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Memorandum

To: **Danielle Dash and Bruce Mellen**
DR Horton, Inc.

From: Bill Grieve

Date: October 17, 2018

Subject: Polo Club of Naperville

The land plan for the proposed Polo Club of Naperville development has changed over the last several months; both in terms of the number of units and the product type. Gewalt Hamilton Associates, Inc. (GHA) has compared the traffic impacts of the update plan dated September 27, 2018 with the previous land plan. Pertinent comments include:

Background Information

1. There were 697 total dwelling units previously proposed, with 166 single family homes, 241 two- and three-story townhomes, and 290 apartments.
2. There are now 637 total dwelling units proposed, with 126 single family homes, 221 townhomes, and 290 apartments. The townhomes and apartments are all in three-story buildings. This results in a loss of 60 dwellings.
3. The planned improvements by DR Horton include:
   - Widening 119th Street to provide a 3-lane pavement with separate left turn lanes at Wolf Drive / apartment full access, Polo Club Drive, and Book Road.
   - Extending Book Road from 119th Street north to 111th Street.
   - Constructing paths / sidewalks along 119th Street and Book Road.
   - Opening a connection from the Polo Club to Hawkweed Drive per the City's direction.

Traffic Generations

1. *Exhibits 1 and 2* summarize the changes in the traffic generations. As can be seen, the changes in the land plan densities and product types will have a significant impact on the traffic generations:
   - The weekday morning peak hour will have a decrease of 60 or 18% *fewer* trips.
   - The weekday evening peak hour will have a decrease of 59 or 14% *fewer* trips.
   - On a daily basis, 950 or 19% *fewer* trips will be generated.
2. Almost 180 of the dwellings are "age targeted", which could result in 25-30% *lower* traffic generations. However, this discount was not applied per City direction to help ensure that the maximum number of trips generated by the Polo Club were analyzed.

Traffic Impact Discussion

1. The most recent GHA analyses dated May 23, 2018 did not include the extension of Book Road from 119th Street to 111th Street. Thus, we analyzed the greatest potential traffic impacts along 119th Street. Based primarily on current travel patterns, about 50% of Polo Club traffic is expected to be oriented to/from the west on 119th Street west of Wolf Drive, 40% to/from the east on 119th Street east of Book Road, and 10% to/from the neighborhood connections to Hawkweed Drive and the portion of Book Road that was originally going to be constructed by DR Horton to Wild Timothy Road north of the site.
2. Information published in the Highway Capacity manual (HCM), 6th Edition indicates that a 2-lane road has a daily vehicle carrying capacity of about 12,000 vehicles per day (vpd). Adding a center lane for separating out left turns from through traffic can add about 6,000 vpd of capacity for a total capacity of 18,000 vehicles per day. The Average Daily Traffic (ADT) calculations are listed below:

   - Existing 119th Street ADT = 8,450 vpd
   - Polo Club traffic at Wolf Drive = 2,065 vpd (maximum using higher ITE rates)
   - Total 119th Street ADT = 10,515 vpd
   - Percent 119th Street capacity used = 58%

   Key Finding. Based on the above calculations, there will still be over 40% of the vehicle carrying capacity still available along 119th Street after the Polo Club has been fully developed and residences occupied. This will help ensure that other area traffic growth can be accommodated.

* * * * * * * * * * * *

This memorandum that updates the Polo Club traffic information was prepared by:

William C. Grieve, P.E., PTOE
Senior Transportation Engineer
bgrieve@gha-engineers.com

Exhibit 1
Traffic Generation Comparisons
Polo Club Subdivision - Naperville, IL.

Part A. Updated Land Plan (September 27, 2018)

			Weekday Peak Hours							
		ITE	Morning			Evening			Daily	
	Size	Code	In	Out	Sum	In	Out	Sum	Sum	%
Age Targeted										
Single Family	89 Dwellings	#210	17	51	68	57	34	91	930	23%
Townhomes	90 Dwellings	#221	8	22	30	24	16	40	490	12%
Non-Age Targeted										
Single Family	37 Dwellings	#210	8	23	31	25	14	39	420	10%
Townhomes	131 Dwellings	#221	12	33	45	35	22	57	710	17%
Subtotals =	347 Dwellings		**45**	**129**	**174**	**141**	**86**	**227**	**2,550**	
Apartments	290 Units	#221	25	72	97	75	48	123	1,580	38%
Totals =	**637 Dwellings**		**70**	**201**	**271**	**216**	**134**	**350**	**4,130**	**100%**

Part B. Previous Land Plan

			Weekday Peak Hours							
		ITE	Morning			Evening			Daily	
	Size	Code	In	Out	Sum	In	Out	Sum	Sum	
Age Targeted										
Single Family	88 Dwellings	#210	17	50	67	57	33	90	920	
Townhomes	93 Dwellings	#220	10	35	45	35	20	55	660	
Non-Age Targeted										
Buckingham Townhomes	78 Dwellings	#220	9	29	38	29	18	47	550	
Seaboard Townhomes	148 Dwellings	#221	13	37	50	39	26	65	800	
Subtotals =	407 Dwellings		**49**	**151**	**200**	**160**	**97**	**257**	**2,930**	
Apartments	290 Units	#220	30	101	131	96	56	152	2,150	
Totals =	**697 Dwellings**		**79**	**252**	**331**	**256**	**153**	**409**	**5,080**	

Part C. Increments (Part A. - Part B.)

			-9	***-51***	***-60***	***-40***	***-19***	***-59***	***-950***	

Notes:

1) Source: Institute of Transportation Engineers (ITE) Trip Generation Manual (10th Edition).

2) All townhomes are now 3-story, as are the aprtment buildings.

3) No trip discounts taken for age-targeted residences. The actual generations may be 25-35% lower.

GEWALT HAMILTON ASSOCIATES, INC.

Exhibit 2

Traffic Generation Comparisons

Polo Club Subdivision - Naperville, IL.

Part A. Updated Land Plan (September 27, 2018)

	Weekday Peak Hours		
	Morning	Evening	Daily
Size	Sum	Sum	Sum
Totals = 637 Dwelling Units	**271**	**350**	**4,130**

Part B. Previous Land Plan

	Weekday Peak Hours		
	Morning	Evening	Daily
Size	Sum	Sum	Sum
Totals = 697 Dwelling Units	**331**	**409**	**5,080**

Part C. Increments (Part A. - Part B.)	***-60***	***-59***	***-950***
(% Decrease)	*-18%*	*-14%*	*-19%*

Notes:

1) Source: Institute of Transportation Engineers (ITE) Trip Generation Manual (10th Edition).

2) Totals include Single-Family Housing, Townhomes, and Apartments.

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Traffic Impact Study

To: **Bruce Mellen**
DR Horton, Inc.

From: Bill Grieve, P.E., PTOE
Senior Transportation Engineer

Justin Opitz
Transportation Planner

Date: May 15, 2018

Subject: **Naperville Polo Club**

Part I. Introduction and Project Context

Gewalt Hamilton Associates, Inc. (GHA) has conducted a Traffic Impact Study (TIS) for the proposed residential development located along the north side of 119th Street at Book Road in Naperville, Illinois. The site is currently used for recreation, including soccer and polo.

As proposed, the residential development will include age-targeted single-family homes and townhomes and non-age targeted townhomes and apartments, totaling 723 dwellings. The following provides a summary of existing conditions, site traffic characteristics, and the analyses conducted of the development's impact on the surrounding roadway network. *Exhibits* and *Appendices* referenced are located at the end of this document.

Part II. Background Information

Site Location Map and Roadway Inventory

Exhibit 1 provides an aerial location map of the site vicinity. *Exhibit 2* provides a photo inventory of current traffic operations. Pertinent comments to the adjacent roadways include:

<u>119th Street</u>

- 119th Street is an east-west minor arterial roadway under the jurisdiction of the Wheatland Township Road Commission. It provides one travel lane in each direction.
- 119th Street is classified as a "Minor Arterial" on the Illinois Department of Transportation (IDOT) Functional Classification Map.
- In the westbound direction, the posted speed limit is 45 miles per hour (mph) east of the DuPage River and then increases to 50 mph in the site vicinity until approximately 500 feet east of an existing parking lot access drive, where it becomes 35 mph. In the eastbound direction, the posted speed limit is 35 mph just east of IL 59 and in the site vicinity until approximately 2,000 west of Book Road where it becomes 50 mph. The speed limit returns to 45 mph once east of the DuPage River.

Book Road

- Book Road is currently shown as a Minor Arterial on the City of Naperville Master Thoroughfare Plan. It intersects 119th Street at the east end of the site and currently dead-ends north of 119th Street.
- One unstriped travel lane is provided in each direction. The Book Road approaches at 119th Street have Stop control.
- Book Road continues north of 111th Street and is also classified as a Minor Arterial route by the City; however, it is classified as a Major Collector on the IDOT Functional Classification Map. It has a three-lane pavement section.

Discussion Point. There are two projects anticipated on Book Road. The first is the vacation of the road from 119th Street to 127th Street in the Village of Plainfield. The second is the relocation and construction from 119th Street to 111th Street in the City of Naperville.

Wolf Drive

- Wolf Drive is a local street that has its northern terminus at 119th Street.
- It has one travel lane in each direction and has Stop control at 119th Street.

Existing Traffic

GHA conducted weekday morning and evening peak period traffic counts on Thursday, October 12, 2017. *Exhibit 3* summarizes the peak hour traffic volumes, which occurred from 7:15-8:15 AM and 5:00-6:00 PM, as well as the Average Daily Traffic (ADT) 24-hour volumes that were obtained from the IDOT web-site. Summaries of the existing traffic counts can be found in *Appendix A*. No unusual activities (e.g. roadway construction, or inclement weather) were observed during our counts that would be expected to impact traffic volumes or travel patterns in the site vicinity.

Discussion Point. The traffic counts for the 119th Street and Wolf Drive intersection were used as the "base" volumes, because Book Road south of 119th Street is to be vacated.

Part III. Project Traffic Characteristics

Site Plan

Attached as *Exhibit 4* is the site plan for the Polo Club prepared by Gary R. Weber Associates, Inc. As proposed, the development consists of constructing 723 residential units:

- 95 single family homes that are age-targeted.
- 93 townhomes that are age-targeted.
- 78, 2-story townhomes.
- 148, 3-story townhomes.
- 309 apartment units

The Polo Club access system will include:

- A street intersection (Hawkweed Drive) for the homes and townhomes on relocated Book Road.
- A street intersection (Polo Club Drive) on 119th Street for the homes and townhomes.
- A street connection to the north for the homes and townhomes at Hawkweed Drive.
- A full access for the apartments located on 119th Street, opposite Wolf Drive.
- A limited access (right turns in/out only) for the apartments at the west end of the site on 119th Street.

Traffic Generations and Trip Distribution

Exhibit 5 – Part A tabulates the traffic generation calculations for the proposed development. Traffic generations are based on historically observed trip rate data published by the Institute of Transportation Engineers (ITE) in the most recent, 10th Edition of the manual *Trip Generation*. The pertinent trip generation pages for the various residential land uses are included as *Appendix B*.

> *Discussion Point.* Even though many of the dwellings will be "age-targeted", the standard higher generation rates for single and multi-family dwellings were used. The actual traffic generations for the age-targeted area may be 25-35% lower than calculated in *Exhibit 5 – Part A*. This will help ensure that maximum potential site traffic impacts are tested.

Exhibit 5 – Part B presents the anticipated trip distribution, which is primarily based on the expected vehicle patterns, the street system characteristics, as well as the proposed access system.

Site and Total Traffic Assignments

Exhibit 6 illustrates the Site Traffic assignment during the weekday morning and weekday evening peak hours, which is based on the traffic characteristics summarized in *Exhibit 5* (traffic generations and trip distribution) and assigned to the area roadways.

Typical industry practice suggests that other area development growth be considered to project volumes to test for an analysis horizon that is "build-out + 5-years". CMAP was contacted for their Year 2040 traffic projections. Build-out is expected to be completed in 2020. Thus, the future analysis horizon becomes the Year 2025.

Site traffic and the existing volumes (see *Exhibits 6 and 3, respectively*) were combined, adjusted for the CMAP projected 10% growth on 119th Street to produce the Year 2025 Total Traffic assignment, which is presented in *Exhibit 7*.

> *Discussion Point.* The traffic assignments assume that Book Road will be vacated south of 119th Street and will be relocated and constructed north of 119th Street through the site to meet Wild Timothy Road in the neighborhood to the north.

Part IV. Traffic Evaluation and Recommendations

Intersection Capacity Analyses

Intersection capacity analyses were conducted using the Highway Capacity Software (HCS) and results are shown in *Exhibit 8*. The analysis parameters are listed in Part A, as published in the Transportation Research Board's (TRB) *Highway Capacity Manual – 6th Edition*, 2016 (HCM). At signalized intersections, Level of Service (LOS) "reports" traffic operations using the letter designations "A" (best) through "F" (worst). LOS reports operations based on the average control delay per vehicle in seconds. At unsignalized intersections where the minor approaches have stop control, the HCS measurement is approach delay in seconds.

LOS C is often referred to as the intersection "design" guideline and LOS D is typically considered as providing the lower threshold of "acceptable" operations. LOS E and F are usually considered "unacceptable". The results are summarized in *Exhibit 8 and t*he HCS summary printouts are provided in *Appendix C*.

Discussion Point. The capacity analyses results indicate that the study area intersections and approaches will operate at acceptable levels of service (LOS D or better) for the Year 2025 analysis horizon, with exception of the southbound left turn movement exiting the apartments, opposite Wolf Drive, during the weekday evening peak hour that will operate near the LOS D / LOS E threshold.

