1d

TWO-WAY STOP CONTROL SUMMARY

Analyst: md
Agency/Co.:
Date Performed: 12/15/2004
Analysis Time Period: am
Intersection: sth 158/i-94 nb interchange
Jurisdiction: wisdot
Units: U. S. Customary
Analysis Year: 2017
Project ID: 2017 site + background - no improvements
East/West Street: sth 158
North/South Street: i-94 nb interchange
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1 L	2 T	3 R	4 L	5 T	6 R
Volume	25	840			625	540
Peak-Hour Factor, PHF	1.00	1.00			1.00	1.00
Hourly Flow Rate, HFR	25	840			625	540
Percent Heavy Vehicles	0	--	--		--	--
Median Type/Storage	Undivided		/			
RT Channelized?						No
Lanes	1	2			2	1
Configuration	L	T			T	R
Upstream Signal?		No			No	

Minor Street: Approach	Northbound			Southbound		
Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume	1	1				
Peak Hour Factor, PHF	1.00	1.00				
Hourly Flow Rate, HFR	1	1				
Percent Heavy Vehicles	0	0				
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/			/
Lanes	0	1				
Configuration		LT				

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	L		LT					
v (vph)	25		2					
C(m) (vph)	607		82					
v/c	0.04		0.02					
95% queue length	0.13		0.07					
Control Delay	11.2		50.0-					
LOS	B		E					
Approach Delay				50.0-				
Approach LOS				E				

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HCS2000: Unsignalized Intersections Release 4.1d

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 12/15/2004
Analysis Time Period: am
Intersection: sth 158/i-94 nb interchange
Jurisdiction: wisdot
Units: U. S. Customary
Analysis Year: 2017
Project ID: 2017 site + background - no improvements
East/West Street: sth 158
North/South Street: i-94 nb interchange
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume	25	840			625	540
Peak-Hour Factor, PHF	1.00	1.00			1.00	1.00
Peak-15 Minute Volume	6	210			156	135
Hourly Flow Rate, HFR	25	840			625	540
Percent Heavy Vehicles	0	--	--		--	--
Median Type/Storage	Undivided		/			
RT Channelized?						No
Lanes	1	2			2	1
Configuration	L	T			T	R
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume	1	1				
Peak Hour Factor, PHF	1.00	1.00				
Peak-15 Minute Volume	0	0				
Hourly Flow Rate, HFR	1	1				
Percent Heavy Vehicles	0	0				
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/			/
RT Channelized?						
Lanes	0	1				
Configuration		LT				

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn							
Through							
S5 Left-Turn							
Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1		7.5	6.5				
t(c,hv)		2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
P(hv)		0		0	0				
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Grade/100				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00		0.70	0.00				
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage	4.1		6.8	6.5				
	2-stage								

Follow-Up Time Calculations Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20		3.50	4.00				
t(f,HV)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(HV)	0		0	0				
t(f)	2.2		3.5	4.0				

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal	Movement 2 V(t)	Movement 2 V(l,prot)	Movement 5 V(t)	Movement 5 V(l,prot)
V prog				
Total Saturation Flow Rate, s (vph)				
Arrival Type				
Effective Green, g (sec)				
Cycle Length, C (sec)				
Rp (from Exhibit 16-11)				
Proportion vehicles arriving on green P				
g(q1)				
g(q2)				
g(q)				

Computation 2-Proportion of TWSC Intersection Time blocked	Movement 2 V(t)	Movement 2 V(l,prot)	Movement 5 V(t)	Movement 5 V(l,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p		0.000		0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x	1165		1202	2055				
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		3000		3000				
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 2: LT from Major St.	4	1
Conflicting Flows		1165
Potential Capacity		607
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		607
Probability of Queue free St.	1.00	0.96
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows	2055	
Potential Capacity	56	
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.96	0.96
Movement Capacity	54	
Probability of Queue free St.	0.98	1.00

Step 4: LT from Minor St.	7	10
Conflicting Flows	1202	
Potential Capacity	180	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.94
Maj. L, Min T Adj. Imp Factor.		0.95
Cap. Adj. factor due to Impeding mvmnt	0.96	0.95
Movement Capacity	173	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	2055	
Potential Capacity	56	
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.96	0.96
Movement Capacity	54	
Result for 2 stage process:		
a		
y		
C t	54	
Probability of Queue free St.	0.98	1.00

Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	1202	
Potential Capacity	180	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.94
Maj. L, Min T Adj. Imp Factor.		0.95
Cap. Adj. factor due to Impeding mvmnt	0.96	0.95
Movement Capacity	173	
Results for Two-stage process:		
a		
y		
C t	173	

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	1	1				
Movement Capacity (vph)	173	54				
Shared Lane Capacity (vph)	82					

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	173	54				
Volume	1	1				
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh	82					
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	L		LT					
v (vph)	25		2					
C(m) (vph)	607		82					
v/c	0.04		0.02					
95% queue length	0.13		0.07					
Control Delay	11.2		50.0-					
LOS	B		E					
Approach Delay				50.0-				
Approach LOS				E				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.96	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4	11.2	
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS2000: Unsignalized Intersections Release 4.1d

TWO-WAY STOP CONTROL SUMMARY

Analyst: md
Agency/Co.:
Date Performed: 12/15/2004
Analysis Time Period: pm
Intersection: sth 158/i-94 nb interchange
Jurisdiction: wisdot
Units: U. S. Customary
Analysis Year: 2017
Project ID: 2017 site + background - no improvements
East/West Street: sth 158
North/South Street: i-94 nb interchange
Intersection Orientation: EW
Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1 L	2 T	3 R	4 L	5 T	6 R
Volume	15	875			650	755
Peak-Hour Factor, PHF	1.00	1.00			1.00	1.00
Hourly Flow Rate, HFR	15	875			650	755
Percent Heavy Vehicles	0	--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?						No
Lanes	1	2			2	1
Configuration	L	T			T	R
Upstream Signal?		No			No	

Minor Street: Approach	Northbound			Southbound		
Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume	1	1				
Peak Hour Factor, PHF	1.00	1.00				
Hourly Flow Rate, HFR	1	1				
Percent Heavy Vehicles	0	0				
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/			/
Lanes	0	1				
Configuration	LT					

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	L		LT					
v (vph)	15		2					
C(m) (vph)	492		62					
v/c	0.03		0.03					
95% queue length	0.09		0.10					
Control Delay	12.5		65.0					
LOS	B		F					
Approach Delay				65.0				
Approach LOS				F				

HCS2000: Unsignalized Intersections Release 4.1d

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TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 12/15/2004
Analysis Time Period: pm
Intersection: sth 158/i-94 nb interchange
Jurisdiction: wisdot
Units: U. S. Customary
Analysis Year: 2017
Project ID: 2017 site + background - no improvements
East/West Street: sth 158
North/South Street: i-94 nb interchange
Intersection Orientation: EW
Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume	15	875			650	755
Peak-Hour Factor, PHF	1.00	1.00			1.00	1.00
Peak-15 Minute Volume	4	219			162	189
Hourly Flow Rate, HFR	15	875			650	755
Percent Heavy Vehicles	0	--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?						No
Lanes	1	2			2	1
Configuration	L	T			T	R
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume	1	1				
Peak Hour Factor, PHF	1.00	1.00				
Peak-15 Minute Volume	0	0				
Hourly Flow Rate, HFR	1	1				
Percent Heavy Vehicles	0	0				
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/			/
RT Channelized?						
Lanes	0	1				
Configuration	LT					

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0
Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn							
Through							
S5 Left-Turn							
Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1		7.5	6.5				
t(c,hv)		2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
P(hv)		0		0	0				
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Grade/100				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00		0.70	0.00				
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage	4.1		6.8	6.5				
	2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20		3.50	4.00				
t(f,HV)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(HV)	0		0	0				
t(f)	2.2		3.5	4.0				

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2 V(t)	Movement 2 V(l,prot)	Movement 5 V(t)	Movement 5 V(l,prot)
V prog				
Total Saturation Flow Rate, s (vph)				
Arrival Type				
Effective Green, g (sec)				
Cycle Length, C (sec)				
Rp (from Exhibit 16-11)				
Proportion vehicles arriving on green P				
g(q1)				
g(q2)				
g(q)				

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2 V(t)	Movement 2 V(l,prot)	Movement 5 V(t)	Movement 5 V(l,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p		0.000		0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5

Single-Stage Process Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x	1405		1230	2310				
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		3000		3000				
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 2: LT from Major St.	4	1
Conflicting Flows		1405
Potential Capacity		492
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		492
Probability of Queue free St.	1.00	0.97
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows	2310	
Potential Capacity	39	
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.97	0.97
Movement Capacity	38	
Probability of Queue free St.	0.97	1.00

Step 4: LT from Minor St.	7	10
Conflicting Flows	1230	
Potential Capacity	173	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.94
Maj. L, Min T Adj. Imp Factor.		0.96
Cap. Adj. factor due to Impeding mvmnt	0.97	0.96
Movement Capacity	168	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	2310	
Potential Capacity	39	
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.97	0.97
Movement Capacity	38	
Result for 2 stage process:		
a		
y		
C t	38	
Probability of Queue free St.	0.97	1.00

Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	1230	
Potential Capacity	173	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.94
Maj. L, Min T Adj. Imp Factor.		0.96
Cap. Adj. factor due to Impeding mvmnt	0.97	0.96
Movement Capacity	168	
Results for Two-stage process:		
a		
y		
C t	168	

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	1	1				
Movement Capacity (vph)	168	38				
Shared Lane Capacity (vph)	62					

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	168	38				
Volume	1	1				
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh	62					
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	L		LT					
v (vph)	15		2					
C(m) (vph)	492		62					
v/c	0.03		0.03					
95% queue length	0.09		0.10					
Control Delay	12.5		65.0					
LOS	B		F					
Approach Delay				65.0				
Approach LOS				F				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.97	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4	12.5	
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS2000: Signalized Intersections Release 4.1e

Analyst: md
Agency:
Date: 12/15/2004
Period: am
Project ID: 2017 site+background - no improvements
E/W St: sth 158

Inter.: sth 158/I-94 SB Interchange
Area Type: All other areas
Jurisd: WisDOT
Year : 2017
N/S St: I-94 SB Intechange

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	1	1	2	0	0	0	0	1	1	0
LGConfig		T	R	L	T					L	LTR	
Volume		125	15	530	95					740	2	40
Lane Width		12.0	12.0	12.0	12.0					12.0	12.0	
RTOR Vol			0									0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left					NB Left				
Thru		A			Thru				
Right		A			Right				
Peds					Peds				
WB Left	A	A			SB Left	A			
Thru	A	A			Thru	A			
Right					Right	A			
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	40.0	9.0				35.0			
Yellow	3.0	4.5				4.5			
All Red	0.0	2.0				2.0			

Cycle Length: 100.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
T	326	3618	0.43	0.09	44.0	D	43.8	D
R	145	1615	0.12	0.09	42.2	D		
Westbound								
L	798	1805	0.74	0.52	21.1	C		
T	1881	3618	0.06	0.52	11.9	B	19.7	B
Northbound								
Southbound								
L	632	1805	0.72	0.35	32.0	C		
LTR	626	1790	0.66	0.35	30.2	C	31.2	C

Intersection Delay = 27.7 (sec/veh) Intersection LOS = C

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 12/15/2004
Analysis Time Period: am
Intersection: sth 158/I-94 SB Interchange
Area Type: All other areas
Jurisdiction: WisDOT
Analysis Year: 2017
Project ID: 2017 site+background - no improvements
East/West Street: sth 158 North/South Street: I-94 SB Intechange

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume		125	15	530	95					740	2	40
% Heavy Veh		0	0	0	0					0	0	0
PHF		0.90	0.90	0.90	0.90					0.90	0.90	0.90
PK 15 Vol		35	4	147	26					206	1	11
Hi Ln Vol												
% Grade		0			0						0	
Ideal Sat		1900	1900	1900	1900					1900	1900	
ParkExist												
NumPark												
No. Lanes	0	2	1	1	2	0	0	0	0	1	1	0
LGConfig		T	R	L	T					L	LTR	
Lane Width		12.0	12.0	12.0	12.0					12.0	12.0	
RTOR Vol			0									0
Adj Flow		139	17	589	106					452	416	
%InSharedLn										45		
Prop LTs		0.000		1.000	0.000						0.889	
Prop RTs		0.000	1.000		0.000						0.106	
Peds Bikes	0						0				0	
Buses		0	0	0	0					0	0	
%InProtPhase				0.0								

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0	0.0	0.0	0.0					0.0	0.0	
Arriv. Type		3	3	3	3					3	3	
Unit Ext.		3.0	3.0	3.0	3.0					3.0	3.0	
I Factor		1.000			1.000						1.000	
Lost Time		2.0	2.0	2.0	2.0					2.0	2.0	
Ext of g		2.0	2.0	2.0	2.0					2.0	2.0	

Ped Min g	3.2			3.2		3.2	

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left					NB Left				
Thru		A			Thru				
Right		A			Right				
Peds					Peds				
WB Left	A	A			SB Left	A			
Thru	A	A			Thru	A			
Right					Right	A			
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	40.0	9.0				35.0			
Yellow	3.0	4.5				4.5			
All Red	0.0	2.0				2.0			

Cycle Length: 100.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V		125	15	530	95					740	2	40
PHF		0.90	0.90	0.90	0.90					0.90	0.90	0.90
Adj flow		139	17	589	106					822	2	44
No. Lanes	0	2	1	1	2	0	0	0	0	1	1	0
Lane group		T	R	L	T					L	LTR	
Adj flow		139	17	589	106					452	416	
Prop LTs		0.000		1.000	0.000						0.889	
Prop RTs		0.000	1.000		0.000						0.106	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	T	R		L	T					L	LTR	
So	1900	1900		1900	1900					1900	1900	
Lanes	0 2	1		1	2	0	0	0	0	1	1	0
fW	1.000	1.000		1.000	1.000					1.000	1.000	
fHV	1.000	1.000		1.000	1.000					1.000	1.000	
fG	1.000	1.000		1.000	1.000					1.000	1.000	
fP	1.000	1.000		1.000	1.000					1.000	1.000	
fBB	1.000	1.000		1.000	1.000					1.000	1.000	
fA	1.000	1.000		1.000	1.000					1.000	1.000	
fLU	0.952	1.000		1.000	0.952					1.000	1.000	
fRT	1.000	0.850			1.000						0.984	
fLT	1.000			0.950	1.000					0.950	0.957	
Sec.				0.333								
fLpb	1.000			1.000	1.000					1.000	1.000	
fRpb	1.000	1.000			1.000						1.000	
S	3618	1615		1805	3618					1805	1790	
Sec.				633								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	139	3618	# 0.04	0.09	326	0.43
Right	R	17	1615	0.01	0.09	145	0.12
Westbound							
Prot		589	1805	# 0.33	0.400	722	0.82
Perm		0	633	0.00	0.120	76	0.00
Left	L	589			0.52	798	0.74
Prot							
Perm							
Thru	T	106	3618	0.03	0.52	1881	0.06
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Southbound							
Prot							
Perm							
Left	L	452	1805	# 0.25	0.35	632	0.72
Prot							
Perm							
Thru	LTR	416	1790	0.23	0.35	626	0.66
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.62
Total lost time per cycle, L = 19.50 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.76