Roadway and Site Access Operations

119th Street

- The preliminary engineering plans prepared by CEMCON indicate that 119th Street will be widened to a 3-lane pavement section along the site, then taper back to a 2-lane section east of Book Road (relocated).
- The road design will include curb and gutter. Per the IDOT BDE Manual, roads with curb and gutter should have a maximum posted speed limit of 45-mph.
- As the Polo Club development becomes built-out, a speed study should be conducted along 119th Street to determine if the posted limit can be reduced even further.

Book Road (Relocated)

- The CEMCON plans indicate that Book Road (relocated) will be constructed as a 3-lane pavement section with curb and gutter from 119th Street north through the site to Wild Timothy Road.
- The posted speed limit on Book Road north of 111th Street is 40-mph. Prior to completing the stretch of road, between Wild Timothy Road and 111th Street, it may be appropriate to initially post a slower speed limit.

119th Street @ Book Road (Relocated)

- A separate eastbound left turn lane is to be provided.
- Two southbound lanes, striped for separate left and right turns, should be provided.
- Book Road should have Stop control.

Book Road @ Hawkweed Drive

- The site access may have a landscape median separating the inbound and outbound lanes.
- Exiting site traffic should have Stop control.

119th Street @ Polo Club Drive

- A separate eastbound left turn lane is to be provided.
- Two southbound lanes are to be provided and striped for separate left and right turns.
- A landscaped median may separate the inbound and outbound lanes.
- Southbound street traffic should have Stop control.

Polo Club Drive @ Hawkweed Drive

- One travel lane should be provided on all four intersection approaches.
- All-way Stop control should be considered at this on-site intersection.
- Other Polo Club streets should have Stop control at Polo Club Drive and Hawkweed Drive.

119th Street @ Wolf Drive / Apartment Access

- Separate eastbound and westbound left turn lanes are to be provided.
- Two southbound access lanes are to be provided. They should be striped for a shared left / through lane and a separate right turn lane, to best align with the Wolf Drive approach.
- Exiting apartment traffic should have Stop control.

119th Street @ Western Apartment Access

- One inbound and one outbound lane should be provided.
- To help physically and visually demonstrate that access is limited to right turns in/out only, a channeling island should be provided between the inbound and outbound lanes.
- Exiting apartment traffic should have Stop control.

Part V. Technical Addendum

The following *Exhibits* and *Appendices* were previously referenced. They provide technical support for our observations, findings and recommendations discussed in the text.

Exhibits

1. Aerial Location Map
2. Photo Inventory
3. Existing Traffic
4. Site Plan
5. Traffic Characteristics
6. Site Traffic
7. Total Traffic – Year 2025
8. Intersection Capacity Analyses

Appendices

A. Traffic Count Summaries
B. ITE Trip Generation Manual - 10th Edition Land Use Excerpts
C. Capacity Analyses Printouts

EXHIBITS

Proposed Residential Development – Unincorporated Will County, Illinois

GEWALT HAMILTON ASSOCIATES, INC.

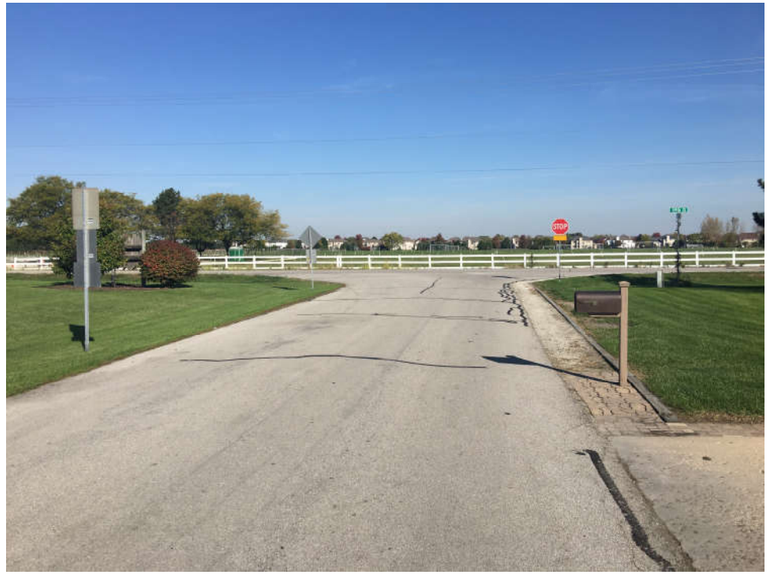
Exhibit 1
Location Map

Looking south along Book Rd at 119th St

Looking west along 119th St at Book Rd

Looking north along Book Rd at 119th St

Looking east along 119th St at Book Rd



Looking north along Wolf Dr at 119th St

Looking east along 119th St at Wolf Dr

Looking west along 119th St at Wolf Dr

Looking south along Wolf Dr from 119th St

Looking west from Book Rd at Site

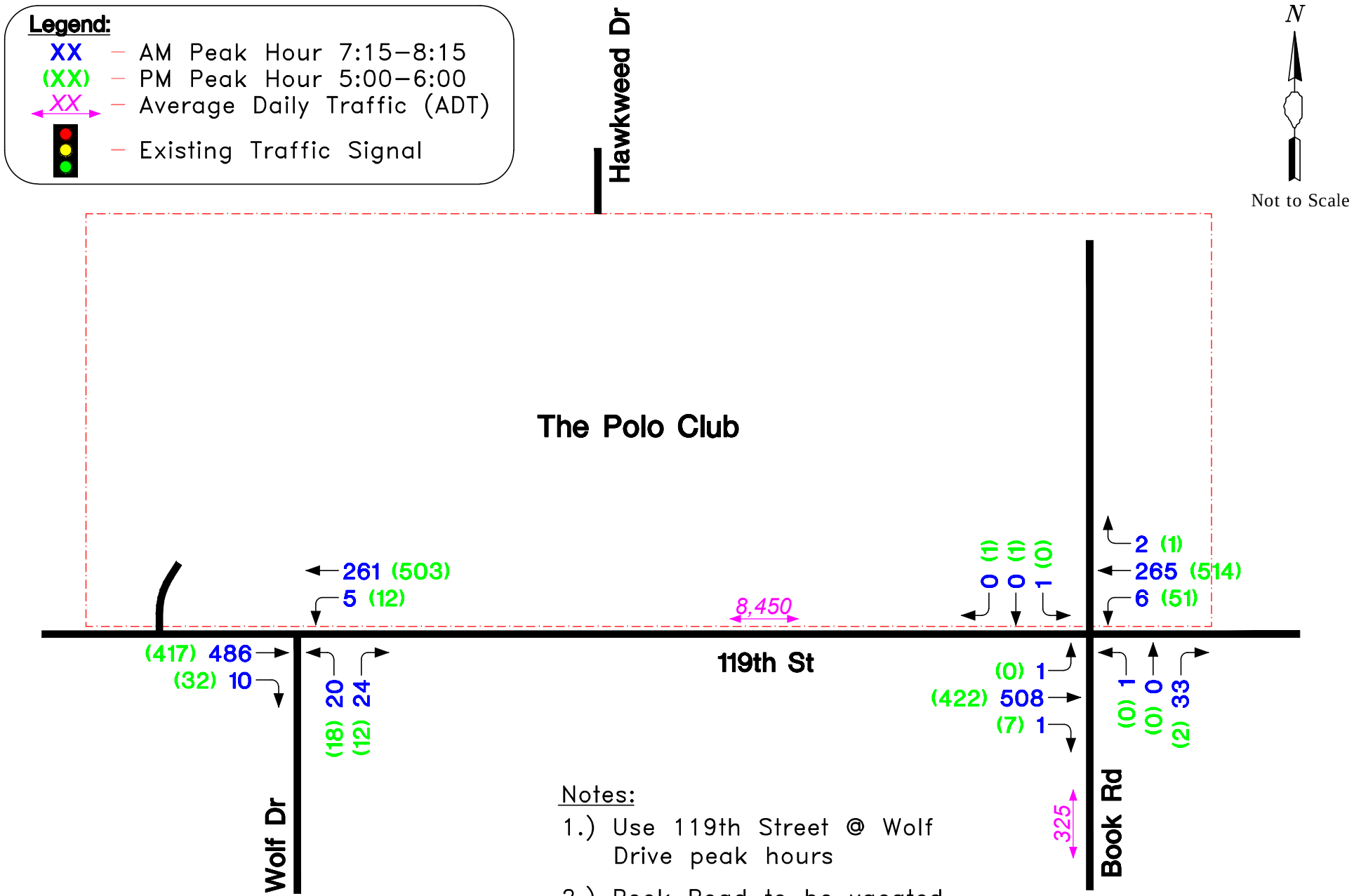


Exhibit 3
Existing Traffic
Sources: 1) GHA Oct 2017
2) IDOT Website

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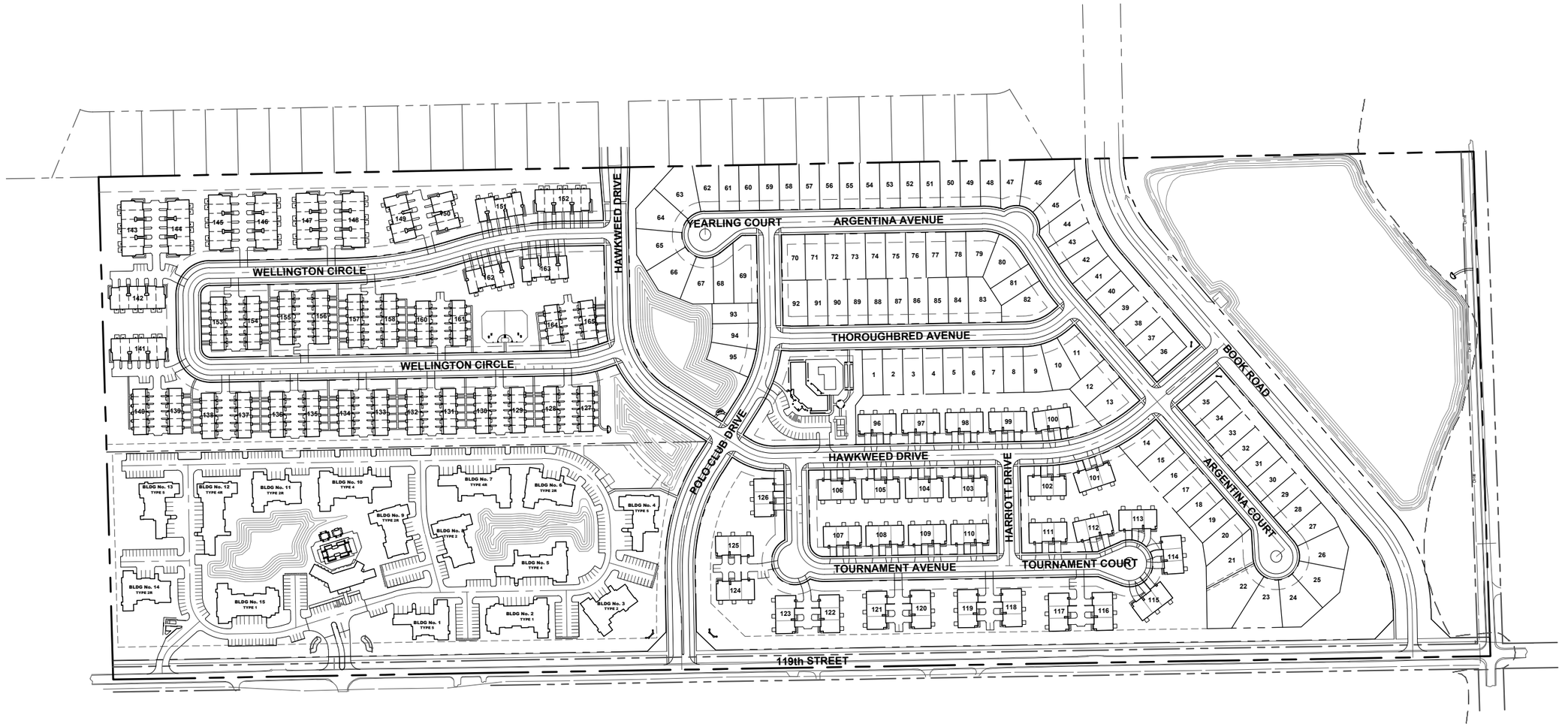

LAND USE	UNITS
SINGLE FAMILY DETACHED	95
SINGLE FAMILY ATTACHED	319
MULTI-FAMILY	309
TOTAL	723

0 150' 300' 600'
SCALE: 1"=300'

NORTH

SITE PLAN
NAPERVILLE, ILLINOIS

5/14/2018

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Exhibit 5
Project Traffic Characteristics
Polo Club Subdivision - Naperville, IL.

Part A. Traffic Generation Calculations

			Weekday Peak Hours						
		ITE	Morning			Evening			Daily
	Size	Code	In	Out	Sum	In	Out	Sum	Sum
Age Targeted									
Single Family	95 Dwellings	#210	18	54	72	61	36	97	990
Townhomes	93 Dwellings; 2-story	#220	10	34	44	35	20	55	662
Non-Age Targeted									
Buckingham Townhomes	78 Dwellings; 2-story	#220	9	29	38	30	17	47	548
Seaboard Townhomes	148 Dwellings; 3-story	#221	13	37	50	39	25	64	804
	Subtotals =		**50**	**154**	**204**	**165**	**98**	**263**	**3,004**
Apartments	309 Units	#220	32	107	139	101	60	161	2,296
	Totals =		**82**	**261**	**343**	**266**	**158**	**424**	**5,300**

Notes:

1) Source: Institute of Transportation Engineers (ITE) Trip Generation Manual (10th Edition).

2) No trip discounts taken for age-targeted residences. The actual generations may be 25-35% lower.

3) Assumes Book Road constructed from 119th Street north to Wild Timothy Road.