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
T	0.43	0.09	43.1	1.000	326	0.11	0.9	0.0	44.0	D	43.8	D
R	0.12	0.09	41.8	1.000	145	0.11	0.4	0.0	42.2	D		
Westbound												
L	0.74	0.52	17.5	1.000	798	0.30	3.6	0.0	21.1	C		
T	0.06	0.52	11.9	1.000	1881	0.11	0.0	0.0	11.9	B	19.7	B
Northbound												
Southbound												
L	0.72	0.35	28.2	1.000	632	0.28	3.9	0.0	32.0	C		

LTR 0.66 0.35 27.5 1.000 626 0.24 2.7 0.0 30.2 C 31.2 C

Intersection delay = 27.7 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach		M		
Cycle length, C 100.0 sec				
Total actual green time for LT lane group, G (s)		52.0		
Effective permitted green time for LT lane group, g(s)		12.0		
Opposing effective green time, go (s)		9.0		
Number of lanes in LT lane group, N		1		
Number of lanes in opposing approach, No		2		
Adjusted LT flow rate, VLT (veh/h)		589		
Proportion of LT in LT lane group, PLT		1.000		
Proportion of LT in opposing flow, PLTo		0.00		
Adjusted opposing flow rate, Vo (veh/h)		139		
Lost time for LT lane group, tL		6.50		
Computation				
LT volume per cycle, LTC=VLTC/3600		16.36		
Opposing lane util. factor, fLUo	0.952	0.952	1.000	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		2.03		
gf=G[exp(- a * (LTC ** b)]-tl, gf<=g		0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.91		
gq, (see Exhibit C16-4,5,6,7,8)		6.50		
gu=g-gq if gq>=gf, or = g-gf if gq<gf		5.50		
n=Max(gq-gf)/2,0)		3.25		
PTHo=1-PLTo		1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00		
EL1 (refer to Exhibit C16-3)		1.51		
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.33		
gdiff=max(gq-gf,0)		0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.33		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.333		

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 100.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000		0.889
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	0.952	0.952	1.000	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b)]-tl, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 100.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v		589		
v/c ratio from Capacity Worksheet, X		0.74		
Protected phase effective green interval, g (s)		40.0		
Opposing queue effective green interval, gq		6.50		
Unopposed green interval, gu		5.50		
Red time r=(C-g-gq-gu)		48.0		
Arrival rate, qa=v/(3600(max[X,1.0]))		0.16		
Protected ph. departure rate, Sp=s/3600		0.501		
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)		0.38		
XPerm		0.93		
XProt		0.72		
Case		1		
Queue at beginning of green arrow, Qa		7.85		
Queue at beginning of unsaturated green, Qu		1.06		
Residual queue, Qr		0.00		
Uniform Delay, d1		17.5		

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Dur. Unmet Demand Q veh	Unmet Demand t hrs.	Uniform Delay Unadj. ds	Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Lane Queue Delay d3 sec	Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 27.7 sec/veh Intersection LOS C

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound			Southbound		
LaneGroup	T	R	L	T				L	LTR	
Init Queue	0.0	0.0	0.0	0.0				0.0	0.0	
Flow Rate	73	17	589	55				452	416	
So	1900	1900	1900	1900				1900	1900	
No.Lanes	2	1	1	2	0	0	0	1	1	0
SL	1900	1615	1535	1900				1805	1790	
LnCapacity	171	145	798	987				632	626	
Flow Ratio	0.04	0.01	0.38	0.03				0.25	0.23	
v/c Ratio	0.43	0.12	0.74	0.06				0.72	0.66	
Grn Ratio	0.09	0.09	0.52	0.52				0.35	0.35	
I Factor	1.000			1.000					1.000	
AT or PVG	3	3	3	3				3	3	
Pltn Ratio	1.00	1.00	1.00	1.00				1.00	1.00	
PF2	1.00	1.00	1.00	1.00				1.00	1.00	
Q1	1.9	0.4	11.1	0.8				10.9	9.8	
kB	0.3	0.2	0.6	0.7				0.6	0.6	
Q2	0.2	0.0	1.7	0.0				1.3	1.1	
Q Average	2.1	0.5	12.8	0.8				12.2	10.8	
Q Spacing	25.0	25.0	25.0	25.0				25.0	25.0	
Q Storage	0	0	0	0				0	0	
Q S Ratio										
70th Percentile Output:										
fB%	1.2	1.2	1.2	1.2				1.2	1.2	
BOQ	2.5	0.6	15.1	1.0				14.3	12.8	
QSRatio										
85th Percentile Output:										
fB%	1.6	1.6	1.5	1.6				1.5	1.5	
BOQ	3.3	0.7	19.2	1.3				18.3	16.4	
QSRatio										
90th Percentile Output:										
fB%	1.8	1.8	1.6	1.8				1.6	1.6	
BOQ	3.7	0.8	20.7	1.4				19.7	17.7	
QSRatio										
95th Percentile Output:										
fB%	2.0	2.1	1.8	2.1				1.8	1.8	
BOQ	4.3	1.0	23.0	1.7				22.0	19.8	
QSRatio										
98th Percentile Output:										
fB%	2.6	2.7	2.1	2.6				2.1	2.1	
BOQ	5.4	1.2	26.6	2.1				25.5	23.1	
QSRatio										

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: md
Agency:
Date: 12/15/2004
Period: am
Project ID: 2017 site+background - no improvements
E/W St: sth 158

Inter.: sth 158/I-94 SB Interchange
Area Type: All other areas
Jurisd: WisDOT
Year : 2017
N/S St: I-94 SB Intechange

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	1	1	2	0	0	0	0	1	1	0
LGConfig		T	R	L	T					L	LTR	
Volume		90	15	495	155					805	5	85
Lane Width		12.0	12.0	12.0	12.0					12.0	12.0	
RTOR Vol			0								0	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left					NB Left				
Thru		A			Thru				
Right		A			Right				
Peds					Peds				
WB Left	A	A			SB Left	A			
Thru	A	A			Thru	A			
Right					Right	A			
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	35.0	17.0				42.0			
Yellow	3.0	4.5				4.5			
All Red	0.0	2.0				2.0			

Cycle Length: 110.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
T	559	3618	0.18	0.15	40.6	D	40.5	D
R	250	1615	0.07	0.15	39.8	D		
Westbound								
L	735	1805	0.75	0.50	24.4	C		
T	1809	3618	0.10	0.50	14.5	B	22.0	C
Northbound								
Southbound								
L	689	1805	0.71	0.38	32.4	C		
LTR	678	1775	0.74	0.38	33.6	C	33.0	C

Intersection Delay = 29.2 (sec/veh) Intersection LOS = C

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 12/15/2004
Analysis Time Period: am
Intersection: sth 158/I-94 SB Interchange
Area Type: All other areas
Jurisdiction: WisDOT
Analysis Year: 2017
Project ID: 2017 site+background - no improvements

East/West Street: sth 158
North/South Street: I-94 SB Intechange

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume		90	15	495	155					805	5	85
% Heavy Veh		0	0	0	0					0	0	0
PHF		0.90	0.90	0.90	0.90					0.90	0.90	0.90
PK 15 Vol		25	4	138	43					224	2	24
Hi Ln Vol												
% Grade		0			0						0	
Ideal Sat		1900	1900	1900	1900					1900	1900	
ParkExist												
NumPark												
No. Lanes	0	2	1	1	2	0	0	0	0	1	1	0
LGConfig		T	R	L	T					L	LTR	
Lane Width		12.0	12.0	12.0	12.0					12.0	12.0	
RTOR Vol			0								0	
Adj Flow		100	17	550	172					492	502	
%InSharedLn										45		
Prop LTs		0.000		1.000	0.000						0.801	
Prop RTs	0.000	1.000		0.000						0.187		
Peds Bikes	0						0			0		
Buses		0	0	0	0					0	0	
%InProtPhase				0.0								

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0	0.0	0.0	0.0					0.0	0.0	
Arriv. Type		3	3	3	3					3	3	
Unit Ext.		3.0	3.0	3.0	3.0					3.0	3.0	
I Factor		1.000			1.000						1.000	
Lost Time		2.0	2.0	2.0	2.0					2.0	2.0	
Ext of g		2.0	2.0	2.0	2.0					2.0	2.0	
Ped Min g		3.2					3.2			3.2		

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left					NB Left				
Thru		A			Thru				
Right		A			Right				
Peds					Peds				
WB Left	A	A			SB Left	A			
Thru	A	A			Thru	A			
Right					Right	A			
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	35.0	17.0				42.0			
Yellow	3.0	4.5				4.5			
All Red	0.0	2.0				2.0			

Cycle Length: 110.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V		90	15	495	155					805	5	85
PHF		0.90	0.90	0.90	0.90					0.90	0.90	0.90
Adj flow		100	17	550	172					894	6	94
No. Lanes	0	2	1	1	2	0	0	0	0	1	1	0
Lane group		T	R	L	T					L	LTR	
Adj flow		100	17	550	172					492	502	
Prop LTs		0.000		1.000	0.000						0.801	
Prop RTs		0.000	1.000		0.000					0.187		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	T	R	L	T			L	LTR
So	1900	1900	1900	1900			1900	1900
Lanes 0	2	1	1	2	0	0	0	0	1	1	0
fW	1.000	1.000	1.000	1.000					1.000	1.000
fHV	1.000	1.000	1.000	1.000					1.000	1.000
fG	1.000	1.000	1.000	1.000					1.000	1.000
fP	1.000	1.000	1.000	1.000					1.000	1.000
fBB	1.000	1.000	1.000	1.000					1.000	1.000
fA	1.000	1.000	1.000	1.000					1.000	1.000
fLU	0.952	1.000	1.000	0.952					1.000	1.000
fRT	1.000	0.850		1.000						0.972
fLT	1.000		0.950	1.000					0.950	0.961
Sec.			0.465							
fLpb	1.000		1.000	1.000					1.000	1.000
fRpb	1.000	1.000		1.000						1.000
S	3618	1615	1805	3618					1805	1775
Sec.			884							

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	100	3618	# 0.03	0.15	559	0.18
Right	R	17	1615	0.01	0.15	250	0.07
Westbound							
Prot		550	1805	# 0.30	0.318	574	0.96
Perm		0	884	0.00	0.182	161	0.00
Left	L	550			0.50	735	0.75
Prot							
Perm							
Thru	T	172	3618	0.05	0.50	1809	0.10
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Southbound							
Prot							
Perm							
Left	L	492	1805	0.27	0.38	689	0.71
Prot							
Perm							
Thru	LTR	502	1775	# 0.28	0.38	678	0.74
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.62
Total lost time per cycle, L = 19.50 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.75

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
T	0.18	0.15	40.4	1.000	559	0.11	0.2	0.0	40.6	D	40.5	D
R	0.07	0.15	39.7	1.000	250	0.11	0.1	0.0	39.8	D		
Westbound												
L	0.75	0.50	20.1	1.000	735	0.30	4.3	0.0	24.4	C		
T	0.10	0.50	14.4	1.000	1809	0.11	0.0	0.0	14.5	B	22.0	C
Northbound												
Southbound												
L	0.71	0.38	28.9	1.000	689	0.28	3.5	0.0	32.4	C		

LTR 0.74 0.38 29.3 1.000 678 0.30 4.3 0.0 33.6 C 33.C C

Intersection delay = 29.2 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach		M		
Cycle length, C 110.0 sec				
Total actual green time for LT lane group, G (s)		55.0		
Effective permitted green time for LT lane group, g(s)		20.0		
Opposing effective green time, go (s)		17.0		
Number of lanes in LT lane group, N		1		
Number of lanes in opposing approach, No		2		
Adjusted LT flow rate, VLT (veh/h)		550		
Proportion of LT in LT lane group, PLT		1.000		
Proportion of LT in opposing flow, PLTo		0.00		
Adjusted opposing flow rate, Vo (veh/h)		100		
Lost time for LT lane group, tL		6.50		
Computation				
LT volume per cycle, LTC=VLTC/3600		16.81		
Opposing lane util. factor, fLUo	0.952	0.952	1.000	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		1.60		
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g		0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.85		
gq, (see Exhibit C16-4,5,6,7,8)		6.50		
gu=g-gq if gq>=gf, or = g-gf if gq<gf		13.50		
n=Max(gq-gf)/2,0)		3.25		
PTHo=1-PLTo		1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00		
EL1 (refer to Exhibit C16-3)		1.45		
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.20		
gdiff=max(gq-gf,0)		0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.47		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.465		

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 110.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000		0.801
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	0.952	0.952	1.000	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 110.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v		550		
v/c ratio from Capacity Worksheet, X		0.75		
Protected phase effective green interval, g (s)		35.0		
Opposing queue effective green interval, gq		6.50		
Unopposed green interval, gu		13.50		
Red time r=(C-g-gq-gu)		55.0		
Arrival rate, qa=v/(3600(max[X,1.0]))		0.15		
Protected ph. departure rate, Sp=s/3600		0.501		
Permitted ph. departure rate, Sa=s(gq+gu)/(gu*3600)		0.36		
XPerm		0.62		
XProt		0.78		
Case		1		
Queue at beginning of green arrow, Qa		8.40		
Queue at beginning of unsaturated green, Qu		0.99		
Residual queue, Qr		0.00		
Uniform Delay, d1		20.1		

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 29.2 sec/veh Intersection LOS C

BACK OF QUEUE WORKSHEET

LaneGroup	Eastbound T	Eastbound R	Westbound L	Westbound T	Northbound	Southbound L	Southbound LTR
Init Queue	0.0	0.0	0.0	0.0		0.0	0.0
Flow Rate	52	17	550	90		492	502
So	1900	1900	1900	1900		1900	1900
No.Lanes	2	1	1	2 0	0 0 0	1	1 0
SL	1900	1615	1470	1900		1805	1775
LnCapacity	293	250	735	950		689	678
Flow Ratio	0.03	0.01	0.37	0.05		0.27	0.28
v/c Ratio	0.18	0.07	0.75	0.09		0.71	0.74
Grn Ratio	0.15	0.15	0.50	0.50		0.38	0.38
I Factor	1.000			1.000			1.000
AT or PVG	3	3	3	3		3	3
Pltn Ratio	1.00	1.00	1.00	1.00		1.00	1.00
PF2	1.00	1.00	1.00	1.00		1.00	1.00
Q1	1.4	0.4	11.0	1.4		12.8	13.2
kB	0.4	0.3	0.6	0.8		0.6	0.6
Q2	0.1	0.0	1.8	0.1		1.5	1.6
Q Average	1.5	0.5	12.8	1.5		14.2	14.9
Q Spacing	25.0	25.0	25.0	25.0		25.0	25.0
Q Storage	0	0	0	0		0	0
Q S Ratio							
70th Percentile Output:							
fB%	1.2	1.2	1.2	1.2		1.2	1.2
BOQ	1.7	0.6	15.0	1.8		16.7	17.4
QSRatio							
85th Percentile Output:							
fB%	1.6	1.6	1.5	1.6		1.5	1.5
BOQ	2.3	0.7	19.2	2.4		21.2	22.0
QSRatio							
90th Percentile Output:							
fB%	1.8	1.8	1.6	1.8		1.6	1.6
BOQ	2.6	0.8	20.6	2.7		22.7	23.6
QSRatio							
95th Percentile Output:							
fB%	2.1	2.1	1.8	2.1		1.8	1.8
BOQ	3.0	1.0	23.0	3.1		25.2	26.2
QSRatio							
98th Percentile Output:							
fB%	2.6	2.7	2.1	2.6		2.0	2.0
BOQ	3.8	1.2	26.6	3.9		29.0	30.0
QSRatio							

ERROR MESSAGES

No errors to report.

HCS2000: Unsignalized Intersections Release 4.1d

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ALL-WAY STOP CONTROL(AWSC) ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/5/2005
Analysis Time Period: am
Intersection: sth 158/western frontage road
Jurisdiction: wisdot
Units: U. S. Customary
Analysis Year: 2017
Project ID: 2017 site + background - no improvements
East/West Street: sth158
North/South Street: western frontage road

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	0	0	0	130	0	1	0	1	110	30	1	0
% Thrus Left Lane												

	Eastbound L1	Eastbound L2	Westbound L1	Westbound L2	Northbound L1	Northbound L2	Southbound L1	Southbound L2
Configuration			LR		TR		LT	
PHF			1.00		1.00		1.00	
Flow Rate			131		111		31	
% Heavy Veh			0		0		0	
No. Lanes			1		1		1	
Opposing-Lanes			0		1		1	
Conflicting-lanes			1		1		1	
Geometry group			1		1		1	

Duration, T 0.25 hrs.

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound L1	Eastbound L2	Westbound L1	Westbound L2	Northbound L1	Northbound L2	Southbound L1	Southbound L2
Flow Rates:								
Total in Lane			131		111		31	
Left-Turn			130		0		30	
Right-Turn			1		110		0	
Prop. Left-Turns			1.0		0.0		1.0	
Prop. Right-Turns			0.0		1.0		0.0	
Prop. Heavy Vehicle			0.0		0.0		0.0	
Geometry Group			1		1		1	
Adjustments Exhibit 17-33:								
hLT-adj			0.2		0.2		0.2	
hRT-adj			-0.6		-0.6		-0.6	
hHV-adj			1.7		1.7		1.7	
hadj, computed			0.2		-0.6		0.2	

Worksheet 4 - Departure Headway and Service Time

	Eastbound L1	Eastbound L2	Westbound L1	Westbound L2	Northbound L1	Northbound L2	Southbound L1	Southbound L2
Flow rate			131		111		31	
hd, initial value	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20
x, initial			0.12		0.10		0.03	
hd, final value			4.38		3.65		4.51	
x, final value			0.16		0.11		0.04	
Move-up time, m			2.0		2.0		2.0	
Service Time			2.4		1.7		2.5	

Worksheet 5 - Capacity and Level of Service

	Eastbound L1	Eastbound L2	Westbound L1	Westbound L2	Northbound L1	Northbound L2	Southbound L1	Southbound L2
Flow Rate			131		111		31	
Service Time			2.4		1.7		2.5	
Utilization, x			0.16		0.11		0.04	
Dep. headway, hd			4.38		3.65		4.51	
Capacity			381		361		281	
Delay			8.21		7.11		7.69	
LOS			A		A		A	
Approach:								
Delay			8.21		7.11		7.69	
LOS			A		A		A	

Intersection Delay 7.71 Intersection LOS A

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ALL-WAY STOP CONTROL(AWSC) ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/5/2005
Analysis Time Period: pm
Intersection: sth 158/western frontage road
Jurisdiction: wisdot
Units: U. S. Customary
Analysis Year: 2017
Project ID: 2017 site + background - no improvements
East/West Street: sth158
North/South Street: western frontage road

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	0	0	0	240	0	1	0	1	85	20	1	0
% Thrus Left Lane												

	Eastbound L1	Eastbound L2	Westbound L1	Westbound L2	Northbound L1	Northbound L2	Southbound L1	Southbound L2
Configuration			LR		TR		LT	
PHF			1.00		1.00		1.00	
Flow Rate			241		86		21	
% Heavy Veh			0		0		0	
No. Lanes			1		1		1	
Opposing-Lanes			0		1		1	
Conflicting-lanes			1		1		1	
Geometry group			1		1		1	

Duration, T 0.25 hrs.

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound L1	Eastbound L2	Westbound L1	Westbound L2	Northbound L1	Northbound L2	Southbound L1	Southbound L2
Flow Rates:								
Total in Lane			241		86		21	
Left-Turn			240		0		20	
Right-Turn			1		85		0	
Prop. Left-Turns			1.0		0.0		1.0	
Prop. Right-Turns			0.0		1.0		0.0	
Prop. Heavy Vehicle			0.0		0.0		0.0	
Geometry Group			1		1		1	
Adjustments Exhibit 17-33:								
hLT-adj			0.2		0.2		0.2	
hRT-adj			-0.6		-0.6		-0.6	
hHV-adj			1.7		1.7		1.7	
hadj, computed			0.2		-0.6		0.2	

Worksheet 4 - Departure Headway and Service Time

	Eastbound L1	Eastbound L2	Westbound L1	Westbound L2	Northbound L1	Northbound L2	Southbound L1	Southbound L2
Flow rate			241		86		21	
hd, initial value	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20
x, initial			0.21		0.08		0.02	
hd, final value			4.33		3.90		4.75	
x, final value			0.29		0.09		0.03	
Move-up time, m			2.0		2.0		2.0	
Service Time			2.3		1.9		2.7	

Worksheet 5 - Capacity and Level of Service

	Eastbound L1	Eastbound L2	Westbound L1	Westbound L2	Northbound L1	Northbound L2	Southbound L1	Southbound L2
Flow Rate			241		86		21	
Service Time			2.3		1.9		2.7	
Utilization, x			0.29		0.09		0.03	
Dep. headway, hd			4.33		3.90		4.75	
Capacity			491		336		271	
Delay			9.08		7.30		7.88	
LOS			A		A		A	
Approach:								
Delay			9.08		7.30		7.88	
LOS			A		A		A	

Intersection Delay 8.57 Intersection LOS A

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ALL-WAY STOP CONTROL(AWSC) ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 11/15/2004
Analysis Time Period: am
Intersection: CTH K/104th
Jurisdiction: Kenosha County
Units: U. S. Customary
Analysis Year: 2017
Project ID: 2017 site+background - no improvements
East/West Street: CTH K
North/South Street: 104th

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	15	185	40	100	130	130	5	225	95	80	320	25
% Thrus Left Lane												

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	LT	R	LTR		L	TR	LT	R
PHF	1.00	1.00	1.00		1.00	1.00	1.00	1.00
Flow Rate	200	40	360		5	320	400	25
% Heavy Veh	0	0	0		0	0	0	0
No. Lanes	2		1		2		2	
Opposing-Lanes	1		2		2		2	
Conflicting-lanes	2		2		2		2	
Geometry group	5		4b		5		5	

Duration, T 0.25 hrs.

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	200	40	360		5	320	400	25
Left-Turn	15	0	100		5	0	80	0
Right-Turn	0	40	130		0	95	0	25
Prop. Left-Turns	0.1	0.0	0.3		1.0	0.0	0.2	0.0
Prop. Right-Turns	0.0	1.0	0.4		0.0	0.3	0.0	1.0
Prop. Heavy Vehicle	0.0	0.0	0.0		0.0	0.0	0.0	0.0
Geometry Group	5		4b		5		5	
Adjustments Exhibit 17-33:								
hLT-adj	0.5		0.2		0.5		0.5	
hRT-adj	-0.7		-0.6		-0.7		-0.7	
hHV-adj	1.7		1.7		1.7		1.7	
hadj, computed	0.0	-0.7	-0.2		0.5	-0.2	0.1	-0.7

Worksheet 4 - Departure Headway and Service Time

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow rate	200	40	360		5	320	400	25
hd, initial value	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20
x, initial	0.18	0.04	0.32		0.00	0.28	0.36	0.02
hd, final value	8.47	7.72	7.73		8.57	7.84	7.87	7.05
x, final value	0.47	0.09	0.77		0.01	0.70	0.87	0.05
Move-up time, m	2.3		2.3		2.3		2.3	
Service Time	6.2	5.4	5.4		6.3	5.5	5.6	4.7

Worksheet 5 - Capacity and Level of Service

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rate	200	40	360		5	320	400	25
Service Time	6.2	5.4	5.4		6.3	5.5	5.6	4.7
Utilization, x	0.47	0.09	0.77		0.01	0.70	0.87	0.05
Dep. headway, hd	8.47	7.72	7.73		8.57	7.84	7.87	7.05
Capacity	387	290	448		255	436	449	275
Delay	18.48	11.14	32.17		11.37	26.64	44.74	10.11
LOS	C	B	D		B	D	E	B
Approach:								
Delay	17.26		32.17		26.40		42.71	
LOS	C		D		D		E	

Intersection Delay 31.45 Intersection LOS D

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ALL-WAY STOP CONTROL(AWSC) ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 11/15/2004
Analysis Time Period: pm
Intersection: CTH K/104th
Jurisdiction: Kenosha County
Units: U. S. Customary
Analysis Year: 2017
Project ID: 2017 site+background - no improvements
East/West Street: CTH K
North/South Street: 104th

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	15	250	25	90	205	170	20	290	110	160	265	30

% Thrus Left Lane

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	LT	R	LTR		L	TR	LT	R
PHF	1.00	1.00	1.00		1.00	1.00	1.00	1.00
Flow Rate	265	25	465		20	400	425	30
% Heavy Veh	0	0	0		0	0	0	0
No. Lanes	2		1		2		2	
Opposing-Lanes	1		2		2		2	
Conflicting-lanes	2		2		2		2	
Geometry group	5		4b		5		5	

Duration, T 0.25 hrs.

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	265	25	465		20	400	425	30
Left-Turn	15	0	90		20	0	160	0
Right-Turn	0	25	170		0	110	0	30
Prop. Left-Turns	0.1	0.0	0.2		1.0	0.0	0.4	0.0
Prop. Right-Turns	0.0	1.0	0.4		0.0	0.3	0.0	1.0
Prop. Heavy Vehicle	0.0	0.0	0.0		0.0	0.0	0.0	0.0
Geometry Group	5		4b		5		5	
Adjustments Exhibit 17-33:								
hLT-adj	0.5		0.2		0.5		0.5	
hRT-adj	-0.7		-0.6		-0.7		-0.7	
hHV-adj	1.7		1.7		1.7		1.7	
hadj, computed	0.0	-0.7	-0.2		0.5	-0.2	0.2	-0.7

Worksheet 4 - Departure Headway and Service Time

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow rate	265	25	465		20	400	425	30
hd, initial value	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20
x, initial	0.24	0.02	0.41		0.02	0.36	0.38	0.03
hd, final value	9.81	9.05	8.95		9.80	9.07	9.47	8.54
x, final value	0.72	0.06	1.16		0.05	1.01	1.12	0.07
Move-up time, m	2.3		2.3		2.3		2.3	
Service Time	7.5	6.8	6.7		7.5	6.8	7.2	6.2

Worksheet 5 - Capacity and Level of Service

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rate	265	25	465		20	400	425	30
Service Time	7.5	6.8	6.7		7.5	6.8	7.2	6.2
Utilization, x	0.72	0.06	1.16		0.05	1.01	1.12	0.07
Dep. headway, hd	9.81	9.05	8.95		9.80	9.07	9.47	8.54
Capacity	367	275	465		270	400	425	280
Delay	34.26	12.36	123.53		13.06	77.81	112.74	11.89
LOS	D	B	F		B	F	F	B
Approach:								
Delay	32.37		123.53		74.73		106.09	
LOS	D		F		F		F	

Intersection Delay 89.87 Intersection LOS F

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ALL-WAY STOP CONTROL(AWSC) ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/4/2005
Analysis Time Period: am
Intersection: cth k/eastern frontage road
Jurisdiction: kenosha county
Units: U. S. Customary
Analysis Year: 2007
Project ID: 2017 site+background - no improvements
East/West Street: cth k
North/South Street: eastern frontage road

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	15	145	30	50	105	5	5	95	95	1	1	1
% Thrus Left Lane												

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	LTR		LTR		LTR		LTR	
PHF	1.00		1.00		1.00		1.00	
Flow Rate	190		160		195		3	
% Heavy Veh	0		0		0		0	
No. Lanes	1		1		1		1	
Opposing-Lanes	1		1		1		1	
Conflicting-lanes	1		1		1		1	
Geometry group	1		1		1		1	

Duration, T 0.25 hrs.

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	190		160		195		3	
Left-Turn	15		50		5		1	
Right-Turn	30		5		95		1	
Prop. Left-Turns	0.1		0.3		0.0		0.3	
Prop. Right-Turns	0.2		0.0		0.5		0.3	
Prop. Heavy Vehicle	0.0		0.0		0.0		0.0	
Geometry Group	1		1		1		1	
Adjustments Exhibit 17-33:								
hLT-adj	0.2		0.2		0.2		0.2	
hRT-adj	-0.6		-0.6		-0.6		-0.6	
hHV-adj	1.7		1.7		1.7		1.7	
hadj, computed	-0.1		0.0		-0.3		-0.1	

Worksheet 4 - Departure Headway and Service Time

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow rate	190		160		195		3	
hd, initial value	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20
x, initial	0.17		0.14		0.17		0.00	
hd, final value	4.49		4.64		4.44		4.85	
x, final value	0.24		0.21		0.24		0.00	
Move-up time, m	2.0		2.0		2.0		2.0	
Service Time	2.5		2.6		2.4		2.8	

Worksheet 5 - Capacity and Level of Service

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rate	190		160		195		3	
Service Time	2.5		2.6		2.4		2.8	
Utilization, x	0.24		0.21		0.24		0.00	
Dep. headway, hd	4.49		4.64		4.44		4.85	
Capacity	440		410		445		253	
Delay	8.87		8.84		8.84		7.87	
LOS	A		A		A		A	
Approach:								
Delay	8.87		8.84		8.84		7.87	
LOS	A		A		A		A	

Intersection Delay 8.85 Intersection LOS A

HCS2000: Unsignalized Intersections Release 4.1d

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ALL-WAY STOP CONTROL(AWSC) ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/4/2005
Analysis Time Period: pm
Intersection: cth k/eastern frontage road
Jurisdiction: kenosha county
Units: U. S. Customary
Analysis Year: 2007
Project ID: 2017 site+background - no improvements
East/West Street: cth k
North/South Street: eastern frontage road

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	30	170	70	70	160	25	20	140	105	10	5	10

% Thrus Left Lane

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	LTR		LTR		LTR		LTR	
PHF	1.00		1.00		1.00		1.00	
Flow Rate	270		255		265		25	
% Heavy Veh	0		0		0		0	
No. Lanes	1		1		1		1	
Opposing-Lanes	1		1		1		1	
Conflicting-lanes	1		1		1		1	
Geometry group	1		1		1		1	

Duration, T 0.25 hrs.