Part B. Trip Distribution

Route & Direction	Percent Use To/From Site
119th Street	
- East of Book Road	40%
- West of Wolf Drive	50%
Hawkweed Drive	
- North of Site	5%
Wolf Drive	
- South of 119th Street	Negligible
Book Road	
- North of Site	5%
- South of 119th Street	To be vacated
Totals =	100%

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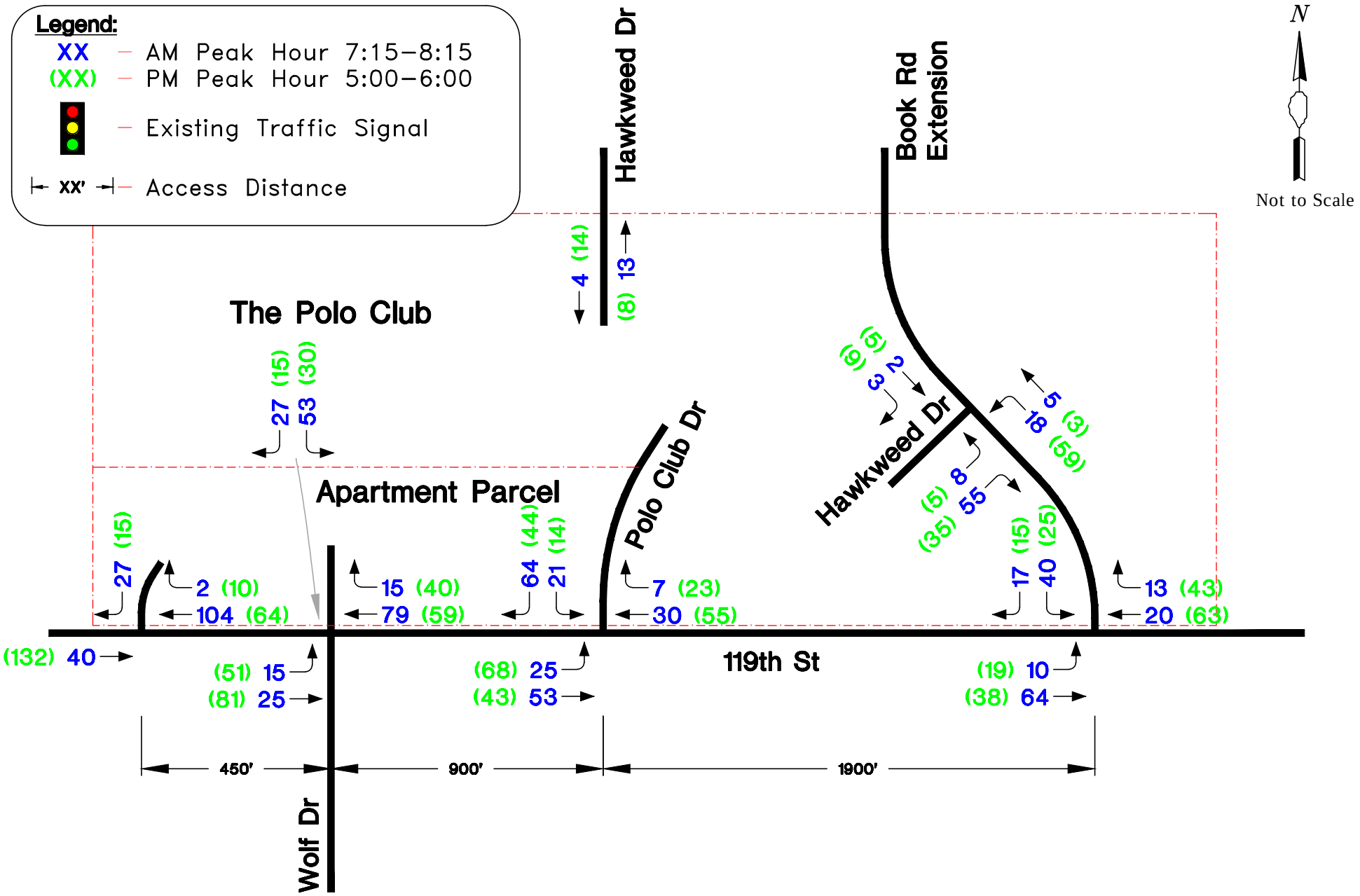

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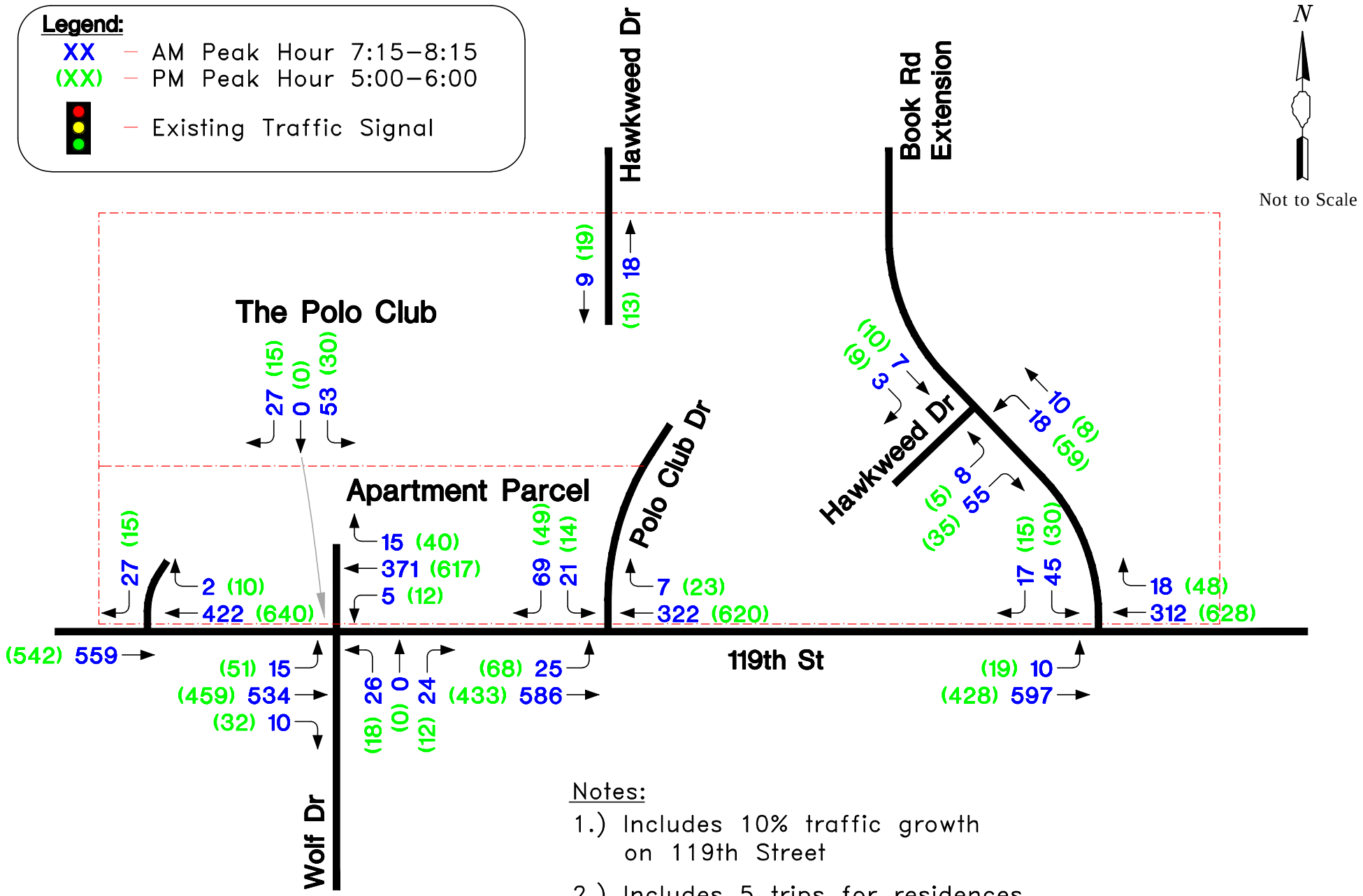
Exhibit 6
Site Traffic



Notes:

1.) Includes 10% traffic growth on 119th Street

2.) Includes 5 trips for residences to the north

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Exhibit 7
Total Traffic

Exhibit 8
Intersection Capacity Analyses
Polo Club - Naperville, Illinois

Part A. Parameters - Type of Traffic Control (Source: 2016 Highway Capacity Manual)

I. Traffic Signals

LOS	Delay (sec / veh)	Description
A	≤ 10	All signal phases clear waiting vehicles without delay
B	>10 and ≤ 20	Minimal delay experienced on select signal phases
C	>20 and ≤ 35	Some delay experienced on several phases; often used as design criteria
D	>35 and ≤ 55	Usually considered as the acceptable delay standard
E	>55 and ≤ 80	Very long delays experienced during the peak hours
F	>80	Unacceptable delays experienced throughout the peak hours

II. Stop Sign

LOS	Delay (sec / veh)
A	≤ 10
B	>10 and ≤ 15
C	>15 and ≤ 25
D	>25 and ≤ 35
E	>35 and ≤ 50
F	>50

Part B. Results

	Traffic Control & Roadway Conditions	LOS Per Movement Group By Approach (> = Shared Lane; - = Non Critical or not Allowed Movement; TRT - Shared Through/Right lane (with extra Through lane))												Intersection / Approach	
		Eastbound			Westbound			Northbound			Southbound			Delay (sec / veh)	LOS
1. 119th Street @ Book Road	**SB Stops**	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	**SB Approach Delay**	
A. Weekday Morning Peak Hour															
Total Traffic - Year 2025 (see *Exhibit 7*)	• As Planned	A	-	-	-	-	-	-	-	-	C	-	B	18.9	C
B. Weekday Evening Peak Hour															
Total Traffic	• As Planned	A	-	-	-	-	-	-	-	-	D	-	B	22.7	C
2. 119th Street @ Polo Club Dr.	**SB Stops**	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	**SB Approach Delay**	
A. Weekday Morning Peak Hour															
Total Traffic	• As Planned	A	-	-	-	-	-	-	-	-	C	-	B	13.3	B
B. Weekday Evening Peak Hour															
Total Traffic	• As Planned	A	-	-	-	-	-	-	-	-	D	-	B	17.6	C
3. 119th Street @ Wolf Dr. / Apartments	**NB/SB Stops**	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	**SB Approach Delay**	
A. Weekday Morning Peak Hour															
Total Traffic	• As Planned	A	-	-	A	-	-	>	C	<	D	<	B	24.9	C
B. Weekday Evening Peak Hour															
Total Traffic	• As Planned	A	-	-	A	-	-	>	D	<	E	<	B	36.1	E

GHA GEWALT HAMILTON ASSOCIATES, INC.

APPENDIX A

Existing Traffic Count Summaries

Gewalt Hamilton Associates Inc.
625 Forest Edge Drive

Vernon Hills, Illinois, United States 60061
(847) 478-9700 jopitz@gha-engineers.com

Count Name: W 119th St & Book Rd
Site Code:
Start Date: 10/12/2017

Turning Movement Data

Start Time	Book Rd Southbound					119th St Westbound					Book Rd Northbound					119th St Eastbound					
	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Int. Total
6:00 AM	0	0	0	0	0	0	24	0	0	24	1	0	1	0	2	1	80	0	0	81	107
6:15 AM	0	0	0	0	0	0	45	0	0	45	0	0	0	0	0	0	80	0	0	80	125
6:30 AM	0	0	0	0	0	0	45	0	0	45	3	0	1	0	4	0	127	0	0	127	176
6:45 AM	0	0	0	0	0	0	63	3	0	66	11	0	0	0	11	1	128	0	0	129	206
Hourly Total	0	0	0	0	0	0	177	3	0	180	15	0	2	0	17	2	415	0	0	417	614
7:00 AM	0	0	0	0	0	0	46	2	0	48	12	0	1	0	13	0	120	0	0	120	181
7:15 AM	0	0	0	0	0	1	61	1	0	63	7	0	0	0	7	0	147	0	0	147	217
7:30 AM	0	0	1	0	1	1	64	0	0	65	3	0	0	0	3	0	149	1	0	150	219
7:45 AM	0	0	0	0	0	0	69	0	0	69	3	0	1	0	4	0	111	0	0	111	184
Hourly Total	0	0	1	0	1	2	240	3	0	245	25	0	2	0	27	0	527	1	0	528	801
8:00 AM	0	0	0	0	0	0	73	0	0	73	3	0	0	0	3	0	117	1	0	118	194
8:15 AM	0	0	0	0	0	0	50	0	0	50	1	0	1	0	2	1	84	0	0	85	137
8:30 AM	0	0	0	0	0	0	72	1	0	73	0	0	0	0	0	1	95	0	0	96	169
8:45 AM	0	1	0	0	1	0	55	0	0	55	0	0	1	0	1	0	62	0	0	62	119
Hourly Total	0	1	0	0	1	0	250	1	0	251	4	0	2	0	6	2	358	1	0	361	619
*** BREAK ***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3:00 PM	0	0	0	0	0	0	108	0	0	108	1	0	1	0	2	1	64	0	0	65	175
3:15 PM	1	0	1	0	2	0	107	4	0	111	2	0	2	0	4	0	64	1	0	65	182
3:30 PM	0	0	0	0	0	0	112	3	0	115	0	0	2	0	2	1	83	1	0	85	202
3:45 PM	0	0	0	0	0	1	124	3	0	128	1	0	2	0	3	1	93	0	0	94	225
Hourly Total	1	0	1	0	2	1	451	10	0	462	4	0	7	0	11	3	304	2	0	309	784
4:00 PM	0	1	0	0	1	0	167	9	0	176	1	0	3	0	4	3	67	0	0	70	251
4:15 PM	0	0	0	0	0	0	143	7	0	150	1	0	2	0	3	5	84	0	0	89	242
4:30 PM	0	0	0	0	0	0	107	10	0	117	0	1	1	0	2	6	92	0	0	98	217
4:45 PM	1	0	1	0	2	0	111	13	0	124	0	0	1	0	1	1	72	2	0	75	202
Hourly Total	1	1	1	0	3	0	528	39	0	567	2	1	7	0	10	15	315	2	0	332	912
5:00 PM	0	0	0	0	0	1	138	7	0	146	0	0	0	0	0	1	88	0	0	89	235
5:15 PM	0	1	0	0	1	0	144	16	0	160	1	0	0	0	1	0	89	0	0	89	251
5:30 PM	1	0	0	0	1	0	112	13	0	125	0	0	0	0	0	4	113	0	0	117	243
5:45 PM	0	0	0	0	0	0	123	15	0	138	1	0	0	0	1	2	115	0	0	117	256
Hourly Total	1	1	0	0	2	1	517	51	0	569	2	0	0	0	2	7	405	0	0	412	985
Grand Total	3	3	3	0	9	4	2163	107	0	2274	52	1	20	0	73	29	2324	6	0	2359	4715
Approach %	33.3	33.3	33.3	0.0	-	0.2	95.1	4.7	0.0	-	71.2	1.4	27.4	0.0	-	1.2	98.5	0.3	0.0	-	-
Total %	0.1	0.1	0.1	0.0	0.2	0.1	45.9	2.3	0.0	48.2	1.1	0.0	0.4	0.0	1.5	0.6	49.3	0.1	0.0	50.0	-
Lights	3	3	3	0	9	4	2111	106	0	2221	51	1	19	0	71	29	2269	5	0	2303	4604
% Lights	100.0	100.0	100.0	-	100.0	100.0	97.6	99.1	-	97.7	98.1	100.0	95.0	-	97.3	100.0	97.6	83.3	-	97.6	97.6
Mediums	0	0	0	0	0	0	50	1	0	51	1	0	1	0	2	0	48	0	0	48	101
% Mediums	0.0	0.0	0.0	-	0.0	0.0	2.3	0.9	-	2.2	1.9	0.0	5.0	-	2.7	0.0	2.1	0.0	-	2.0	2.1
Articulated Trucks	0	0	0	0	0	0	2	0	0	2	0	0	0	0	0	0	7	0	0	7	9
% Articulated Trucks	0.0	0.0	0.0	-	0.0	0.0	0.1	0.0	-	0.1	0.0	0.0	0.0	-	0.0	0.0	0.3	0.0	-	0.3	0.2
Bicycles on Road	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1