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	270		255		265		25	
Left-Turn	30		70		20		10	
Right-Turn	70		25		105		10	
Prop. Left-Turns	0.1		0.3		0.1		0.4	
Prop. Right-Turns	0.3		0.1		0.4		0.4	
Prop. Heavy Vehicle	0.0		0.0		0.0		0.0	
Geometry Group	1		1		1		1	
Adjustments Exhibit 17-33:								
hLT-adj	0.2		0.2		0.2		0.2	
hRT-adj	-0.6		-0.6		-0.6		-0.6	
hHV-adj	1.7		1.7		1.7		1.7	
hadj, computed	-0.1		-0.0		-0.2		-0.2	

Worksheet 4 - Departure Headway and Service Time

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow rate	270		255		265		25	
hd, initial value	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20
x, initial	0.24		0.23		0.24		0.02	
hd, final value	4.92		5.06		5.04		5.53	
x, final value	0.37		0.36		0.37		0.04	
Move-up time, m	2.0		2.0		2.0		2.0	
Service Time	2.9		3.1		3.0		3.5	

Worksheet 5 - Capacity and Level of Service

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rate	270		255		265		25	
Service Time	2.9		3.1		3.0		3.5	
Utilization, x	0.37		0.36		0.37		0.04	
Dep. headway, hd	4.92		5.06		5.04		5.53	
Capacity	520		505		515		275	
Delay	10.76		10.85		10.99		8.75	
LOS	B		B		B		A	
Approach:								
Delay	10.76		10.85		10.99		8.75	
LOS	B		B		B		A	

Intersection Delay 10.80 Intersection LOS B

2017 TOTAL TRAFFIC CAPACITY ANALYSIS – WITH IMPROVEMENTS

HCS2000: Signalized Intersections Release 4.1e

Analyst: md
Agency:
Date: 1/4/2005
Period: am
Project ID: 2017 total traffic - with improvements
E/W St: sth 158

Inter.: sth 158/cth h
Area Type: All other areas
Jurisd: wisdot
Year : 2017
N/S St: cth h

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	2	1	1	2	0	0	1	0	0	1	1
LGConfig	L	T	R	L	TR			LTR			LT	R
Volume	100	800	135	75	925	30	5	185	75	65	305	125
Lane Width	12.0	12.0	12.0	12.0	12.0			12.0			12.0	12.0
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A	A			NB Left		A		
Thru		A			Thru		A		
Right		A			Right		A		
Peds					Peds				
WB Left	A	A			SB Left	A	A		
Thru		A			Thru	A	A		
Right		A			Right	A	A		
Peds					Peds				
NB Right					EB Right				
SB Right	A				WB Right				
Green	5.0	39.0				10.0	28.0		
Yellow	3.0	4.5				3.0	4.5		
All Red	0.0	1.5				0.0	1.5		

Cycle Length: 100.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	162	1752	0.70	0.47	33.0	C		
T	1314	3370	0.69	0.39	27.1	C	26.8	C
R	630	1615	0.24	0.39	20.8	C		
Westbound								
L	204	1752	0.42	0.47	19.0	B		
TR	1314	3368	0.83	0.39	31.9	C	31.0	C
Northbound								
LTR	497	1776	0.61	0.28	33.3	C	33.3	C
Southbound								
LT	527	1783	0.80	0.41	34.4	C	28.9	C
R	808	1553	0.18	0.52	12.8	B		

Intersection Delay = 29.3 (sec/veh) Intersection LOS = C

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/4/2005
Analysis Time Period: am
Intersection: sth 158/cth h
Area Type: All other areas
Jurisdiction: wisdot
Analysis Year: 2017
Project ID: 2017 total traffic - with improvements
East/West Street: sth 158 North/South Street: cth h

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	100	800	135	75	925	30	5	185	75	65	305	125
% Heavy Veh	3	13	0	3	7	4	20	1	3	4	6	4
PHF	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
PK 15 Vol	28	227	38	21	263	9	2	53	21	18	87	36
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	2000	1900	1900	1900			1900			1900	1900
ParkExist												
NumPark												
No. Lanes	1	2	1	1	2	0	0	1	0	0	1	1
LGConfig	L	T	R	L	TR			LTR			LT	R
Lane Width	12.0	12.0	12.0	12.0	12.0			12.0			12.0	12.0
RTOR Vol						0			0			0
Adj Flow	114	909	153	85	1085			301			421	142
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000			0.020			0.176	
Prop RTs		0.000	1.000		0.031		0.282			0.000	1.000	
Peds Bikes		0			0		0			0		
Buses	0	0	0	0	0			0			0	0
%InProtPhase	0.0			0.0						0.0		

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0	0.0	0.0	0.0			0.0			0.0	0.0
Arriv. Type	3	3	3	3	3			3			3	3
Unit Ext.	3.0	3.0	3.0	3.0	3.0			3.0			3.0	3.0
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0	2.0	2.0	2.0			2.0			2.0	2.0
Ext of g	2.0	2.0	2.0	2.0	2.0			2.0			2.0	2.0
Ped Min g	3.2			3.2			3.2			3.2		

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A	A			NB Left		A		
Thru		A			Thru		A		
Right		A			Right		A		
Peds					Peds				
WB Left	A	A			SB Left	A	A		
Thru		A			Thru	A	A		
Right		A			Right	A	A		
Peds					Peds				
NB Right					EB Right				
SB Right	A				WB Right				
Green	5.0	39.0				10.0	28.0		
Yellow	3.0	4.5				3.0	4.5		
All Red	0.0	1.5				0.0	1.5		

Cycle Length: 100.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	100	800	135	75	925	30	5	185	75	65	305	125
PHF	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Adj flow	114	909	153	85	1051	34	6	210	85	74	347	142
No. Lanes	1	2	1	1	2	0	0	1	0	0	1	1
Lane group	L	T	R	L	TR			LTR			LT	R
Adj flow	114	909	153	85	1085			301			421	142
Prop LTs	1.000	0.000		1.000	0.000			0.020			0.176	
Prop RTs		0.000	1.000		0.031		0.282			0.000	1.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L	T	R	L	TR			LTR			LT	R
So	1900	2000	1900	1900	1900			1900			1900	1900
Lanes	1	2	1	1	2	0	0	1	0	0	1	1
fW	1.000	1.000	1.000	1.000	1.000			1.000			1.000	1.000
fHV	0.971	0.885	1.000	0.971	0.935			0.981			0.947	0.962
fG	1.000	1.000	1.000	1.000	1.000			1.000			1.000	1.000
fP	1.000	1.000	1.000	1.000	1.000			1.000			1.000	1.000
fBB	1.000	1.000	1.000	1.000	1.000			1.000			1.000	1.000
fA	1.000	1.000	1.000	1.000	1.000			1.000			1.000	1.000
fLU	1.000	0.952	1.000	1.000	0.952			1.000			1.000	1.000
fRT		1.000	0.850		0.995			0.962			1.000	0.850
fLT	0.950	1.000		0.950	1.000			0.991			0.991	
Sec.	0.095			0.150							0.626	
fLpb	1.000	1.000		1.000	1.000			1.000			1.000	
fRpb		1.000	1.000		1.000			1.000			1.000	1.000
S	1752	3370	1615	1752	3368			1776			1783	1553
Sec.	176			276							1126	

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		88	1752	# 0.05	0.050	88	1.00
Perm		26	176	0.15	0.420	74	0.35
Left	L	114			0.47	162	0.70
Prot							
Perm							
Thru	T	909	3370	0.27	0.39	1314	0.69
Right	R	153	1615	0.09	0.39	630	0.24
Westbound							
Prot		85	1752	0.05	0.050	88	0.97
Perm		0	276	0.00	0.420	116	0.00
Left	L	85			0.47	204	0.42
Prot							
Perm							
Thru	TR	1085	3368	# 0.32	0.39	1314	0.83
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	301	1776	0.17	0.28	497	0.61
Right							
Southbound							
Prot							
Perm							
Left							
Prot		178	1783	# 0.10	0.100	178	1.00
Perm		243	1126	# 0.22	0.310	349	0.70
Thru	LT	421			0.41	527	0.80
Right	R	142	1553	0.09	0.52	808	0.18

Sum of flow ratios for critical lane groups, Yc = Sum (V/s) = 0.69
Total lost time per cycle, L = 18.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.84

Control Delay and LOS Determination

Appr/ Lane Grp	v/c	g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	0.70	0.47	20.1	1.000	162	0.27	12.9	0.0	33.0	C		
T	0.69	0.39	25.5	1.000	1314	0.26	1.6	0.0	27.1	C	26.8	C
R	0.24	0.39	20.6	1.000	630	0.11	0.2	0.0	20.8	C		
Westbound												
L	0.42	0.47	17.6	1.000	204	0.11	1.4	0.0	19.0	B		
TR	0.83	0.39	27.4	1.000	1314	0.36	4.5	0.0	31.9	C	31.0	C
Northbound												
LTR	0.61	0.28	31.2	1.000	497	0.19	2.1	0.0	33.3	C	33.3	C
Southbound												

LT	0.80	0.41	25.9	1.000	527	0.34	8.5	0.0	34.4	C	28.9	C
R	0.18	0.52	12.7	1.000	808	0.11	0.1	0.0	12.8	B		

Intersection delay = 29.3 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M		
Cycle length, C 100.0 sec				
Total actual green time for LT lane group, G (s)	47.0	47.0		
Effective permitted green time for LT lane group, g(s)	42.0	42.0		
Opposing effective green time, go (s)	39.0	39.0		
Number of lanes in LT lane group, N	1	1		
Number of lanes in opposing approach, No	2	2		
Adjusted LT flow rate, VLT (veh/h)	114	85		
Proportion of LT in LT lane group, PLT	1.000	1.000		
Proportion of LT in opposing flow, PLTo	0.00	0.00		
Adjusted opposing flow rate, Vo (veh/h)	1085	909		
Lost time for LT lane group, tL	6.00	6.00		
Computation				
LT volume per cycle, LTC=VLTC/3600	3.17	2.36		
Opposing lane util. factor, fLUo	0.952	0.952	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	15.83	13.26		
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g	0.0	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.61	0.61		
gq, (see Exhibit C16-4,5,6,7,8)	28.26	22.02		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	13.74	19.98		
n=Max(gq-gf)/2,0)	14.13	11.01		
PTHo=1-PLTo	1.00	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00		
EL1 (refer to Exhibit C16-3)	3.99	3.18		
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.10	0.10		
gdiff=max(gq-gf,0)	0.00	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.10	0.15		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.095	0.150		

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach			M	S
Cycle length, C 100.0 sec				
Total actual green time for LT lane group, G (s)			28.0	41.0
Effective permitted green time for LT lane group, g(s)			28.0	31.0
Opposing effective green time, go (s)			41.0	28.0
Number of lanes in LT lane group, N			1	1
Number of lanes in opposing approach, No			1	1
Adjusted LT flow rate, VLT (veh/h)			6	74
Proportion of LT in LT lane group, PLT	0.000	0.000	0.020	0.176
Proportion of LT in opposing flow, PLTo			0.18	0.02
Adjusted opposing flow rate, Vo (veh/h)			421	301
Lost time for LT lane group, tL			6.00	6.00
Computation				
LT volume per cycle, LTC=VLTC/3600			0.17	2.06
Opposing lane util. factor, fLUo	0.952	0.952	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			11.69	8.36
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g			15.9	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.59	0.72
gq, (see Exhibit C16-4,5,6,7,8)			0.00	17.59
gu=g-gq if gq>=gf, or = g-gf if gq<gf			12.06	13.41
n=Max(gq-gf)/2,0)			0.00	8.80
PTHo=1-PLTo			0.82	0.98
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			0.02	0.18
EL1 (refer to Exhibit C16-3)			2.13	1.88
EL2=Max((1-Ptho**n)/Plto, 1.0)			1.00	8.14
fmin=2(1+PL)/g or fmin=2(1+Pl)/g			0.07	0.08
gdiff=max(gq-gf,0)			0.00	17.59
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.99	0.63
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.991	0.626

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 100.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v	114	85		
v/c ratio from Capacity Worksheet, X	0.70	0.42		
Protected phase effective green interval, g (s)	5.0	5.0		
Opposing queue effective green interval, gq	28.26	22.02		
Unopposed green interval, gu	13.74	19.98		
Red time r=(C-g-gq-gu)	53.0	53.0		
Arrival rate, qa=v/(3600(max(X,1.0)))	0.03	0.02		
Protected ph. departure rate, Sp=s/3600	0.487	0.487		
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.15	0.16		
XPerm	0.65	0.31		
XProt	0.75	0.56		
Case	1	1		
Queue at beginning of green arrow, Qa	1.68	1.25		
Queue at beginning of unsaturated green, Qu	0.89	0.52		
Residual queue, Qr	0.00	0.00		
Uniform Delay, d1	20.1	17.6		

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Dur. Unmet Demand Q veh	Initial Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 29.3 sec/veh Intersection LOS C

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	T	R	L	TR		LTR			LT	R	
Init Queue	0.0	0.0	0.0	0.0	0.0		0.0			0.0	0.0	
Flow Rate	114	477	153	85	569		301			421	142	
So	1900	2000	1900	1900	1900		1900			1900	1900	
No.Lanes	1	2	1	1	2	0	0	1	0	0	1	1
SL	344	1769	1615	433	1768		1776			1286	1553	
LnCapacity	162	690	630	204	690		497			527	808	
Flow Ratio	0.33	0.27	0.09	0.20	0.32		0.17			0.33	0.09	
v/c Ratio	0.70	0.69	0.24	0.42	0.82		0.61			0.80	0.18	
Grn Ratio	0.47	0.39	0.39	0.47	0.39		0.28			0.41	0.52	
I Factor		1.000			1.000		1.000			1.000		
AT or PVG	3	3	3	3	3		3			3	3	
Pltn Ratio	1.00	1.00	1.00	1.00	1.00		1.00			1.00	1.00	
PF2	1.00	1.00	1.00	1.00	1.00		1.00			1.00	1.00	
Q1	1.7	11.1	2.9	1.3	14.2		7.2			7.5	2.1	
kB	0.2	0.6	0.6	0.3	0.6		0.5			0.5	0.6	
Q2	0.5	1.3	0.2	0.2	2.4		0.7			1.8	0.1	
Q Average	2.3	12.3	3.0	1.5	16.6		8.0			9.3	2.2	
Q Spacing	25.0	25.0	25.0	25.0	25.0		25.0			25.0	25.0	
Q Storage	0	0	0	0	0		0			0	0	
Q S Ratio												
70th Percentile Output:												
fB%	1.2	1.2	1.2	1.2	1.2		1.2			1.2	1.2	
BOQ	2.7	14.5	3.6	1.8	19.4		9.4			10.9	2.7	
QSRatio												
85th Percentile Output:												
fB%	1.6	1.5	1.6	1.6	1.5		1.5			1.5	1.6	
BOQ	3.6	18.5	4.8	2.3	24.4		12.2			14.1	3.5	
QSRatio												
90th Percentile Output:												
fB%	1.8	1.6	1.7	1.8	1.6		1.7			1.7	1.8	
BOQ	4.0	19.9	5.3	2.6	26.1		13.3			15.3	3.9	
QSRatio												
95th Percentile Output:												
fB%	2.0	1.8	2.0	2.1	1.7		1.9			1.9	2.0	
BOQ	4.6	22.2	6.1	3.0	28.9		15.0			17.2	4.5	
QSRatio												
98th Percentile Output:												
fB%	2.5	2.1	2.5	2.6	2.0		2.2			2.2	2.5	
BOQ	5.8	25.7	7.6	3.8	32.8		17.9			20.3	5.6	
QSRatio												