% Bicycles on Road	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	0.0	16.7	-	0.0	0.0

Gewalt Hamilton Associates Inc.
625 Forest Edge Drive

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Count Name: W 119th St & Book Rd
Site Code:
Start Date: 10/12/2017

Turning Movement Peak Hour Data (6:45 AM)

Start Time	Book Rd Southbound					119th St Westbound					Book Rd Northbound					119th St Eastbound					
	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Int. Total
6:45 AM	0	0	0	0	0	0	63	3	0	66	11	0	0	0	11	1	128	0	0	129	206
7:00 AM	0	0	0	0	0	0	46	2	0	48	12	0	1	0	13	0	120	0	0	120	181
7:15 AM	0	0	0	0	0	1	61	1	0	63	7	0	0	0	7	0	147	0	0	147	217
7:30 AM	0	0	1	0	1	1	64	0	0	65	3	0	0	0	3	0	149	1	0	150	219
Total	0	0	1	0	1	2	234	6	0	242	33	0	1	0	34	1	544	1	0	546	823
Approach %	0.0	0.0	100.0	0.0	-	0.8	96.7	2.5	0.0	-	97.1	0.0	2.9	0.0	-	0.2	99.6	0.2	0.0	-	-
Total %	0.0	0.0	0.1	0.0	0.1	0.2	28.4	0.7	0.0	29.4	4.0	0.0	0.1	0.0	4.1	0.1	66.1	0.1	0.0	66.3	-
PHF	0.000	0.000	0.250	0.000	0.250	0.500	0.914	0.500	0.000	0.917	0.688	0.000	0.250	0.000	0.654	0.250	0.913	0.250	0.000	0.910	0.939
Lights	0	0	1	0	1	2	219	5	0	226	32	0	1	0	33	1	526	1	0	528	788
% Lights	-	-	100.0	-	100.0	100.0	93.6	83.3	-	93.4	97.0	-	100.0	-	97.1	100.0	96.7	100.0	-	96.7	95.7
Mediums	0	0	0	0	0	0	14	1	0	15	1	0	0	0	1	0	16	0	0	16	32
% Mediums	-	-	0.0	-	0.0	0.0	6.0	16.7	-	6.2	3.0	-	0.0	-	2.9	0.0	2.9	0.0	-	2.9	3.9
Articulated Trucks	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	2	0	0	2	3
% Articulated Trucks	-	-	0.0	-	0.0	0.0	0.4	0.0	-	0.4	0.0	-	0.0	-	0.0	0.0	0.4	0.0	-	0.4	0.4
Bicycles on Road	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bicycles on Road	-	-	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	0.0

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Count Name: W 119th St & Book Rd
Site Code:
Start Date: 10/12/2017

Turning Movement Peak Hour Data (5:00 PM)

Start Time	Book Rd Southbound					119th St Westbound					Book Rd Northbound					119th St Eastbound					
	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Int. Total
5:00 PM	0	0	0	0	0	1	138	7	0	146	0	0	0	0	0	1	88	0	0	89	235
5:15 PM	0	1	0	0	1	0	144	16	0	160	1	0	0	0	1	0	89	0	0	89	251
5:30 PM	1	0	0	0	1	0	112	13	0	125	0	0	0	0	0	4	113	0	0	117	243
5:45 PM	0	0	0	0	0	0	123	15	0	138	1	0	0	0	1	2	115	0	0	117	256
Total	1	1	0	0	2	1	517	51	0	569	2	0	0	0	2	7	405	0	0	412	985
Approach %	50.0	50.0	0.0	0.0	-	0.2	90.9	9.0	0.0	-	100.0	0.0	0.0	0.0	-	1.7	98.3	0.0	0.0	-	-
Total %	0.1	0.1	0.0	0.0	0.2	0.1	52.5	5.2	0.0	57.8	0.2	0.0	0.0	0.0	0.2	0.7	41.1	0.0	0.0	41.8	-
PHF	0.250	0.250	0.000	0.000	0.500	0.250	0.898	0.797	0.000	0.889	0.500	0.000	0.000	0.000	0.500	0.438	0.880	0.000	0.000	0.880	0.962
Lights	1	1	0	0	2	1	514	51	0	566	2	0	0	0	2	7	402	0	0	409	979
% Lights	100.0	100.0	-	-	100.0	100.0	99.4	100.0	-	99.5	100.0	-	-	-	100.0	100.0	99.3	-	-	99.3	99.4
Mediums	0	0	0	0	0	0	3	0	0	3	0	0	0	0	0	0	2	0	0	2	5
% Mediums	0.0	0.0	-	-	0.0	0.0	0.6	0.0	-	0.5	0.0	-	-	-	0.0	0.0	0.5	-	-	0.5	0.5
Articulated Trucks	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1
% Articulated Trucks	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	0.0	0.0	-	-	-	0.0	0.0	0.2	-	-	0.2	0.1
Bicycles on Road	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bicycles on Road	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

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Start Date: 10/12/2017

Turning Movement Data

Start Time	119th St Westbound				Wolf Dr Northbound				119th St Eastbound				Int. Total
	Thru	Left	U-Turn	App. Total	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	
6:00 AM	27	0	0	27	6	3	0	9	1	74	0	75	111
6:15 AM	41	1	0	42	0	5	0	5	1	81	0	82	129
6:30 AM	46	1	0	47	6	3	0	9	0	130	0	130	186
6:45 AM	58	0	0	58	10	5	0	15	0	116	0	116	189
Hourly Total	172	2	0	174	22	16	0	38	2	401	0	403	615
7:00 AM	57	0	0	57	3	6	0	9	0	126	0	126	192
7:15 AM	55	1	0	56	2	7	0	9	3	135	0	138	203
7:30 AM	63	1	0	64	9	5	0	14	1	138	0	139	217
7:45 AM	69	3	0	72	4	3	0	7	2	107	0	109	188
Hourly Total	244	5	0	249	18	21	0	39	6	506	0	512	800
8:00 AM	74	0	0	74	9	5	0	14	4	106	0	110	198
8:15 AM	46	2	0	48	3	3	0	6	5	87	0	92	146
8:30 AM	72	1	0	73	3	3	0	6	2	87	0	89	168
8:45 AM	55	1	0	56	2	8	0	10	5	65	0	70	136
Hourly Total	247	4	0	251	17	19	0	36	16	345	0	361	648
*** BREAK ***	-	-	-	-	-	-	-	-	-	-	-	-	-
3:00 PM	99	2	0	101	1	5	0	6	3	71	0	74	181
3:15 PM	107	3	0	110	0	7	0	7	4	63	0	67	184
3:30 PM	116	4	0	120	2	3	0	5	9	85	0	94	219
3:45 PM	118	3	0	121	2	5	0	7	7	87	0	94	222
Hourly Total	440	12	0	452	5	20	0	25	23	306	0	329	806
4:00 PM	149	9	0	158	1	4	0	5	8	74	0	82	245
4:15 PM	110	9	0	119	9	2	0	11	5	75	0	80	210
4:30 PM	131	7	1	139	3	2	0	5	4	87	0	91	235
4:45 PM	115	1	0	116	3	4	0	7	6	72	0	78	201
Hourly Total	505	26	1	532	16	12	0	28	23	308	0	331	891
5:00 PM	130	4	0	134	4	5	0	9	8	85	0	93	236
5:15 PM	141	4	0	145	2	7	0	9	8	100	0	108	262
5:30 PM	114	3	2	119	5	1	0	6	8	114	1	123	248
5:45 PM	118	1	1	120	1	5	0	6	8	118	0	126	252
Hourly Total	503	12	3	518	12	18	0	30	32	417	1	450	998
Grand Total	2111	61	4	2176	90	106	0	196	102	2283	1	2386	4758
Approach %	97.0	2.8	0.2	-	45.9	54.1	0.0	-	4.3	95.7	0.0	-	-
Total %	44.4	1.3	0.1	45.7	1.9	2.2	0.0	4.1	2.1	48.0	0.0	50.1	-
Lights	2067	56	4	2127	84	100	0	184	93	2234	1	2328	4639
% Lights	97.9	91.8	100.0	97.7	93.3	94.3	-	93.9	91.2	97.9	100.0	97.6	97.5
Mediums	37	4	0	41	5	6	0	11	9	43	0	52	104
% Mediums	1.8	6.6	0.0	1.9	5.6	5.7	-	5.6	8.8	1.9	0.0	2.2	2.2
Articulated Trucks	7	1	0	8	1	0	0	1	0	5	0	5	14
% Articulated Trucks	0.3	1.6	0.0	0.4	1.1	0.0	-	0.5	0.0	0.2	0.0	0.2	0.3
Bicycles on Road	0	0	0	0	0	0	0	0	0	1	0	1	1

% Bicycles on Road	0.0	0.0	0.0	0.0	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0	0.0

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Start Date: 10/12/2017

Turning Movement Peak Hour Data (7:15 AM)

Start Time	119th St Westbound				Wolf Dr Northbound				119th St Eastbound				
	Thru	Left	U-Turn	App. Total	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	Int. Total
7:15 AM	55	1	0	56	2	7	0	9	3	135	0	138	203
7:30 AM	63	1	0	64	9	5	0	14	1	138	0	139	217
7:45 AM	69	3	0	72	4	3	0	7	2	107	0	109	188
8:00 AM	74	0	0	74	9	5	0	14	4	106	0	110	198
Total	261	5	0	266	24	20	0	44	10	486	0	496	806
Approach %	98.1	1.9	0.0	-	54.5	45.5	0.0	-	2.0	98.0	0.0	-	-
Total %	32.4	0.6	0.0	33.0	3.0	2.5	0.0	5.5	1.2	60.3	0.0	61.5	-
PHF	0.882	0.417	0.000	0.899	0.667	0.714	0.000	0.786	0.625	0.880	0.000	0.892	0.929
Lights	251	4	0	255	22	17	0	39	6	478	0	484	778
% Lights	96.2	80.0	-	95.9	91.7	85.0	-	88.6	60.0	98.4	-	97.6	96.5
Mediums	8	1	0	9	1	3	0	4	4	8	0	12	25
% Mediums	3.1	20.0	-	3.4	4.2	15.0	-	9.1	40.0	1.6	-	2.4	3.1
Articulated Trucks	2	0	0	2	1	0	0	1	0	0	0	0	3
% Articulated Trucks	0.8	0.0	-	0.8	4.2	0.0	-	2.3	0.0	0.0	-	0.0	0.4
Bicycles on Road	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bicycles on Road	0.0	0.0	-	0.0	0.0	0.0	-	0.0	0.0	0.0	-	0.0	0.0

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Site Code:
Start Date: 10/12/2017

Turning Movement Peak Hour Data (5:00 PM)

Start Time	119th St Westbound				Wolf Dr Northbound				119th St Eastbound				
	Thru	Left	U-Turn	App. Total	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	Int. Total
5:00 PM	130	4	0	134	4	5	0	9	8	85	0	93	236
5:15 PM	141	4	0	145	2	7	0	9	8	100	0	108	262
5:30 PM	114	3	2	119	5	1	0	6	8	114	1	123	248
5:45 PM	118	1	1	120	1	5	0	6	8	118	0	126	252
Total	503	12	3	518	12	18	0	30	32	417	1	450	998
Approach %	97.1	2.3	0.6	-	40.0	60.0	0.0	-	7.1	92.7	0.2	-	-
Total %	50.4	1.2	0.3	51.9	1.2	1.8	0.0	3.0	3.2	41.8	0.1	45.1	-
PHF	0.892	0.750	0.375	0.893	0.600	0.643	0.000	0.833	1.000	0.883	0.250	0.893	0.952
Lights	498	12	3	513	12	18	0	30	32	414	1	447	990
% Lights	99.0	100.0	100.0	99.0	100.0	100.0	-	100.0	100.0	99.3	100.0	99.3	99.2
Mediums	5	0	0	5	0	0	0	0	0	3	0	3	8
% Mediums	1.0	0.0	0.0	1.0	0.0	0.0	-	0.0	0.0	0.7	0.0	0.7	0.8
Articulated Trucks	0	0	0	0	0	0	0	0	0	0	0	0	0
% Articulated Trucks	0.0	0.0	0.0	0.0	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0	0.0
Bicycles on Road	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bicycles on Road	0.0	0.0	0.0	0.0	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0	0.0

APPENDIX B

ITE Trip Generation Excerpts – 10th Edition

Land Use: 210
Single-Family Detached Housing

Description

Single-family detached housing includes all single-family detached homes on individual lots. A typical site surveyed is a suburban subdivision.

Additional Data

The number of vehicles and residents had a high correlation with average weekday vehicle trip ends. The use of these variables was limited, however, because the number of vehicles and residents was often difficult to obtain or predict. The number of dwelling units was generally used as the independent variable of choice because it was usually readily available, easy to project, and had a high correlation with average weekday vehicle trip ends.

This land use included data from a wide variety of units with different sizes, price ranges, locations, and ages. Consequently, there was a wide variation in trips generated within this category. Other factors, such as geographic location and type of adjacent and nearby development, may also have had an effect on the site trip generation.

Single-family detached units had the highest trip generation rate per dwelling unit of all residential uses because they were the largest units in size and had more residents and more vehicles per unit than other residential land uses; they were generally located farther away from shopping centers, employment areas, and other trip attractors than other residential land uses; and they generally had fewer alternative modes of transportation available because they were typically not as concentrated as other residential land uses.

Time-of-day distribution data for this land use are presented in Appendix A. For the six general urban/suburban sites with data, the overall highest vehicle volumes during the AM and PM on a weekday were counted between 7:15 and 8:15 a.m. and 4:00 and 5:00 p.m., respectively. For the two sites with Saturday data, the overall highest vehicle volume was counted between 3:00 and 4:00 p.m. For the one site with Sunday data, the overall highest vehicle volume was counted between 10:15 and 11:15 a.m.

The sites were surveyed in the 1980s, the 1990s, the 2000s, and the 2010s in California, Connecticut, Delaware, Illinois, Indiana, Maryland, Minnesota, Montana, New Jersey, North Carolina, Ohio, Oregon, Pennsylvania, South Carolina, South Dakota, Tennessee, Vermont, and Virginia.

Source Numbers

100, 105, 114, 126, 157, 167, 177, 197, 207, 211, 217, 267, 275, 293, 300, 319, 320, 356, 357, 367, 384, 387, 407, 435, 522, 550, 552, 579, 598, 601, 603, 614, 637, 711, 716, 720, 728, 735, 868, 903, 925, 936

Single-Family Detached Housing
(210)

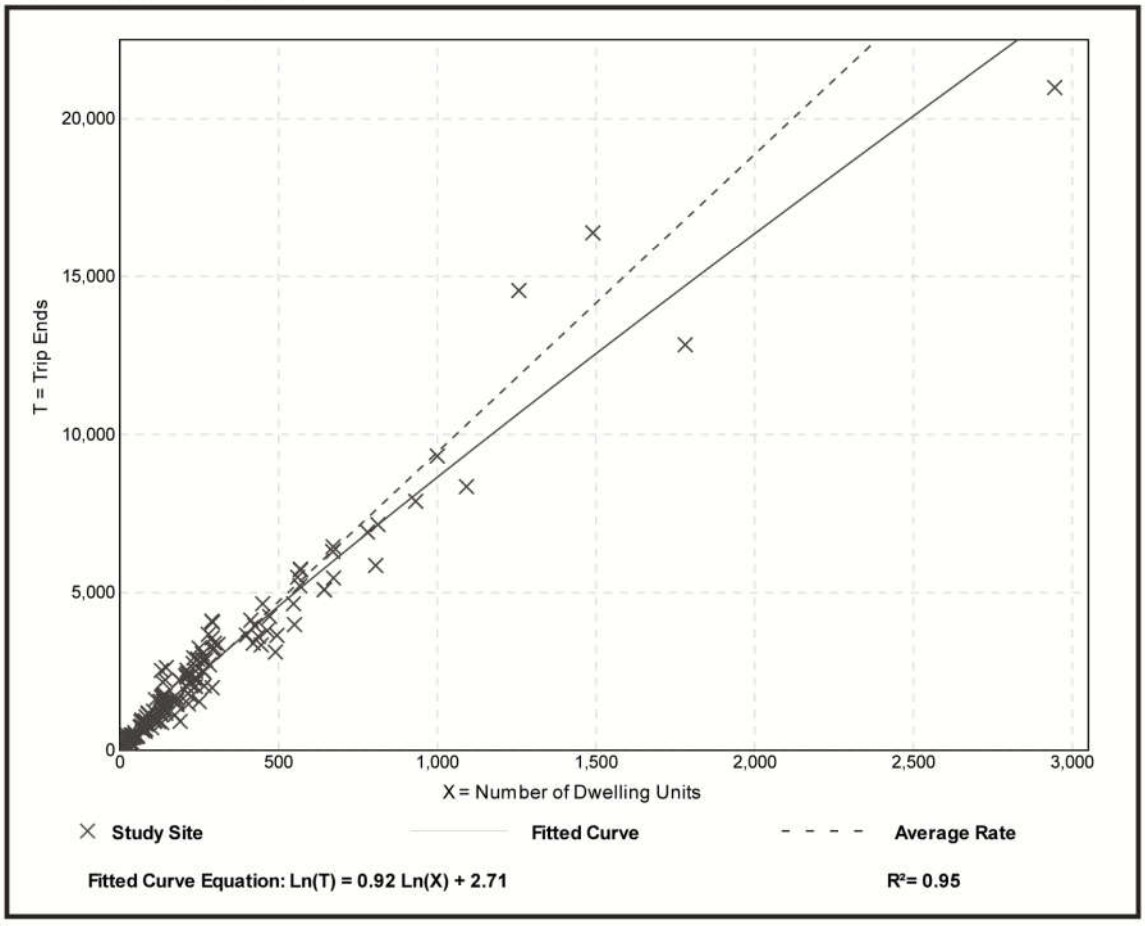
Vehicle Trip Ends vs: **Dwelling Units**
On a: **Weekday**

Setting/Location: **General Urban/Suburban**
Number of Studies: 159
Avg. Num. of Dwelling Units: 264
Directional Distribution: 50% entering, 50% exiting

Vehicle Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
9.44	4.81 - 19.39	2.10

Data Plot and Equation



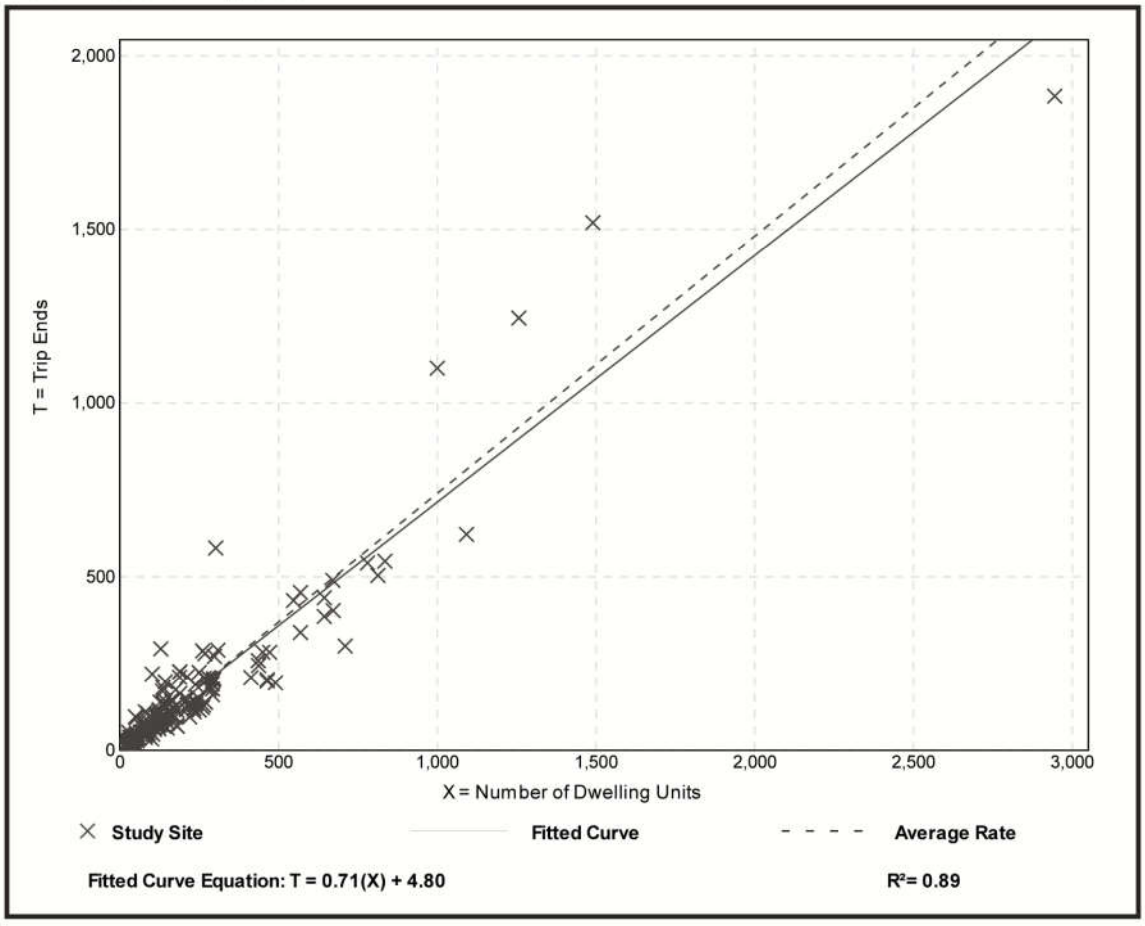
Single-Family Detached Housing
(210)

Vehicle Trip Ends vs: **Dwelling Units**
On a: **Weekday,**
Peak Hour of Adjacent Street Traffic,
One Hour Between 7 and 9 a.m.
Setting/Location: **General Urban/Suburban**
Number of Studies: 173
Avg. Num. of Dwelling Units: 219
Directional Distribution: 25% entering, 75% exiting

Vehicle Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
0.74	0.33 - 2.27	0.27

Data Plot and Equation



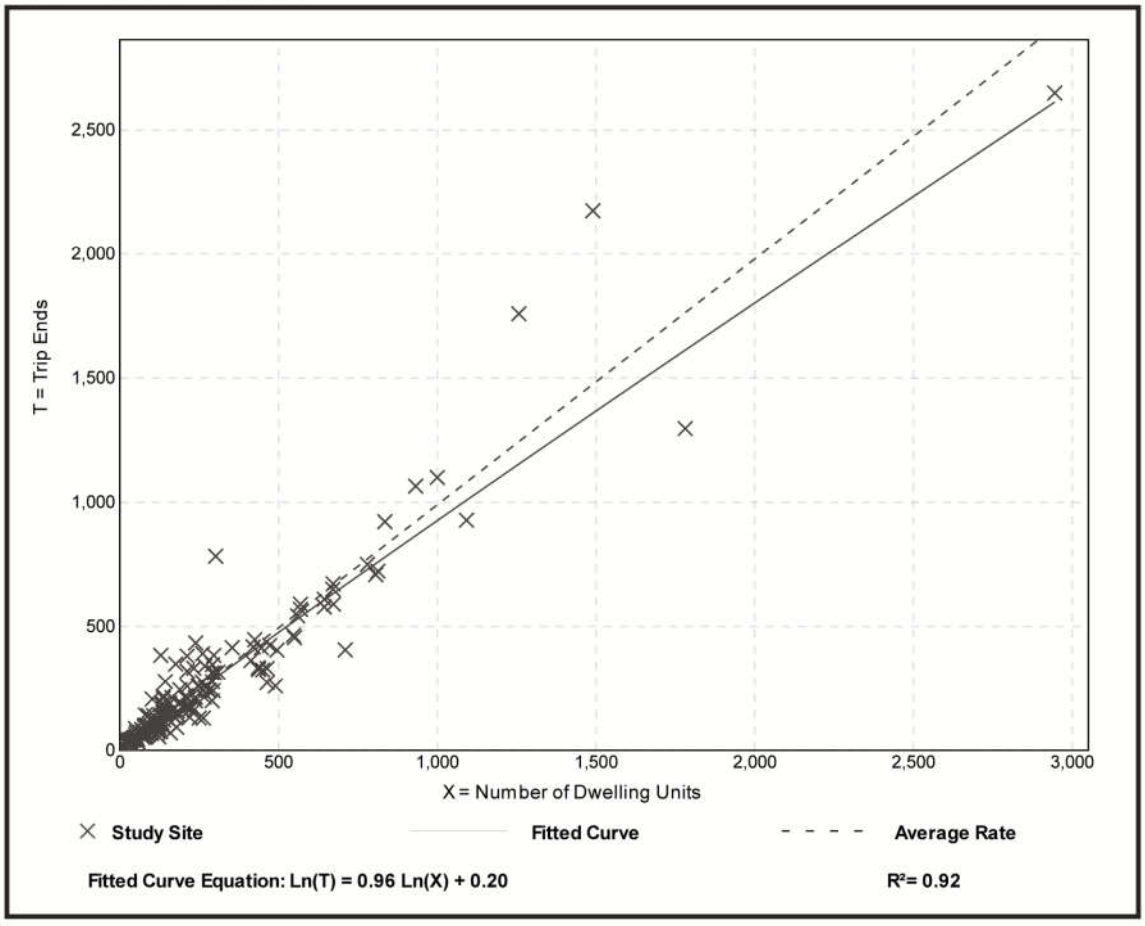
Single-Family Detached Housing
(210)

Vehicle Trip Ends vs: **Dwelling Units**
On a: **Weekday,**
Peak Hour of Adjacent Street Traffic,
One Hour Between 4 and 6 p.m.
Setting/Location: **General Urban/Suburban**
Number of Studies: 190
Avg. Num. of Dwelling Units: 242
Directional Distribution: 63% entering, 37% exiting

Vehicle Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
0.99	0.44 - 2.98	0.31

Data Plot and Equation



Land Use: 220
Multifamily Housing (Low-Rise)

Description

Low-rise multifamily housing includes apartments, townhouses, and condominiums located within the same building with at least three other dwelling units and that have one or two levels (floors). Multifamily housing (mid-rise) (Land Use 221), multifamily housing (high-rise) (Land Use 222), and off-campus student apartment (Land Use 225) are related land uses.