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: md
Agency:
Date: 1/4/2005
Period: pm
Project ID: 2017 total traffic - with improvements
E/W St: sth 158

Inter.: sth 158/cth h
Area Type: All other areas
Jurisd: wisdot
Year : 2017
N/S St: cth h

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	2	1	1	2	0	0	1	0	0	1	1
LGConfig	L	T	R	L	TR			LTR			LT	R
Volume	210	1110	170	45	800	70	10	365	60	65	325	80
Lane Width	12.0	12.0	12.0	12.0	12.0			12.0			12.0	12.0
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A	A	A		NB Left		A		
Thru		A	A		Thru		A		
Right		A	A		Right		A		
Peds					Peds				
WB Left	A		A		SB Left	A	A		
Thru			A		Thru	A	A		
Right			A		Right	A	A		
Peds					Peds				
NB Right					EB Right				
SB Right	A	A			WB Right				
Green	5.0	7.0	33.0			10.0	34.0		
Yellow	3.0	3.0	4.5			3.0	4.5		
All Red	0.0	0.0	1.5			0.0	1.5		

Cycle Length: 110.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	315	1805	0.76	0.46	36.3	D		
T	1418	3627	0.89	0.39	38.6	D	36.6	D
R	631	1615	0.31	0.39	23.5	C		
Westbound								
L	151	1805	0.34	0.35	27.6	C		
TR	1043	3478	0.95	0.30	54.5	D	53.2	D
Northbound								
LTR	555	1796	0.89	0.31	52.6	D	52.6	D
Southbound								
LT	477	1847	0.93	0.43	54.6	D	46.8	D
R	899	1455	0.10	0.62	8.6	A		

Intersection Delay = 44.7 (sec/veh) Intersection LOS = D

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/4/2005
Analysis Time Period: pm
Intersection: sth 158/cth h
Area Type: All other areas
Jurisdiction: wisdot
Analysis Year: 2017
Project ID: 2017 total traffic - with improvements
East/West Street: sth 158 North/South Street: cth h

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	210	1110	170	45	800	70	10	365	60	65	325	80
% Heavy Veh	0	5	0	0	3	0	10	2	4	2	2	11
PHF	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
PK 15 Vol	60	315	48	13	227	20	3	104	17	18	92	23
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	2000	1900	1900	1900			1900			1900	1900
ParkExist												
NumPark												
No. Lanes	1	2	1	1	2	0	0	1	0	0	1	1
LGConfig	L	T	R	L	TR			LTR			LT	R
Lane Width	12.0	12.0	12.0	12.0	12.0			12.0			12.0	12.0
RTOR Vol						0			0			0
Adj Flow	239	1261	193	51	989			494			443	91
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000			0.022			0.167	
Prop RTs		0.000	1.000		0.081		0.138			0.000	1.000	
Peds Bikes	0			0			0			0		
Buses	0	0	0	0	0		0			0	0	
%InProtPhase	0.0			0.0						0.0		

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0	0.0	0.0	0.0			0.0			0.0	0.0
Arriv. Type	3	3	3	3	3			3			3	3
Unit Ext.	3.0	3.0	3.0	3.0	3.0			3.0			3.0	3.0
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0	2.0	2.0	2.0			2.0			2.0	2.0
Ext of g	2.0	2.0	2.0	2.0	2.0			2.0			2.0	2.0

Ped Min g	3.2		3.2		3.2		3.2	

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A	A	A		NB Left		A		
Thru		A	A		Thru		A		
Right		A	A		Right		A		
Peds					Peds				
WB Left	A		A		SB Left	A	A		
Thru			A		Thru	A	A		
Right			A		Right	A	A		
Peds					Peds				
NB Right					EB Right				
SB Right	A	A			WB Right				
Green	5.0	7.0	33.0			10.0	34.0		
Yellow	3.0	3.0	4.5			3.0	4.5		
All Red	0.0	0.0	1.5			0.0	1.5		

Cycle Length: 110.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	210	1110	170	45	800	70	10	365	60	65	325	80
PHF	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Adj flow	239	1261	193	51	989	80	11	415	68	74	369	91
No. Lanes	1	2	1	1	2	0	0	1	0	0	1	1
Lane group	L	T	R	L	TR			LTR			LT	R
Adj flow	239	1261	193	51	989			494			443	91
Prop LTs	1.000	0.000		1.000	0.000			0.022			0.167	
Prop RTs		0.000	1.000		0.081		0.138			0.000	1.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L	T	R	L	TR		LTR			LT	R	
So	1900	2000	1900	1900	1900		1900			1900	1900	
Lanes	1	2	1	1	2	0	0	1	0	0	1	1
fW	1.000	1.000	1.000	1.000	1.000			1.000			1.000	1.000
fHV	1.000	0.952	1.000	1.000	0.973			0.976			0.980	0.901
fG	1.000	1.000	1.000	1.000	1.000			1.000			1.000	1.000
fP	1.000	1.000	1.000	1.000	1.000			1.000			1.000	1.000
fBB	1.000	1.000	1.000	1.000	1.000			1.000			1.000	1.000
fA	1.000	1.000	1.000	1.000	1.000			1.000			1.000	1.000
fLU	1.000	0.952	1.000	1.000	0.952			1.000			1.000	1.000
fRT		1.000	0.850		0.988			0.981			1.000	0.850
fLT	0.950	1.000		0.950	1.000			0.987			0.992	
Sec.	0.111			0.121							0.494	
fLpb	1.000	1.000		1.000	1.000			1.000			1.000	
fRpb		1.000	1.000		1.000			1.000			1.000	1.000
S	1805	3627	1615	1805	3478			1796			1847	1455
Sec.	211			230							920	

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		239	1805	# 0.13	0.136	246	0.97
Perm		0	211	0.00	0.327	69	0.00
Left	L	239			0.46	315	0.76
Prot							
Perm							
Thru	T	1261	3627	0.35	0.39	1418	0.89
Right	R	193	1615	0.12	0.39	631	0.31
Westbound							
Prot		51	1805	0.03	0.045	82	0.62
Perm		0	230	0.00	0.300	69	0.00
Left	L	51			0.35	151	0.34
Prot							
Perm							
Thru	TR	989	3478	# 0.28	0.30	1043	0.95
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	494	1796	0.28	0.31	555	0.89
Right							
Southbound							
Prot							
Perm							
Left							
Prot		168	1847	# 0.09	0.091	168	1.00
Perm		275	920	# 0.30	0.336	309	0.89
Thru	LT	443			0.43	477	0.93
Right	R	91	1455	0.06	0.62	899	0.10

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.81
Total lost time per cycle, L = 18.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.96

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	0.76	0.46	26.1	1.000	315	0.31	10.2	0.0	36.3	D		
T	0.89	0.39	31.3	1.000	1418	0.41	7.4	0.0	38.6	D	36.6	D
R	0.31	0.39	23.2	1.000	631	0.11	0.3	0.0	23.5	C		
Westbound												
L	0.34	0.35	26.2	1.000	151	0.11	1.3	0.0	27.6	C		
TR	0.95	0.30	37.7	1.000	1043	0.46	16.9	0.0	54.5	D	53.2	D
Northbound												
LTR	0.89	0.31	36.2	1.000	555	0.41	16.4	0.0	52.6	D	52.6	D
Southbound												

LT	0.93	0.43	29.9	1.000	477	0.44	24.7	0.0	54.6	D	46.8	D
R	0.10	0.62	8.6	1.000	899	0.11	0.0	0.0	8.6	A		

Intersection delay = 44.7 (sec/veh) Intersection LOS = D

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M		
Cycle length, C 110.0 sec				
Total actual green time for LT lane group, G (s)	51.0	38.0		
Effective permitted green time for LT lane group, g(s)	36.0	33.0		
Opposing effective green time, go (s)	33.0	43.0		
Number of lanes in LT lane group, N	1	1		
Number of lanes in opposing approach, No	2	2		
Adjusted LT flow rate, VLT (veh/h)	239	51		
Proportion of LT in LT lane group, PLT	1.000	1.000		
Proportion of LT in opposing flow, PLTo	0.00	0.00		
Adjusted opposing flow rate, Vo (veh/h)	989	1261		
Lost time for LT lane group, tL	6.00	9.00		
Computation				
LT volume per cycle, LTC=VLTC/3600	7.30	1.56		
Opposing lane util. factor, fLUo	0.952	0.952	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	15.87	20.24		
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g	0.0	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.70	0.61		
gq, (see Exhibit C16-4,5,6,7,8)	31.23	20.00		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	4.77	13.00		
n=Max(gq-gf)/2,0)	15.62	10.00		
PTHo=1-PLTo	1.00	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00		
EL1 (refer to Exhibit C16-3)	3.63	4.52		
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.11	0.12		
gdiff=max(gq-gf,0)	0.00	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.11	0.12		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.111	0.121		

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach			N	S
Cycle length, C 110.0 sec				
Total actual green time for LT lane group, G (s)			34.0	47.0
Effective permitted green time for LT lane group, g(s)			34.0	37.0
Opposing effective green time, go (s)			47.0	34.0
Number of lanes in LT lane group, N			1	1
Number of lanes in opposing approach, No			1	1
Adjusted LT flow rate, VLT (veh/h)			11	74
Proportion of LT in LT lane group, PLT	0.000	0.000	0.022	0.167
Proportion of LT in opposing flow, PLTo			0.17	0.02
Adjusted opposing flow rate, Vo (veh/h)			443	494
Lost time for LT lane group, tL			6.00	6.00
Computation				
LT volume per cycle, LTC=VLTC/3600			0.34	2.26
Opposing lane util. factor, fLUo	0.952	0.952	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			13.54	15.09
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g			16.7	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.57	0.69
gq, (see Exhibit C16-4,5,6,7,8)			0.92	26.42
gu=g-gq if gq>=gf, or = g-gf if gq<gf			17.29	10.58
n=Max(gq-gf)/2,0)			0.00	13.21
PTHo=1-PLTo			0.83	0.98
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			0.02	0.17
EL1 (refer to Exhibit C16-3)			2.17	2.29
EL2=Max((1-Ptho**n)/Plto, 1.0)			1.00	11.55
fmin=2(1+PL)/g or fmin=2(1+Pl)/g			0.06	0.06
gdiff=max(gq-gf,0)			0.00	26.42
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.99	0.49
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.987	0.494

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 110.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v	239	51		
v/c ratio from Capacity Worksheet, X	0.76	0.34		
Protected phase effective green interval, g (s)	15.0	5.0		
Opposing queue effective green interval, gq	31.23	20.00		
Unopposed green interval, gu	4.77	13.00		
Red time r=(C-g-gq-gu)	59.0	72.0		
Arrival rate, qa=v/(3600(max[X,1.0]))	0.07	0.01		
Protected ph. departure rate, Sp=s/3600	0.501	0.501		
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.44	0.16		
XPerm	1.13	0.22		
XProt	0.65	0.44		
Case	3	1		
Queue at beginning of green arrow, Qa	4.20	1.02		
Queue at beginning of unsaturated green, Qu	2.07	0.28		
Residual queue, Qr	0.28	0.00		
Uniform Delay, d1	26.1	26.2		

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Dur. Unmet Demand Q veh	Unmet Demand t hrs.	Uniform Delay Unadj. ds	Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Lane Queue Delay d3 sec	Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 44.7 sec/veh Intersection LOS D

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	T	R	L	TR		LTR			LT	R	
Init Queue	0.0	0.0	0.0	0.0	0.0		0.0			0.0	0.0	
Flow Rate	239	662	193	51	519		494			443	91	
So	1900	2000	1900	1900	1900		1900			1900	1900	
No.Lanes	1	2	1	1	2	0	0	1	0	0	1	1
SL	680	1904	1615	437	1826		1796			1117	1455	
LnCapacity	315	744	631	151	547		555			477	899	
Flow Ratio	0.35	0.35	0.12	0.12	0.28		0.28			0.40	0.06	
v/c Ratio	0.76	0.89	0.31	0.34	0.95		0.89			0.93	0.10	
Grn Ratio	0.46	0.39	0.39	0.35	0.30		0.31			0.43	0.62	
I Factor		1.000			1.000		1.000			1.000		
AT or PVG	3	3	3	3	3		3			3	3	
Pltn Ratio	1.00	1.00	1.00	1.00	1.00		1.00			1.00	1.00	
PF2	1.00	1.00	1.00	1.00	1.00		1.00			1.00	1.00	
Q1	4.4	18.9	4.1	1.0	15.5		14.4			8.5	1.1	
kB	0.4	0.7	0.6	0.3	0.5		0.5			0.5	0.7	
Q2	1.1	3.8	0.3	0.1	4.4		3.1			3.5	0.1	
Q Average	5.5	22.7	4.3	1.2	20.0		17.5			12.0	1.2	
Q Spacing	25.0	25.0	25.0	25.0	25.0		25.0			25.0	25.0	
Q Storage	0	0	0	0	0		0			0	0	
Q S Ratio												
70th Percentile Output:												
fB%	1.2	1.2	1.2	1.2	1.2		1.2			1.2	1.2	
BOQ	6.5	26.3	5.2	1.4	23.2		20.4			14.1	1.5	
QSRatio												
85th Percentile Output:												
fB%	1.6	1.4	1.6	1.6	1.5		1.5			1.5	1.6	
BOQ	8.5	32.7	6.8	1.8	29.0		25.7			18.0	1.9	
QSRatio												
90th Percentile Output:												
fB%	1.7	1.5	1.7	1.8	1.5		1.6			1.6	1.8	
BOQ	9.3	34.7	7.5	2.1	30.9		27.5			19.5	2.2	
QSRatio												
95th Percentile Output:												
fB%	1.9	1.7	2.0	2.1	1.7		1.7			1.8	2.1	
BOQ	10.6	37.9	8.6	2.4	33.9		30.3			21.7	2.5	
QSRatio												
98th Percentile Output:												
fB%	2.4	1.9	2.4	2.6	1.9		2.0			2.1	2.6	
BOQ	12.9	42.6	10.5	3.0	38.2		34.3			25.2	3.2	
QSRatio												

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: md
Agency:
Date: 1/10/2005
Period: am
Project ID: 2017 total traffic - with improvements
E/W St: STH 158

Inter.: STH 158/104th
Area Type: All other areas
Jurisd: WisDOT
Year : 2017
N/S St: 104th Ave