Additional Data

In prior editions of *Trip Generation Manual*, the low-rise multifamily housing sites were further divided into rental and condominium categories. An investigation of vehicle trip data found no clear differences in trip making patterns between the rental and condominium sites within the ITE database. As more data are compiled for future editions, this land use classification can be reinvestigated.

For the three sites for which both the number of residents and the number of occupied dwelling units were available, there were an average of 2.72 residents per occupied dwelling unit.

For the two sites for which the numbers of both total dwelling units and occupied dwelling units were available, an average of 96.2 percent of the total dwelling units were occupied.

This land use included data from a wide variety of units with different sizes, price ranges, locations, and ages. Consequently, there was a wide variation in trips generated within this category. Other factors, such as geographic location and type of adjacent and nearby development, may also have had an effect on the site trip generation.

Time-of-day distribution data for this land use are presented in Appendix A. For the 10 general urban/suburban sites with data, the overall highest vehicle volumes during the AM and PM on a weekday were counted between 7:15 and 8:15 a.m. and 4:45 and 5:45 p.m., respectively. For the one site with Saturday data, the overall highest vehicle volume was counted between 9:45 and 10:45 a.m. For the one site with Sunday data, the overall highest vehicle volume was counted between 11:45 a.m. and 12:45 p.m.

For the one dense multi-use urban site with 24-hour count data, the overall highest vehicle volumes during the AM and PM on a weekday were counted between 7:00 and 8:00 a.m. and 6:15 and 7:15 p.m., respectively.

For the three sites for which data were provided for both occupied dwelling units and residents, there was an average of 2.72 residents per occupied dwelling unit.

The average numbers of person trips per vehicle trip at the five general urban/suburban sites at which both person trip and vehicle trip data were collected were as follows:

- 1.13 during Weekday, Peak Hour of Adjacent Street Traffic, one hour between 7 and 9 a.m.
- 1.21 during Weekday, Peak Hour of Adjacent Street Traffic, one hour between 4 and 6 p.m.

The sites were surveyed in the 1980s, the 1990s, the 2000s, and the 2010s in British Columbia (CAN), California, District of Columbia, Florida, Georgia, Illinois, Indiana, Maine, Maryland, Minnesota, New Jersey, New York, Ontario, Oregon, Pennsylvania, South Dakota, Tennessee, Texas, Utah, Virginia, and Washington.

It is expected that the number of bedrooms and number of residents are likely correlated to the number of trips generated by a residential site. Many of the studies included in this land use did not indicate the total number of bedrooms. To assist in the future analysis of this land use, it is important that this information be collected and included in trip generation data submissions.

Source Numbers

168, 187, 188, 204, 211, 300, 305, 306, 319, 320, 321, 357, 390, 412, 418, 525, 530, 571, 579, 583, 864, 868, 869, 870, 896, 903, 918, 946, 947, 948, 951

Multifamily Housing (Low-Rise)
(220)

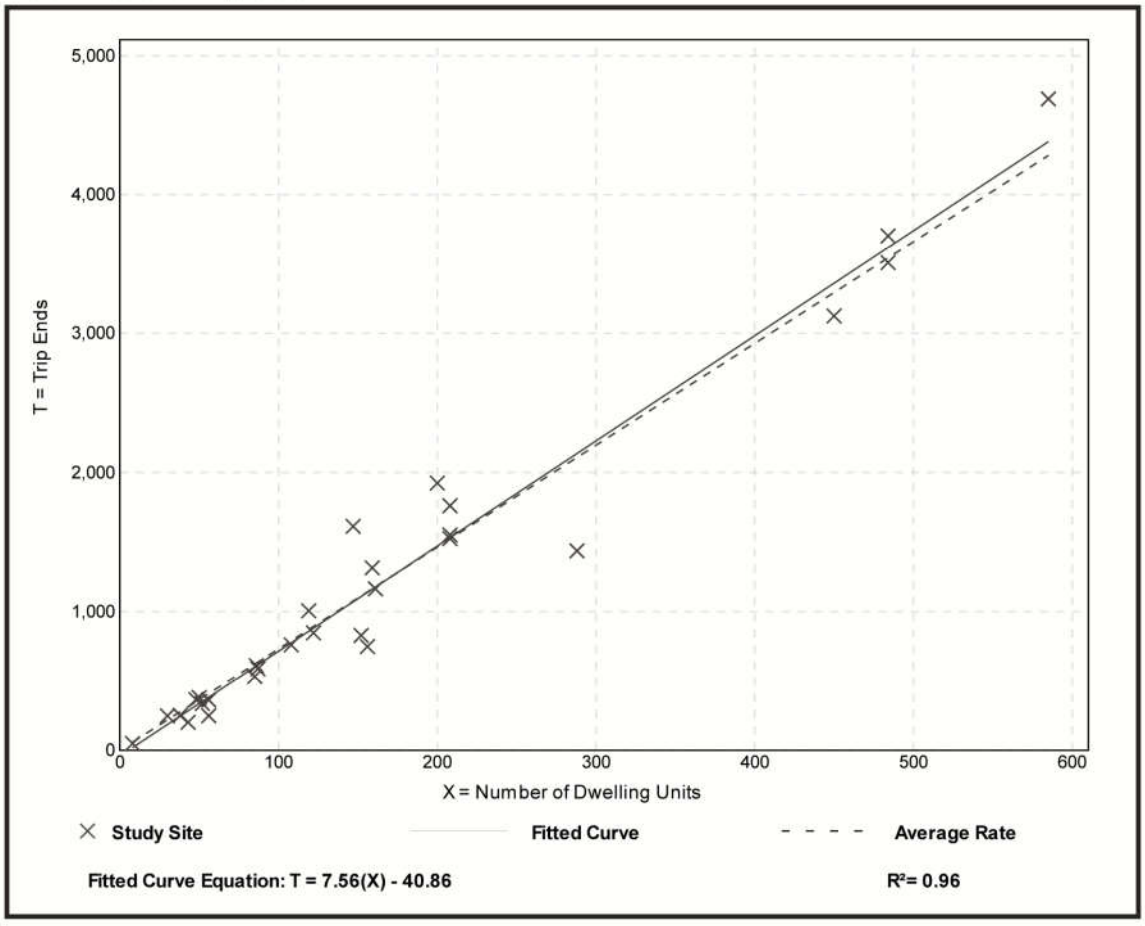
Vehicle Trip Ends vs: **Dwelling Units**
On a: **Weekday**

Setting/Location: **General Urban/Suburban**
Number of Studies: 29
Avg. Num. of Dwelling Units: 168
Directional Distribution: 50% entering, 50% exiting

Vehicle Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
7.32	4.45 - 10.97	1.31

Data Plot and Equation



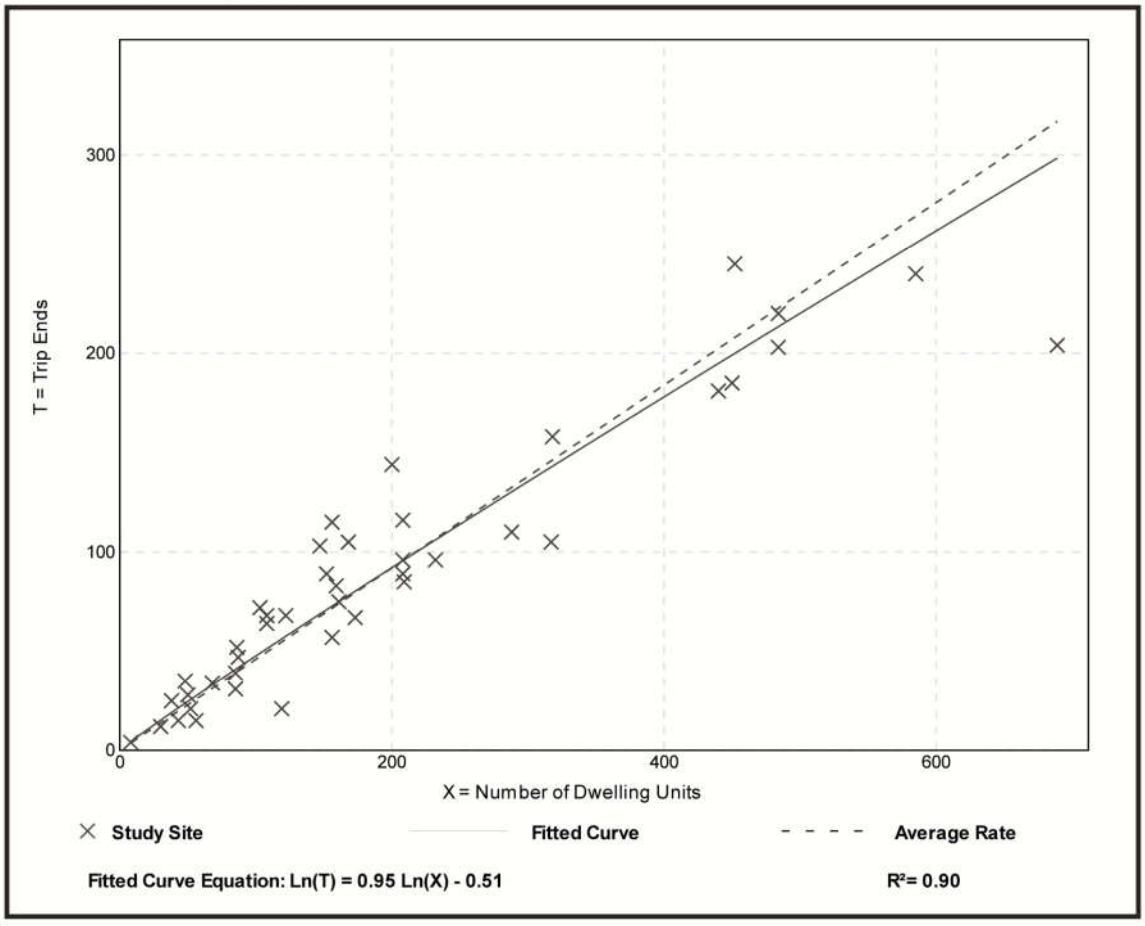
Multifamily Housing (Low-Rise)
(220)

Vehicle Trip Ends vs: **Dwelling Units**
On a: **Weekday,**
Peak Hour of Adjacent Street Traffic,
One Hour Between 7 and 9 a.m.
Setting/Location: **General Urban/Suburban**
Number of Studies: 42
Avg. Num. of Dwelling Units: 199
Directional Distribution: 23% entering, 77% exiting

Vehicle Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
0.46	0.18 - 0.74	0.12

Data Plot and Equation



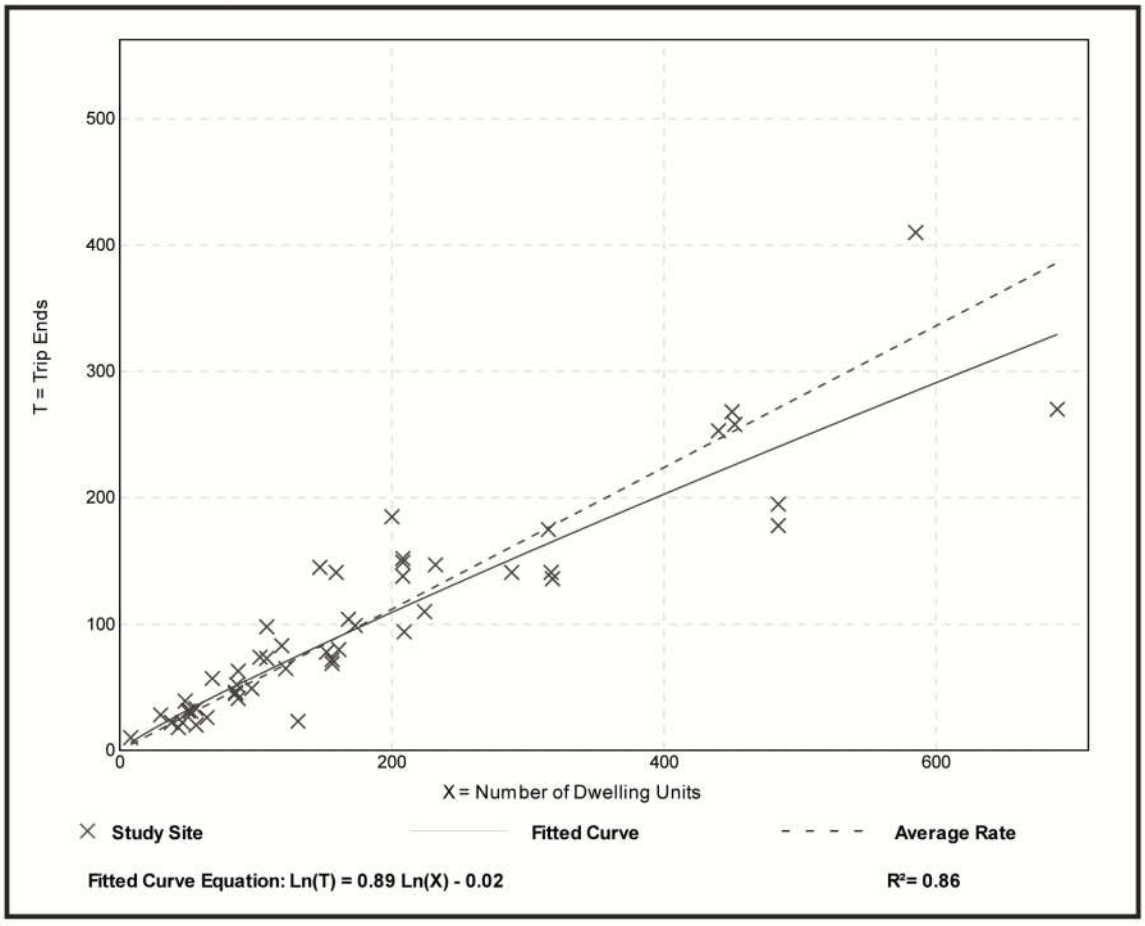
Multifamily Housing (Low-Rise)
(220)

Vehicle Trip Ends vs: **Dwelling Units**
On a: **Weekday,**
Peak Hour of Adjacent Street Traffic,
One Hour Between 4 and 6 p.m.
Setting/Location: **General Urban/Suburban**
Number of Studies: 50
Avg. Num. of Dwelling Units: 187
Directional Distribution: 63% entering, 37% exiting

Vehicle Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
0.56	0.18 - 1.25	0.16

Data Plot and Equation



Land Use: 221
Multifamily Housing (Mid-Rise)

Description

Mid-rise multifamily housing includes apartments, townhouses, and condominiums located within the same building with at least three other dwelling units and that have between three and 10 levels (floors). Multifamily housing (low-rise) (Land Use 220), multifamily housing (high-rise) (Land Use 222), off-campus student apartment (Land Use 225), and mid-rise residential with 1st-floor commercial (Land Use 231) are related land uses.

Additional Data

In prior editions of *Trip Generation Manual*, the mid-rise multifamily housing sites were further divided into rental and condominium categories. An investigation of vehicle trip data found no clear differences in trip making patterns between the rental and condominium sites within the ITE database. As more data are compiled for future editions, this land use classification can be reinvestigated.

For the six sites for which both the number of residents and the number of occupied dwelling units were available, there were an average of 2.46 residents per occupied dwelling unit.

For the five sites for which the numbers of both total dwelling units and occupied dwelling units were available, an average of 95.7 percent of the total dwelling units were occupied.

Time-of-day distribution data for this land use are presented in Appendix A. For the eight general urban/suburban sites with data, the overall highest vehicle volumes during the AM and PM on a weekday were counted between 7:00 and 8:00 a.m. and 4:45 and 5:45 p.m., respectively.

For the four dense multi-use urban sites with 24-hour count data, the overall highest vehicle volumes during the AM and PM on a weekday were counted between 7:15 and 8:15 a.m. and 4:15 and 5:15 p.m., respectively. For the three center city core sites with 24-hour count data, the overall highest vehicle volumes during the AM and PM on a weekday were counted between 6:45 and 7:45 a.m. and 5:00 and 6:00 p.m., respectively.

For the six sites for which data were provided for both occupied dwelling units and residents, there was an average of 2.46 residents per occupied dwelling unit.

For the five sites for which data were provided for both occupied dwelling units and total dwelling units, an average of 95.7 percent of the units were occupied.

The average numbers of person trips per vehicle trip at the five center city core sites at which both person trip and vehicle trip data were collected were as follows:

- 1.84 during Weekday, Peak Hour of Adjacent Street Traffic, one hour between 7 and 9 a.m.
- 1.94 during Weekday, AM Peak Hour of Generator
- 2.07 during Weekday, Peak Hour of Adjacent Street Traffic, one hour between 4 and 6 p.m.
- 2.59 during Weekday, PM Peak Hour of Generator

The average numbers of person trips per vehicle trip at the 32 dense multi-use urban sites at which both person trip and vehicle trip data were collected were as follows:

- 1.90 during Weekday, Peak Hour of Adjacent Street Traffic, one hour between 7 and 9 a.m.
- 1.90 during Weekday, AM Peak Hour of Generator
- 2.00 during Weekday, Peak Hour of Adjacent Street Traffic, one hour between 4 and 6 p.m.
- 2.08 during Weekday, PM Peak Hour of Generator

The average numbers of person trips per vehicle trip at the 13 general urban/suburban sites at which both person trip and vehicle trip data were collected were as follows:

- 1.56 during Weekday, Peak Hour of Adjacent Street Traffic, one hour between 7 and 9 a.m.
- 1.88 during Weekday, AM Peak Hour of Generator
- 1.70 during Weekday, Peak Hour of Adjacent Street Traffic, one hour between 4 and 6 p.m.
- 2.07 during Weekday, PM Peak Hour of Generator

The sites were surveyed in the 1980s, the 1990s, the 2000s, and the 2010s in Alberta (CAN), British Columbia (CAN), California, Delaware, District of Columbia, Florida, Georgia, Illinois, Maryland, Massachusetts, Minnesota, New Hampshire, New Jersey, Ontario, Oregon, Pennsylvania, South Carolina, South Dakota, Tennessee, Utah, Virginia, and Wisconsin.

Source Numbers

168, 188, 204, 305, 306, 321, 357, 390, 436, 525, 530, 579, 638, 818, 857, 866, 901, 904, 910, 912, 918, 934, 936, 939, 944, 947, 948, 949, 959, 963, 964, 966, 967, 969, 970

Multifamily Housing (Mid-Rise)
(221)

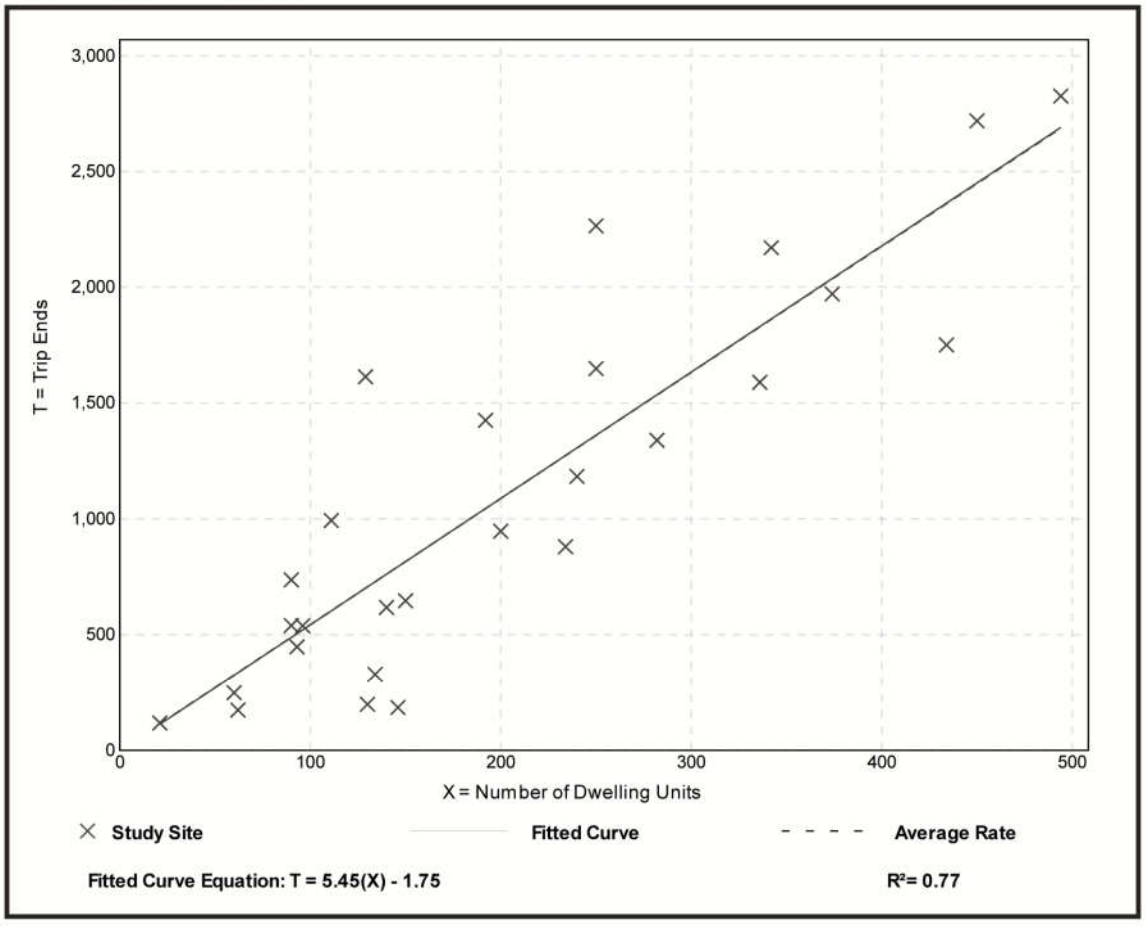
Vehicle Trip Ends vs: **Dwelling Units**
On a: **Weekday**

Setting/Location: **General Urban/Suburban**
Number of Studies: 27
Avg. Num. of Dwelling Units: 205
Directional Distribution: 50% entering, 50% exiting

Vehicle Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
5.44	1.27 - 12.50	2.03

Data Plot and Equation



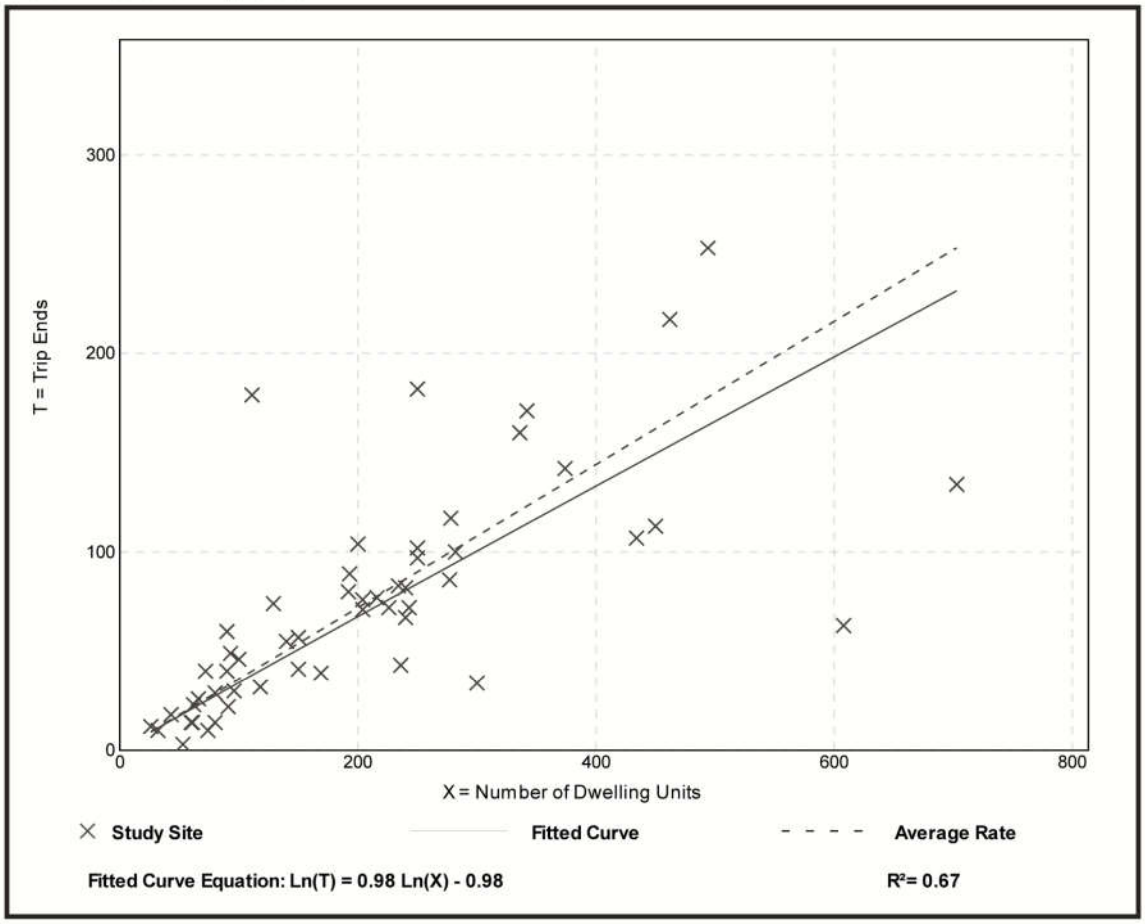
Multifamily Housing (Mid-Rise)
(221)

Vehicle Trip Ends vs: **Dwelling Units**
On a: **Weekday,**
Peak Hour of Adjacent Street Traffic,
One Hour Between 7 and 9 a.m.
Setting/Location: **General Urban/Suburban**
Number of Studies: 53
Avg. Num. of Dwelling Units: 207
Directional Distribution: 26% entering, 74% exiting

Vehicle Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
0.36	0.06 - 1.61	0.19