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	2	1	1	2	1	1	1	1	1	1	0
LGConfig	L	T	R	L	T	R	L	LT	R	L	TR	
Volume	5	815	265	210	780	5	610	5	430	5	10	5
Lane Width	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A		A		NB Left	A			
Thru			A		Thru	A			
Right			A		Right	A			
Peds					Peds				
WB Left	A	A	A		SB Left		A		
Thru		A	A		Thru		A		
Right		A	A		Right		A		
Peds					Peds				
NB Right	A	A			EB Right				
SB Right					WB Right				
Green	5.0	4.0	33.0			28.0	6.0		
Yellow	3.0	3.0	4.5			4.5	4.5		
All Red	0.0	0.0	1.5			1.5	1.5		

Cycle Length: 100.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	231	1770	0.03	0.38	19.6	B		
T	1093	3311	0.90	0.33	42.0	D	39.0	D
R	522	1583	0.61	0.33	30.2	C		
Westbound								
L	287	1770	0.88	0.48	50.6	D		
T	1410	3526	0.67	0.40	25.8	C	31.0	C
R	633	1583	0.01	0.40	18.1	B		
Northbound								
L	505	1805	0.73	0.28	37.9	D		
LT	507	1811	0.74	0.28	38.2	D	36.5	D
R	640	1599	0.81	0.40	34.3	C		
Southbound								
L	106	1770	0.06	0.06	44.6	D		
TR	105	1758	0.17	0.06	45.4	D	45.2	D

Intersection Delay = 35.7 (sec/veh) Intersection LOS = D

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/10/2005
Analysis Time Period: am
Intersection: STH 158/104th
Area Type: All other areas
Jurisdiction: WisDOT
Analysis Year: 2017
Project ID: 2017 total traffic - with improvements
East/West Street: STH 158 North/South Street: 104th Ave

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	5	815	265	210	780	5	610	5	430	5	10	5
% Heavy Veh	2	15	2	2	8	2	0	0	1	2	3	2
PHF	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83
PK 15 Vol	2	245	80	63	235	2	184	2	130	2	3	2
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	2000	1900	1900	2000	1900	1900	1900	1900	1900	1900	
ParkExist												
NumPark												
No. Lanes	1	2	1	1	2	1	1	1	1	1	1	0
LGConfig	L	T	R	L	T	R	L	LT	R	L	TR	
Lane Width	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	
RTOR Vol			0			0			0			0
Adj Flow	6	982	319	253	940	6	368	373	518	6	18	
%InSharedLn							50					
Prop LTs	1.000	0.000		1.000	0.000			0.985			0.000	
Prop RTs		0.000	1.000		0.000	1.000		0.000	1.000		0.333	
Peds Bikes		0			0			0			0	
Buses	0	0	0	0	0	0	0	0	0	0	0	
%InProtPhase	0.0			0.0								

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Arriv. Type	3	3	3	3	3	3	3	3	3	3	3	
Unit Ext.	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	
Ext of g	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	

Ped Min g	3.2	3.2	3.2	3.2

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A		A		NB Left	A			
Thru			A		Thru	A			
Right			A		Right	A			
Peds					Peds				
WB Left	A	A	A		SB Left		A		
Thru		A	A		Thru		A		
Right		A	A		Right		A		
Peds					Peds				
NB Right	A	A			EB Right				
SB Right					WB Right				
Green	5.0	4.0	33.0			28.0	6.0		
Yellow	3.0	3.0	4.5			4.5	4.5		
All Red	0.0	0.0	1.5			1.5	1.5		

Cycle Length: 100.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	5	815	265	210	780	5	610	5	430	5	10	5
PHF	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83
Adj flow	6	982	319	253	940	6	735	6	518	6	12	6
No. Lanes	1	2	1	1	2	1	1	1	1	1	1	0
Lane group	L	T	R	L	T	R	L	LT	R	L	TR	
Adj flow	6	982	319	253	940	6	368	373	518	6	18	
Prop LTs	1.000	0.000		1.000	0.000			0.985			0.000	
Prop RTs		0.000	1.000		0.000	1.000		0.000	1.000		0.333	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L	T	R	L	T	R	L	LT	R	L	TR	
So	1900	2000	1900	1900	2000	1900	1900	1900	1900	1900	1900	
Lanes	1	2	1	1	2	1	1	1	1	1	1	0
fW	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
fHV	0.980	0.870	0.980	0.980	0.926	0.980	1.000	1.000	0.990	0.980	0.974	
fG	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
fP	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
fBB	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
fA	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
fLU	1.000	0.952	1.000	1.000	0.952	1.000	1.000	1.000	1.000	1.000	1.000	
fRT		1.000	0.850		1.000	0.850		1.000	0.850		0.950	
fLT	0.950	1.000		0.950	1.000		0.950	0.953		0.950	1.000	
Sec.	0.231			0.111								
fLpb	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fRpb		1.000	1.000		1.000	1.000		1.000	1.000		1.000	
S	1770	3311	1583	1770	3526	1583	1805	1811	1599	1770	1758	
Sec.	430			207								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		6	1770	0.00	0.050	89	0.07
Perm		0	430	0.00	0.330	142	0.00
Left	L	6			0.38	231	0.03
Prot							
Perm							
Thru	T	982	3311	# 0.30	0.33	1093	0.90
Right	R	319	1583	0.20	0.33	522	0.61
Westbound							
Prot		212	1770	# 0.12	0.120	212	1.00
Perm		41	207	0.20	0.360	75	0.55
Left	L	253			0.48	287	0.88
Prot							
Perm							
Thru	T	940	3526	0.27	0.40	1410	0.67
Right	R	6	1583	0.00	0.40	633	0.01
Northbound							
Prot							
Perm							
Left	L	368	1805	0.20	0.28	505	0.73
Prot							
Perm							
Thru	LT	373	1811	# 0.21	0.28	507	0.74
Right	R	518	1599	0.32	0.40	640	0.81
Southbound							
Prot							
Perm							
Left	L	6	1770	0.00	0.06	106	0.06
Prot							
Perm							
Thru	TR	18	1758	# 0.01	0.06	105	0.17
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.63
Total lost time per cycle, L = 24.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.83

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	0.03	0.38	19.5	1.000	231	0.11	0.0	0.0	19.6	B		
T	0.90	0.33	31.9	1.000	1093	0.42	10.1	0.0	42.0	D	39.0	D
R	0.61	0.33	28.1	1.000	522	0.20	2.1	0.0	30.2	C		
Westbound												
L	0.88	0.48	24.9	1.000	287	0.41	25.7	0.0	50.6	D		
T	0.67	0.40	24.5	1.000	1410	0.24	1.2	0.0	25.8	C	31.0	C
R	0.01	0.40	18.1	1.000	633	0.11	0.0	0.0	18.1	B		
Northbound												
L	0.73	0.28	32.6	1.000	505	0.29	5.3	0.0	37.9	D		
LT	0.74	0.28	32.6	1.000	507	0.29	5.5	0.0	38.2	D	36.5	D
R	0.81	0.40	26.6	1.000	640	0.35	7.7	0.0	34.3	C		
Southbound												
L	0.06	0.06	44.3	1.000	106	0.11	0.2	0.0	44.6	D		

TR	0.17	0.06	44.6	1.000	105	0.11	0.8	0.0	45.4	D	45.2	D

Intersection delay = 35.7 (sec/veh) Intersection LOS = D

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M		
Cycle length, C 100.0 sec				
Total actual green time for LT lane group, G (s)	38.0	48.0		
Effective permitted green time for LT lane group, g(s)	33.0	36.0		
Opposing effective green time, go (s)	40.0	33.0		
Number of lanes in LT lane group, N	1	1		
Number of lanes in opposing approach, No	2	2		
Adjusted LT flow rate, VLT (veh/h)	6	253		
Proportion of LT in LT lane group, PLT	1.000	1.000		
Proportion of LT in opposing flow, PLTo	0.00	0.00		
Adjusted opposing flow rate, Vo (veh/h)	940	982		
Lost time for LT lane group, tL	9.00	6.00		
Computation				
LT volume per cycle, LTC=VLTC/3600	0.17	7.03		
Opposing lane util. factor, fLUo	0.952	0.952	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	13.71	14.33		
gf=G[exp(- a * (LTC ** b)]-tl, gf<=g	0.0	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.60	0.67		
gq, (see Exhibit C16-4,5,6,7,8)	6.68	26.91		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	26.32	9.09		
n=Max(gq-gf)/2,0)	3.34	13.45		
PTHo=1-PLTo	1.00	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00		
EL1 (refer to Exhibit C16-3)	3.45	3.60		
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.12	0.11		
gdiff=max(gq-gf,0)	0.00	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.23	0.11		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.231	0.111		

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 100.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000	0.985	0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	0.952	0.952	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b)]-tl, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 100.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v	6	253		
v/c ratio from Capacity Worksheet, X	0.03	0.88		
Protected phase effective green interval, g (s)	5.0	12.0		
Opposing queue effective green interval, gq	6.68	26.91		
Unopposed green interval, gu	26.32	9.09		
Red time r=(C-g-gq-gu)	62.0	52.0		
Arrival rate, qa=v/(3600(max[X,1.0]))	0.00	0.07		
Protected ph. departure rate, Sp=s/3600	0.492	0.492		
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.15	0.23		
XPerm	0.01	1.22		
XProt	0.05	0.76		
Case	1	3		
Queue at beginning of green arrow, Qa	0.10	4.11		
Queue at beginning of unsaturated green, Qu	0.01	1.89		
Residual queue, Qr	0.00	0.46		
Uniform Delay, d1	19.5	24.9		

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Dur. Unmet Demand Q veh	Initial Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 35.7 sec/veh Intersection LOS D

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	T	R	L	T	R	L	LT	R	L	TR	
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Flow Rate	6	515	319	253	493	6	368	373	518	6	18	
So	1900	2000	1900	1900	2000	1900	1900	1900	1900	1900	1900	
No.Lanes	1	2	1	1	2	1	1	1	1	1	1	0
SL	606	1738	1583	598	1851	1583	1805	1811	1599	1770	1758	
LnCapacity	231	574	522	287	740	633	505	507	640	106	105	
Flow Ratio	0.01	0.30	0.20	0.42	0.27	0.00	0.20	0.21	0.32	0.00	0.01	
v/c Ratio	0.03	0.90	0.61	0.88	0.67	0.01	0.73	0.74	0.81	0.06	0.17	
Grn Ratio	0.38	0.33	0.33	0.48	0.40	0.40	0.28	0.28	0.40	0.06	0.06	
I Factor		1.000			1.000			1.000			1.000	
AT or PVG	3	3	3	3	3	3	3	3	3	3	3	
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
PF2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Q1	0.1	13.6	7.4	4.1	11.2	0.1	9.2	9.4	12.8	0.2	0.5	
kB	0.3	0.5	0.5	0.3	0.6	0.6	0.5	0.5	0.6	0.2	0.2	
Q2	0.0	3.2	0.8	1.8	1.2	0.0	1.2	1.3	2.1	0.0	0.0	
Q Average	0.1	16.8	8.2	5.9	12.4	0.1	10.5	10.7	14.9	0.2	0.5	
Q Spacing	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	
Q Storage	0	0	0	0	0	0	0	0	0	0	0	
Q % Ratio												
70th Percentile Output:												
fB%	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	
BOQ	0.1	19.6	9.7	7.0	14.5	0.1	12.3	12.5	17.4	0.2	0.6	
QSRatio												
85th Percentile Output:												
fB%	1.6	1.5	1.5	1.5	1.5	1.6	1.5	1.5	1.5	1.6	1.6	
BOQ	0.2	24.7	12.5	9.1	18.6	0.2	15.8	16.1	22.0	0.3	0.8	
QSRatio												
90th Percentile Output:												
fB%	1.8	1.6	1.7	1.7	1.6	1.8	1.6	1.6	1.6	1.8	1.8	
BOQ	0.2	26.4	13.7	10.0	20.0	0.2	17.1	17.4	23.6	0.3	0.9	
QSRatio												
95th Percentile Output:												
fB%	2.1	1.7	1.9	1.9	1.8	2.1	1.8	1.8	1.8	2.1	2.1	
BOQ	0.2	29.2	15.4	11.4	22.3	0.2	19.2	19.5	26.2	0.4	1.1	
QSRatio												
98th Percentile Output:												
fB%	2.7	2.0	2.2	2.3	2.1	2.7	2.1	2.1	2.0	2.7	2.7	
BOQ	0.3	33.2	18.3	13.8	25.8	0.3	22.5	22.8	30.0	0.5	1.4	
QSRatio												

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: md
Agency:
Date: 12/10/2004
Period: pm
Project ID: 2017 total traffic - with improvements
E/W St: STH 158

Inter.: STH 158/104th
Area Type: All other areas
Jurisd: WisDOT
Year : 2017
N/S St: 104th Ave

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	2	1	1	2	1	1	1	1	1	1	0
LGConfig	L	T	R	L	T	R	L	LT	R	L	TR	
Volume	5	825	170	200	900	5	1075 5	640		10	5	10
Lane Width	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A		A		NB Left	A			
Thru			A		Thru	A			
Right			A		Right	A			
Peds					Peds				
WB Left	A	A	A		SB Left		A		
Thru		A	A		Thru		A		
Right		A	A		Right		A		
Peds					Peds				
NB Right	A	A			EB Right	A			
SB Right					WB Right		A		
Green	4.0	5.0	30.0			42.0	5.0		
Yellow	3.0	3.0	4.5			4.5	4.5		
All Red	0.0	0.0	1.5			1.5	1.5		

Cycle Length: 110.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	132	1770	0.05	0.31	27.5	C		
T	1008	3697	0.96	0.27	59.4	E	50.1	D
R	1145	1615	0.17	0.71	5.4	A		
Westbound								
L	266	1805	0.88	0.41	54.4	D		
T	1241	3592	0.85	0.35	39.4	D	42.0	D
R	619	1583	0.01	0.39	20.5	C		
Northbound								
L	689	1805	0.92	0.38	49.8	D		
LT	691	1810	0.92	0.38	50.6	D	50.0	D
R	785	1599	0.96	0.49	49.6	D		
Southbound								
L	80	1770	0.15	0.05	51.3	D		
TR	76	1676	0.24	0.05	52.3	D	51.9	D

Intersection Delay = 47.7 (sec/veh) Intersection LOS = D

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 12/10/2004
Analysis Time Period: pm
Intersection: STH 158/104th
Area Type: All other areas
Jurisdiction: WisDOT
Analysis Year: 2017
Project ID: 2017 total traffic - with improvements
East/West Street: STH 158 North/South Street: 104th Ave

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	5	825	170	200	900	5	1075 5		640	10	5	10
% Heavy Veh	2	3	0	0	6	2	0	0	1	2	2	2
PHF	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
PK 15 Vol	2	243	50	59	265	2	316 2		188	3	2	3
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	2000	1900	1900	2000	1900	1900	1900	1900	1900	1900	
ParkExist												
NumPark												
No. Lanes	1	2	1	1	2	1	1	1	1	1	1	0
LGConfig	L	T	R	L	T	R	L	LT	R	L	TR	
Lane Width	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	
RTOR Vol			0			0			0			0
Adj Flow	6	971	200	235	1059	6	633	638	753	12	18	
%InSharedLn							50					
Prop LTs	1.000	0.000		1.000	0.000			0.991			0.000	
Prop RTs		0.000	1.000		0.000	1.000		0.000	1.000		0.667	
Peds Bikes	0			0			0			0		
Buses	0	0	0	0	0	0	0	0	0	0	0	
%InProtPhase	0.0			0.0								

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Arriv. Type	3	3	3	3	3	3	3	3	3	3	3	
Unit Ext.	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
I Factor		1.000			1.000			1.000			1.000	
Lost Time	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	
Ext of g	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	
Ped Min g	3.2			3.2			3.2			3.2		

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left	A		A		NB Left	A			
Thru			A		Thru	A			
Right			A		Right	A			
Peds					Peds				
WB Left	A	A	A		SB Left		A		
Thru		A	A		Thru		A		
Right		A	A		Right		A		
Peds					Peds				
NB Right	A	A			EB Right	A			
SB Right					WB Right		A		
Green	4.0	5.0	30.0			42.0	5.0		
Yellow	3.0	3.0	4.5			4.5	4.5		
All Red	0.0	0.0	1.5			1.5	1.5		

Cycle Length: 110.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	5	825	170	200	900	5	1075 5		640	10	5	10
PHF	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Adj flow	6	971	200	235	1059	6	1265 6		753	12	6	12
No. Lanes	1	2	1	1	2	1	1	1	1	1	1	0
Lane group	L	T	R	L	T	R	L	LT	R	L	TR	
Adj flow	6	971	200	235	1059	6	633	638	753	12	18	
Prop LTs	1.000	0.000		1.000	0.000			0.991			0.000	
Prop RTs		0.000	1.000		0.000	1.000		0.000	1.000		0.667	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L	T	R	L	T	R	L	LT	R	L	TR	
So	1900	2000	1900	1900	2000	1900	1900	1900	1900	1900	1900	
Lanes	1	2	1	1	2	1	1	1	1	1	1	0
fW	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
fHV	0.980	0.971	1.000	1.000	0.943	0.980	1.000	0.990	0.980	0.980	0.980	
fG	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
fP	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
fBB	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
fA	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
fLU	1.000	0.952	1.000	1.000	0.952	1.000	1.000	1.000	1.000	1.000	1.000	
fRT		1.000	0.850		1.000	0.850		1.000	0.850		0.900	
fLT	0.950	1.000		0.950	1.000		0.950	0.953		0.950	1.000	
Sec.	0.133			0.121								
fLpb	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fRpb		1.000	1.000		1.000	1.000		1.000	1.000		1.000	
S	1770	3697	1615	1805	3592	1583	1805	1810	1599	1770	1676	
Sec.	248			230								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		6	1770	0.00	0.036	64	0.09
Perm		0	248	0.00	0.273	68	0.00
Left	L	6			0.31	132	0.05
Prot							
Perm							
Thru	T	971	3697	# 0.26	0.27	1008	0.96
Right	R	200	1615	0.12	0.71	1145	0.17
Westbound							
Prot		197	1805	0.11	0.109	197	1.00
Perm		38	230	0.17	0.300	69	0.55
Left	L	235			0.41	266	0.88
Prot							
Perm							
Thru	T	1059	3592	0.29	0.35	1241	0.85
Right	R	6	1583	0.00	0.39	619	0.01
Northbound							
Prot							
Perm							
Left	L	633	1805	0.35	0.38	689	0.92
Prot							
Perm							
Thru	LT	638	1810	0.35	0.38	691	0.92
Right	R	753	1599	# 0.47	0.49	785	0.96
Southbound							
Prot							
Perm							
Left	L	12	1770	0.01	0.05	80	0.15
Prot							
Perm							
Thru	TR	18	1676	# 0.01	0.05	76	0.24
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.74
Total lost time per cycle, L = 21.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.92

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
L	0.05	0.31	27.4	1.000	132	0.11	0.1	0.0	27.5	C		
T	0.96	0.27	39.5	1.000	1008	0.47	20.0	0.0	59.4	E	50.1	D
R	0.17	0.71	5.3	1.000	1145	0.11	0.1	0.0	5.4	A		
Westbound												
L	0.88	0.41	26.9	1.000	266	0.41	27.5	0.0	54.4	D		
T	0.85	0.35	33.4	1.000	1241	0.39	6.0	0.0	39.4	D	42.0	D
R	0.01	0.39	20.5	1.000	619	0.11	0.0	0.0	20.5	C		
Northbound												
L	0.92	0.38	32.4	1.000	689	0.44	17.5	0.0	49.8	D		
LT	0.92	0.38	32.5	1.000	691	0.44	18.1	0.0	50.6	D	50.0	D
R	0.96	0.49	26.9	1.000	785	0.47	22.6	0.0	49.6	D		
Southbound												
L	0.15	0.05	50.5	1.000	80	0.11	0.9	0.0	51.3	D		

TR	0.24	0.05	50.7	1.000	76	0.11	1.6	0.0	52.3	D	51.9	D

Intersection delay = 47.7 (sec/veh) Intersection LOS = D

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M	M		
Cycle length, C 110.0 sec				
Total actual green time for LT lane group, G (s)	34.0	45.0		
Effective permitted green time for LT lane group, g(s)	30.0	33.0		
Opposing effective green time, go (s)	38.0	30.0		
Number of lanes in LT lane group, N	1	1		
Number of lanes in opposing approach, No	2	2		
Adjusted LT flow rate, VLT (veh/h)	6	235		
Proportion of LT in LT lane group, PLT	1.000	1.000		
Proportion of LT in opposing flow, PLTo	0.00	0.00		
Adjusted opposing flow rate, Vo (veh/h)	1059	971		
Lost time for LT lane group, tL	9.00	6.00		
Computation				
LT volume per cycle, LTC=VLTC/3600	0.18	7.18		
Opposing lane util. factor, fLUo	0.952	0.952	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	16.99	15.58		
gf=G[exp(a * (LTC ** b))]-tl, gf<=g	0.0	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.65	0.73		
gq, (see Exhibit C16-4,5,6,7,8)	15.20	29.00		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	14.80	4.00		
n=Max(gq-gf)/2,0)	7.60	14.50		
PTHo=1-PLTo	1.00	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00		
EL1 (refer to Exhibit C16-3)	3.89	3.56		
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.13	0.12		
gdiff=max(gq-gf,0)	0.00	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.13	0.12		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.133	0.121		

For special case of single-lane approach opposed by multilane approach
see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto
left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach
or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 110.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000	0.991	0.000
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	0.952	0.952	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach,
see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto
left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach
or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 110.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v	6	235		
v/c ratio from Capacity Worksheet, X	0.05	0.88		
Protected phase effective green interval, g (s)	4.0	12.0		
Opposing queue effective green interval, gq	15.20	29.00		
Unopposed green interval, gu	14.80	4.00		
Red time r=(C-g-gq-gu)	76.0	65.0		
Arrival rate, qa=v/(3600(max[X,1.0]))	0.00	0.07		
Protected ph. departure rate, Sp=s/3600	0.492	0.501		
Permitted ph. departure rate, Sa=s(gq+gu)/(gu*3600)	0.14	0.53		
XPerm	0.02	1.02		
XProt	0.07	0.84		
Case	1	3		
Queue at beginning of green arrow, Qa	0.13	4.29		
Queue at beginning of unsaturated green, Qu	0.03	1.89		
Residual queue, Qr	0.00	0.05		
Uniform Delay, d1	27.4	26.9		

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Dur. Unmet Demand Q veh	Initial Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Lane Delay d3 sec	Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 47.7 sec/veh Intersection LOS D

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	T	R	L	T	R	L	LT	R	L	TR	
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Flow Rate	6	509	200	235	556	6	633	638	753	12	18	
So	1900	2000	1900	1900	2000	1900	1900	1900	1900	1900	1900	
No.Lanes	1	2	1	1	2	1	1	1	1	1	1	0
SL	427	1941	1615	650	1886	1583	1805	1810	1599	1770	1676	
LnCapacity	132	529	1145	266	651	619	689	691	785	80	76	
Flow Ratio	0.01	0.26	0.12	0.36	0.29	0.00	0.35	0.35	0.47	0.01	0.01	
v/c Ratio	0.05	0.96	0.17	0.88	0.85	0.01	0.92	0.92	0.96	0.15	0.24	
Grn Ratio	0.31	0.27	0.71	0.41	0.35	0.39	0.38	0.38	0.49	0.05	0.05	
I Factor		1.000			1.000			1.000			1.000	
AT or PVG	3	3	3	3	3	3	3	3	3	3	3	
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
PF2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Q1	0.1	15.3	2.0	4.7	15.8	0.1	18.4	18.6	22.1	0.4	0.5	
kB	0.2	0.5	0.8	0.4	0.6	0.6	0.6	0.6	0.7	0.2	0.2	
Q2	0.0	4.7	0.2	1.8	2.8	0.0	4.3	4.5	6.2	0.0	0.1	
Q Average	0.1	20.0	2.2	6.5	18.6	0.1	22.8	23.1	28.3	0.4	0.6	
Q Spacing	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	
Q Storage	0	0	0	0	0	0	0	0	0	0	0	
Q S Ratio												
70th Percentile Output:												
fB%	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.1	1.2	1.2	
BOQ	0.2	23.2	2.6	7.7	21.6	0.1	26.3	26.7	32.6	0.5	0.7	
QSRatio												
85th Percentile Output:												
fB%	1.6	1.5	1.6	1.5	1.5	1.6	1.4	1.4	1.4	1.6	1.6	
BOQ	0.2	29.1	3.5	10.0	27.2	0.2	32.8	33.2	40.2	0.6	0.9	
QSRatio												
90th Percentile Output:												
fB%	1.8	1.5	1.8	1.7	1.6	1.8	1.5	1.5	1.5	1.8	1.8	
BOQ	0.2	31.0	3.9	11.0	29.0	0.2	34.8	35.2	42.4	0.7	1.0	
QSRatio												
95th Percentile Output:												
fB%	2.1	1.7	2.0	1.9	1.7	2.1	1.7	1.7	1.6	2.1	2.1	
BOQ	0.3	34.0	4.5	12.5	31.9	0.2	38.0	38.5	46.0	0.8	1.2	
QSRatio												
98th Percentile Output:												
fB%	2.7	1.9	2.5	2.3	1.9	2.7	1.9	1.9	1.8	2.7	2.7	
BOQ	0.4	38.3	5.6	15.0	36.1	0.3	42.6	43.2	51.4	1.0	1.5	
QSRatio												

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: md
Agency:
Date: 1/3/2005
Period: am
Project ID: 2017 total traffic - with improvements
E/W St: sth 158

Inter.: sth 158/greyhound access
Area Type: All other areas
Jurisd: wisdot
Year : 2017
N/S St: greyhound access

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	1	2	0	2	0	1	0	0	0
LGConfig		T		L	T		L		R			
Volume		1045		375	1020		45		40			
Lane Width		12.0		12.0	12.0		12.0		12.0			
RTOR Vol									0			

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left					NB Left	A			
Thru		A			Thru				
Right					Right	A			
Peds					Peds				
WB Left	A	A			SB Left				
Thru	A	A			Thru				
Right					Right				
Peds					Peds				
NB Right	A				EB Right				
SB Right					WB Right				
Green	20.0	47.0				18.0			
Yellow	3.0	4.5				4.5			
All Red	0.0	1.5				1.5			

Cycle Length: 100.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
T	1556	3311	0.69	0.47	22.2	C	22.2	C
Westbound								
L	485	1805	0.80	0.70	30.6	C		
T	2468	3526	0.43	0.70	6.5	A	13.0	B
Northbound								
L	631	3505	0.07	0.18	34.1	C		
R	711	1615	0.06	0.44	16.1	B	25.6	C
Southbound								

Intersection Delay = 17.2 (sec/veh) Intersection LOS = B

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/3/2005
Analysis Time Period: am
Intersection: sth 158/greyhound access
Area Type: All other areas
Jurisdiction: wisdot
Analysis Year: 2017
Project ID: 2017 total traffic - with improvements
East/West Street: sth 158 North/South Street: greyhound access

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume		1045		375	1020		45		40			
% Heavy Veh		15		0	8		0		0			
PHF		0.97		0.97	0.97		0.97		0.97			
PK 15 Vol		269		97	263		12		10			
Hi Ln Vol												
% Grade		0			0			0				
Ideal Sat		2000		1900	2000		1900		1900			
ParkExist												
NumPark												
No. Lanes	0	2	0	1	2	0	2	0	1	0	0	0
LGConfig		T		L	T		L		R			
Lane Width		12.0		12.0	12.0		12.0		12.0			
RTOR Vol									0			
Adj Flow		1077		387	1052		46		41			
%InSharedLn												
Prop LTs		0.000		1.000	0.000							
Prop RTs	0.000				0.000				1.000			
Peds	Bikes 0						0			0		
Buses		0		0	0		0		0			
%InProtPhase				0.0								

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0		0.0	0.0		0.0		0.0			
Arriv. Type		3		3	3		3		3			
Unit Ext.		3.0		3.0	3.0		3.0		3.0			
I Factor		1.000			1.000			1.000				
Lost Time		2.0		2.0	2.0		2.0		2.0			
Ext of g		2.0		2.0	2.0		2.0		2.0			
Ped Min g		3.2						3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4		5	6	7	8
EB Left					NB Left	A			
Thru		A			Thru				
Right					Right	A			
Peds					Peds				
WB Left	A	A			SB Left				
Thru	A	A			Thru				
Right					Right				
Peds					Peds				
NB Right	A				EB Right				
SB Right					WB Right				
Green	20.0	47.0				18.0			
Yellow	3.0	4.5				4.5			
All Red	0.0	1.5				1.5			

Cycle Length: 100.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V		1045		375	1020		45		40			
PHF		0.97		0.97	0.97		0.97		0.97			
Adj flow		1077		387	1052		46		41			
No. Lanes	0	2	0	1	2	0	2	0	1	0	0	0
Lane group		T		L	T		L		R			
Adj flow		1077		387	1052		46		41			
Prop LTs		0.000		1.000	0.000							
Prop RTs	0.000				0.000				1.000			

Saturation Flow Rate [see Exhibit 16-7 to determine the adjustment factors]

	Eastbound			Westbound			Northbound			Southbound		
LG		T		L	T		L		R			
So		2000		1900	2000		1900		1900			
Lanes	0	2	0	1	2	0	2	0	1	0	0	0
fW		1.000		1.000	1.000		1.000		1.000			
fHV		0.870		1.000	0.926		1.000		1.000			
fG		1.000		1.000	1.000		1.000		1.000			
fP		1.000		1.000	1.000		1.000		1.000			
fBB		1.000		1.000	1.000		1.000		1.000			
fA		1.000		1.000	1.000		1.000		1.000			
fLU		0.952		1.000	0.952		0.971		1.000			
fRT		1.000			1.000				0.850			
fLT		1.000		0.950	1.000		0.950					
Sec.				0.130								
fLpb		1.000		1.000	1.000		1.000					
fRpb		1.000			1.000				1.000			
S		3311		1805	3526		3505		1615			
Sec.				247								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	1077	3311	# 0.33	0.47	1556	0.69
Right							
Westbound							
Prot		361	1805	# 0.20	0.200	361	1.00
Perm		26	247	0.11	0.500	124	0.21
Left	L	387			0.70	485	0.80
Prot							
Perm							
Thru	T	1052	3526	0.30	0.70	2468	0.43
Right							
Northbound							
Prot							
Perm							
Left	L	46	3505	# 0.01	0.18	631	0.07
Prot							
Perm							
Thru							
Right	R	41	1615	0.03	0.44	711	0.06
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.54
Total lost time per cycle, L = 18.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.66

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
T	0.69	0.47	20.8	1.000	1556	0.26	1.3	0.0	22.2	C	22.2	C
Westbound												
L	0.80	0.70	21.5	1.000	485	0.34	9.1	0.0	30.6	C		
T	0.43	0.70	6.4	1.000	2468	0.11	0.1	0.0	6.5	A	13.0	B
Northbound												
L	0.07	0.18	34.1	1.000	631	0.11	0.0	0.0	34.1	C		
R	0.06	0.44	16.1	1.000	711	0.11	0.0	0.0	16.1	B	25.6	C
Southbound												

Intersection delay = 17.2 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach		M		
Cycle length, C 100.0 sec				
Total actual green time for LT lane group, G (s)		70.0		
Effective permitted green time for LT lane group, g(s)		50.0		
Opposing effective green time, go (s)		47.0		
Number of lanes in LT lane group, N		1		
Number of lanes in opposing approach, No		2		
Adjusted LT flow rate, VLT (veh/h)		387		
Proportion of LT in LT lane group, PLT		1.000		
Proportion of LT in opposing flow, PLTo		0.00		
Adjusted opposing flow rate, Vo (veh/h)		1077		
Lost time for LT lane group, tL		6.00		
Computation				
LT volume per cycle, LTC=VLTC/3600		10.75		
Opposing lane util. factor, fLUo	0.952	0.952		
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		15.71		
gf=G[exp(- a * (LTC ** b)]-tl, gf<=g		0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.53		
gq, (see Exhibit C16-4,5,6,7,8)		24.29		
gu=g-gq if gq>=gf, or = g-gf if gq<gf		25.71		
n=Max(gq-gf)/2,0)		12.14		
PTHo=1-PLTo		1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00		
EL1 (refer to Exhibit C16-3)		3.96		
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.08		
gdiff=max(gq-gf,0)		0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.13		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.130		

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 100.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000		
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	0.952	0.952		
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b)]-tl, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 100.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v		387		
v/c ratio from Capacity Worksheet, X		0.80		
Protected phase effective green interval, g (s)		20.0		
Opposing queue effective green interval, gq		24.29		
Unopposed green interval, gu		25.71		
Red time r=(C-g-gq-gu)		30.0		
Arrival rate, qa=v/[3600(max[X,1.0])]		0.11		
Protected ph. departure rate, Sp=s/3600		0.501		
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)		0.13		
XPerm		1.57		
XProt		0.54		
Case		3		
Queue at beginning of green arrow, Qa		5.17		
Queue at beginning of unsaturated green, Qu		2.61		
Residual queue, Qr		1.94		
Uniform Delay, d1		21.5		

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 17.2 sec/veh Intersection LOS B

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup		T		L	T		L		R			
Init Queue		0.0		0.0	0.0		0.0		0.0			
Flow Rate		565		387	552		23		41			
So		2000		1900	2000		1900		1900			
No.Lanes	0	2	0	1	2	0	2	0	1	0	0	0
SL		1738		692	1851		1805		1615			
LnCapacity		817		485	1296		324		711			
Flow Ratio		0.33		0.56	0.30		0.01		0.03			
v/c Ratio		0.69		0.80	0.43		0.07		0.06			
Grn Ratio		0.47		0.70	0.70		0.18		0.44			
I Factor		1.000			1.000			1.000				
AT or PVG		3		3	3		3		3			
Pltn Ratio		1.00		1.00	1.00		1.00		1.00			
PF2		1.00		1.00	1.00		1.00		1.00			
Q1		12.3		3.8	6.6		0.5		0.7			
kB		0.7		0.5	0.9		0.4		0.6			
Q2		1.4		1.7	0.6		0.0		0.0			
Q Average		13.7		5.5	7.2		0.6		0.7			
Q Spacing		25.0		25.0	25.0		25.0		25.0			
Q Storage		0		0	0		0		0			
Q S Ratio												
70th Percentile Output:												
fB%		1.2		1.2	1.2		1.2		1.2			
BOQ		16.1		6.5	8.5		0.7		0.8			
QSRatio												
85th Percentile Output:												
fB%		1.5		1.5	1.5		1.6		1.6			
BOQ		20.4		8.5	11.0		0.9		1.1			
QSRatio												
90th Percentile Output:												
fB%		1.6		1.7	1.7		1.8		1.8			
BOQ		22.0		9.4	12.1		1.0		1.2			
QSRatio												
95th Percentile Output:												
fB%		1.8		1.9	1.9		2.1		2.1			
BOQ		24.4		10.7	13.7		1.2		1.4			
QSRatio												
98th Percentile Output:												
fB%		2.0		2.4	2.3		2.7		2.6			
BOQ		28.1		12.9	16.4		1.5		1.8			
QSRatio												

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Analyst: md
Agency:
Date: 1/3/2005
Period: pm
Project ID: 2017 total traffic - with improvements
E/W St: sth 158

Inter.: sth 158/greyhound access
Area Type: All other areas
Jurisd: wisdot
Year : 2017
N/S St: greyhound access

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	1	2	0	2	0	1	0	0	0
LGConfig		T		L	T		L		R			
Volume		870		595	1380		170		130			
Lane Width		12.0		12.0	12.0		12.0		12.0			
RTOR Vol									0			

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left	A		
Thru		A			Thru			
Right					Right	A		
Peds					Peds			
WB Left	A	A			SB Left			
Thru	A	A			Thru			
Right					Right			
Peds					Peds			
NB Right	A				EB Right			
SB Right					WB Right			
Green	40.0	39.0			16.0			
Yellow	3.0	4.5			4.5			
All Red	0.0	1.5			1.5			

Cycle Length: 110.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
T	1286	3627	0.73	0.35	33.0	C	33.0	C
Westbound								
L	733	1805	0.87	0.75	37.3	D		
T	2678	3592	0.55	0.75	6.3	A	15.7	B
Northbound								
L	510	3505	0.36	0.15	42.8	D		
R	910	1615	0.15	0.56	11.5	B	29.3	C
Southbound								

Intersection Delay = 21.8 (sec/veh) Intersection LOS = C

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: md
Agency/Co.:
Date Performed: 1/3/2005
Analysis Time Period: pm
Intersection: sth 158/greyhound access
Area Type: All other areas
Jurisdiction: wisdot
Analysis Year: 2017
Project ID: 2017 total traffic - with improvements
East/West Street: sth 158
North/South Street: greyhound access

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume		870		595	1380		170		130			
% Heavy Veh		5		0	6		0		0			
PHF		0.93		0.93	0.93		0.93		0.93			
PK 15 Vol		234		160	371		46		35			
Hi Ln Vol												
% Grade		0			0			0				
Ideal Sat		2000		1900	2000		1900		1900			
ParkExist												
NumPark												
No. Lanes	0	2	0	1	2	0	2	0	1	0	0	0
LGConfig		T		L	T		L		R			
Lane Width		12.0		12.0	12.0		12.0		12.0			
RTOR Vol									0			
Adj Flow		935		640	1484		183		140			
%InSharedLn												
Prop LTs		0.000		1.000	0.000							
Prop RTs		0.000			0.000				1.000			
Peds Bikes	0						0			0		
Buses		0		0	0		0		0			
%InProtPhase				0.0								

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0		0.0	0.0		0.0		0.0			
Arriv. Type		3		3	3		3		3			
Unit Ext.		3.0		3.0	3.0		3.0		3.0			
I Factor		1.000			1.000			1.000				
Lost Time		2.0		2.0	2.0		2.0		2.0			
Ext of g		2.0		2.0	2.0		2.0		2.0			
Ped Min g		3.2					3.2		3.2			

PHASE DATA

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left	A		
Thru		A			Thru			
Right					Right	A		
Peds					Peds			
WB Left	A	A			SB Left			
Thru	A	A			Thru			
Right					Right			
Peds					Peds			
NB Right	A				EB Right			
SB Right					WB Right			
Green	40.0	39.0			16.0			
Yellow	3.0	4.5			4.5			
All Red	0.0	1.5			1.5			

Cycle Length: 110.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V		870		595	1380		170		130			
PHF		0.93		0.93	0.93		0.93		0.93			
Adj flow		935		640	1484		183		140			
No. Lanes	0	2	0	1	2	0	2	0	1	0	0	0
Lane group		T		L	T		L		R			
Adj flow		935		640	1484		183		140			
Prop LTs		0.000		1.000	0.000							
Prop RTs		0.000			0.000				1.000			

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG		T		L	T		L		R			
So		2000		1900	2000		1900		1900			
Lanes	0	2	0	1	2	0	2	0	1	0	0	0
fW		1.000		1.000	1.000		1.000		1.000			
fHV		0.952		1.000	0.943		1.000		1.000			
fG		1.000		1.000	1.000		1.000		1.000			
fP		1.000		1.000	1.000		1.000		1.000			
fBB		1.000		1.000	1.000		1.000		1.000			
fA		1.000		1.000	1.000		1.000		1.000			
fLU		0.952		1.000	0.952		0.971		1.000			
fRT		1.000			1.000				0.850			
fLT		1.000		0.950	1.000		0.950					
Sec.				0.106								
fLpb		1.000		1.000	1.000		1.000					
fRpb		1.000			1.000				1.000			
S		3627		1805	3592		3505		1615			
Sec.				202								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	935	3627	# 0.26	0.35	1286	0.73
Right							
Westbound							
Prot		640	1805	# 0.35	0.364	656	0.98
Perm		0	202	0.00	0.382	77	0.00
Left	L	640			0.75	733	0.87
Prot							
Perm							
Thru	T	1484	3592	0.41	0.75	2678	0.55
Right							
Northbound							
Prot							
Perm							
Left	L	183	3505	# 0.05	0.15	510	0.36
Prot							
Perm							
Thru							
Right	R	140	1615	0.09	0.56	910	0.15
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.66
Total lost time per cycle, L = 18.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.79

Control Delay and LOS Determination

Appr/ Lane Grp	v/c	g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
T	0.73	0.35	30.9	1.000	1286	0.29	2.1	0.0	33.0	C	33.0	C
Westbound												
L	0.87	0.75	26.0	1.000	733	0.40	11.3	0.0	37.3	D		
T	0.55	0.75	6.1	1.000	2678	0.15	0.3	0.0	6.3	A	15.7	B
Northbound												
L	0.36	0.15	42.4	1.000	510	0.11	0.4	0.0	42.8	D		
R	0.15	0.56	11.5	1.000	910	0.11	0.1	0.0	11.5	B	29.3	C
Southbound												

Intersection delay = 21.8 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach		M		
Cycle length, C 110.0 sec				
Total actual green time for LT lane group, G (s)		82.0		
Effective permitted green time for LT lane group, g(s)		42.0		
Opposing effective green time, go (s)		39.0		
Number of lanes in LT lane group, N		1		
Number of lanes in opposing approach, No		2		
Adjusted LT flow rate, VLT (veh/h)		640		
Proportion of LT in LT lane group, PLT		1.000		
Proportion of LT in opposing flow, PLTo		0.00		
Adjusted opposing flow rate, Vo (veh/h)		935		
Lost time for LT lane group, tL		6.00		
Computation				
LT volume per cycle, LTC=VLTC/3600		19.56		
Opposing lane util. factor, fLUo	0.952	0.952		
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		15.00		
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g		0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.65		
gq, (see Exhibit C16-4,5,6,7,8)		26.64		
gu=g-gq if gq>=gf, or = g-gf if gq<gf		15.36		
n=Max(gq-gf)/2,0)		13.32		
PTHo=1-PLTo		1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00		
EL1 (refer to Exhibit C16-3)		3.44		
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.10		
gdiff=max(gq-gf,0)		0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.11		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.106		

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 110.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT	0.000	0.000		
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	0.952	0.952		
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdiff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C 110.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v		640		
v/c ratio from Capacity Worksheet, X		0.87		
Protected phase effective green interval, g (s)		40.0		
Opposing queue effective green interval, gq		26.64		
Unopposed green interval, gu		15.36		
Red time r=(C-g-gq-gu)		28.0		
Arrival rate, qa=v/(3600(max[X,1.0]))		0.18		
Protected ph. departure rate, Sp=s/3600		0.501		
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)		0.15		
XPerm		3.17		
XProt		0.60		
Case		3		
Queue at beginning of green arrow, Qa		10.09		
Queue at beginning of unsaturated green, Qu		4.74		
Residual queue, Qr		5.11		
Uniform Delay, d1		26.0		

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Dur. Unmet Demand Q veh	Unmet Demand t hrs.	Uniform Delay Unadj. ds	Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Lane Queue Delay d3 sec	Group Delay d sec
Eastbound								
Westbound								
Northbound								
Southbound								

Intersection Delay 21.8 sec/veh Intersection LOS C

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup		T		L	T		L	R				
Init Queue		0.0		0.0	0.0		0.0	0.0				
Flow Rate		491		640	779		94	140				
So		2000		1900	2000		1900	1900				
No.Lanes	0	2	0	1	2	0	2	1	0	0	0	
SL		1904		984	1886		1805	1615				
LnCapacity		675		733	1406		262	910				
Flow Ratio		0.26		0.65	0.41		0.05	0.09				
v/c Ratio		0.73		0.87	0.55		0.36	0.15				
Grn Ratio		0.35		0.75	0.75		0.15	0.56				
I Factor		1.000			1.000		1.000					
AT or PVG		3		3	3		3	3				
Pltn Ratio		1.00		1.00	1.00		1.00	1.00				
PF2		1.00		1.00	1.00		1.00	1.00				
Q1		13.0		7.3	10.3		2.6	2.0				
kB		0.6		0.6	1.0		0.3	0.7				
Q2		1.5		3.4	1.2		0.2	0.1				
Q Average		14.6		10.7	11.5		2.8	2.2				
Q Spacing		25.0		25.0	25.0		25.0	25.0				
Q Storage		0		0	0		0	0				
Q S Ratio												
70th Percentile Output:												
fB%		1.2		1.2	1.2		1.2	1.2				
BOQ		17.1		12.6	13.5		3.3	2.6				
QSRatio												
85th Percentile Output:												
fB%		1.5		1.5	1.5		1.6	1.6				
BOQ		21.7		16.2	17.3		4.4	3.4				
QSRatio												
90th Percentile Output:												
fB%		1.6		1.6	1.6		1.7	1.8				
BOQ		23.2		17.5	18.7		4.9	3.8				
QSRatio												
95th Percentile Output:												
fB%		1.8		1.8	1.8		2.0	2.0				
BOQ		25.8		19.6	20.9		5.6	4.4				
QSRatio												
98th Percentile Output:												
fB%		2.0		2.1	2.1		2.5	2.5				
BOQ		29.5		22.9	24.3		7.0	5.5				
QSRatio												

ERROR MESSAGES

No errors to report.