Data Plot and Equation



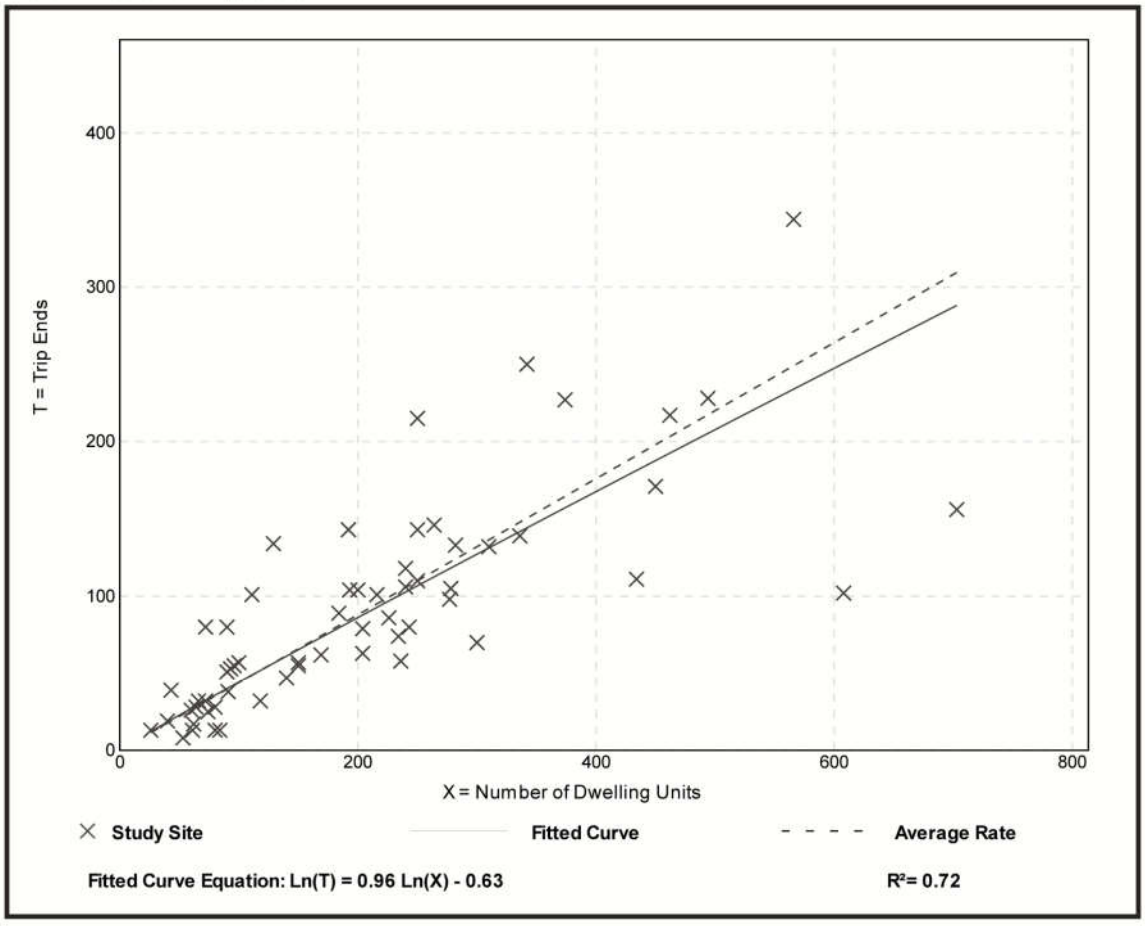
Multifamily Housing (Mid-Rise)
(221)

Vehicle Trip Ends vs: **Dwelling Units**
On a: **Weekday,**
Peak Hour of Adjacent Street Traffic,
One Hour Between 4 and 6 p.m.
Setting/Location: **General Urban/Suburban**
Number of Studies: 60
Avg. Num. of Dwelling Units: 208
Directional Distribution: 61% entering, 39% exiting

Vehicle Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
0.44	0.15 - 1.11	0.19

Data Plot and Equation



APPENDIX C

Capacity Analysis Printouts

HCS7 Two-Way Stop-Control Report

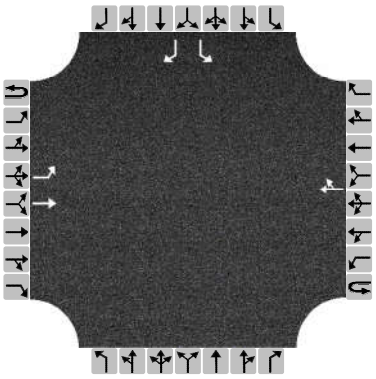
General Information

Analyst	
Agency/Co.	
Date Performed	5/15/2018
Analysis Year	2025
Time Analyzed	AM Peak
Intersection Orientation	East-West
Project Description	

Site Information

Intersection	119th Street @ Book Rd.
Jurisdiction	
East/West Street	119th Street
North/South Street	Book Rd.
Peak Hour Factor	0.92
Analysis Time Period (hrs)	0.25

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	1	1	0	0	0	1	0		0	0	0		1	0	1
Configuration		L	T					TR						L		R
Volume, V (veh/h)		10	597				312	18						45		17
Percent Heavy Vehicles (%)		3												3		3
Proportion Time Blocked																
Percent Grade (%)													0			
Right Turn Channelized	No				No				No				No			
Median Type/Storage	Undivided															

Critical and Follow-up Headways

Base Critical Headway (sec)		4.1												7.1		6.2
Critical Headway (sec)		4.13												6.43		6.23
Base Follow-Up Headway (sec)		2.2												3.5		3.3
Follow-Up Headway (sec)		2.23												3.53		3.33

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		11												49		18
Capacity, c (veh/h)		1193												259		692
v/c Ratio		0.01												0.19		0.03
95% Queue Length, Q (veh)		0.0												0.7		0.1
Control Delay (s/veh)		8.0												22.1		10.3
Level of Service, LOS		A												C		B
Approach Delay (s/veh)	0.1												18.9			
Approach LOS													C			

HCS7 Two-Way Stop-Control Report

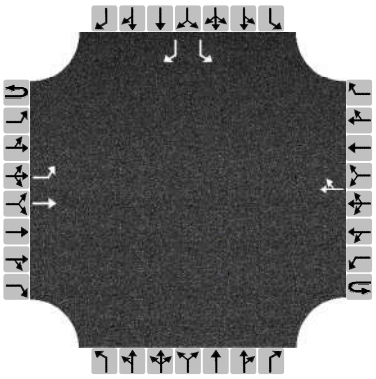
General Information

Analyst	
Agency/Co.	
Date Performed	5/15/2018
Analysis Year	2025
Time Analyzed	PM Peak
Intersection Orientation	East-West
Project Description	

Site Information

Intersection	119th Street @ Book Rd.
Jurisdiction	
East/West Street	119th Street
North/South Street	Book Rd.
Peak Hour Factor	0.92
Analysis Time Period (hrs)	0.25

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	1	1	0	0	0	1	0		0	0	0		1	0	1
Configuration		L	T					TR						L		R
Volume, V (veh/h)		19	428				628	48						30		15
Percent Heavy Vehicles (%)		3												3		3
Proportion Time Blocked																
Percent Grade (%)														0		
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		21												33		16
Capacity, c (veh/h)		865												195		432
v/c Ratio		0.02												0.17		0.04
95% Queue Length, Q (veh)		0.1												0.6		0.1
Control Delay (s/veh)		9.3												27.2		13.7
Level of Service, LOS		A												D		B
Approach Delay (s/veh)		0.4												22.7		
Approach LOS														C		

HCS7 Two-Way Stop-Control Report

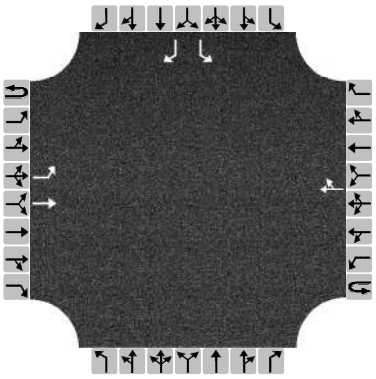
General Information

Analyst	
Agency/Co.	
Date Performed	5/15/2018
Analysis Year	2025
Time Analyzed	AM Peak
Intersection Orientation	East-West
Project Description	

Site Information

Intersection	119th Street @ Polo Club
Jurisdiction	
East/West Street	119th Street
North/South Street	Polo Club Dr.
Peak Hour Factor	0.92
Analysis Time Period (hrs)	0.25

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	1	1	0	0	0	1	0		0	0	0		1	0	1
Configuration		L	T					TR						L		R
Volume, V (veh/h)		25	586				322	7						21		69
Percent Heavy Vehicles (%)		3												3		3
Proportion Time Blocked																
Percent Grade (%)														0		
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		27												23		75
Capacity, c (veh/h)		1194												246		687
v/c Ratio		0.02												0.09		0.11
95% Queue Length, Q (veh)		0.1												0.3		0.4
Control Delay (s/veh)		8.1												21.1		10.9
Level of Service, LOS		A												C		B
Approach Delay (s/veh)		0.3												13.3		
Approach LOS														B		

HCS7 Two-Way Stop-Control Report

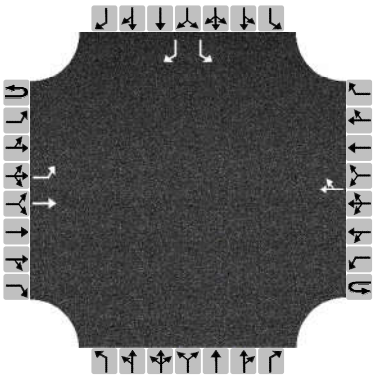
General Information

Analyst	
Agency/Co.	
Date Performed	5/15/2018
Analysis Year	2025
Time Analyzed	PM Peak
Intersection Orientation	East-West
Project Description	

Site Information

Intersection	119th Street @ Polo Club
Jurisdiction	
East/West Street	119th Street
North/South Street	Polo Club Dr.
Peak Hour Factor	0.92
Analysis Time Period (hrs)	0.25

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	1	1	0	0	0	1	0		0	0	0		1	0	1
Configuration		L	T					TR						L		R
Volume, V (veh/h)		68	433				620	23						14		49
Percent Heavy Vehicles (%)		3												3		3
Proportion Time Blocked																
Percent Grade (%)														0		
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)		4.1												7.1		6.2
Critical Headway (sec)		4.13												6.43		6.23
Base Follow-Up Headway (sec)		2.2												3.5		3.3
Follow-Up Headway (sec)		2.23												3.53		3.33

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		74												15		53
Capacity, c (veh/h)		892												161		446
v/c Ratio		0.08												0.09		0.12
95% Queue Length, Q (veh)		0.3												0.3		0.4
Control Delay (s/veh)		9.4												29.6		14.2
Level of Service, LOS		A												D		B
Approach Delay (s/veh)		1.3												17.6		
Approach LOS														C		

HCS7 Two-Way Stop-Control Report

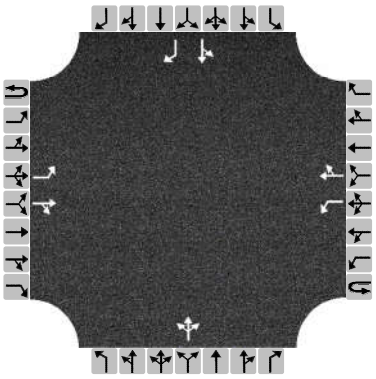
General Information

Analyst	
Agency/Co.	
Date Performed	5/15/2018
Analysis Year	2025
Time Analyzed	AM Peak
Intersection Orientation	East-West
Project Description	

Site Information

Intersection	119th St. @ Wolf Dr./Site
Jurisdiction	
East/West Street	119th Street
North/South Street	Wolf Dr./Site
Peak Hour Factor	0.92
Analysis Time Period (hrs)	0.25

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	1	1	0	0	1	1	0		0	1	0		0	1	1
Configuration		L		TR		L		TR			LTR			LT		R
Volume, V (veh/h)		15	534	10		5	371	15		26	0	24		53	0	27
Percent Heavy Vehicles (%)		3				3				3	3	3		3	3	3
Proportion Time Blocked																
Percent Grade (%)									0				0			
Right Turn Channelized	No				No				No				No			
Median Type/Storage	Undivided															

Critical and Follow-up Headways

Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		16				5					54			58		29
Capacity, c (veh/h)		1133				979					272			190		638
v/c Ratio		0.01				0.01					0.20			0.30		0.05
95% Queue Length, Q (veh)		0.0				0.0					0.7			1.2		0.1
Control Delay (s/veh)		8.2				8.7					21.5			32.1		10.9
Level of Service, LOS		A				A					C			D		B
Approach Delay (s/veh)	0.2				0.1				21.5				24.9			
Approach LOS									C				C			

HCS7 Two-Way Stop-Control Report

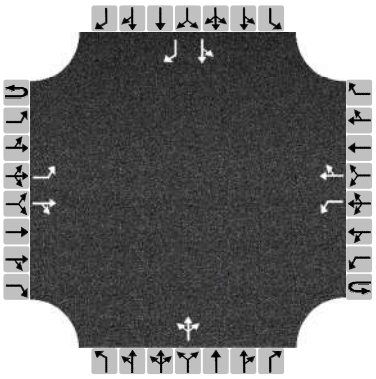
General Information

Analyst	
Agency/Co.	
Date Performed	5/15/2018
Analysis Year	2025
Time Analyzed	PM Peak
Intersection Orientation	East-West
Project Description	

Site Information

Intersection	119th St. @ Wolf Dr./Site
Jurisdiction	
East/West Street	119th Street
North/South Street	Wolf Dr./Site
Peak Hour Factor	0.92
Analysis Time Period (hrs)	0.25

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	1	1	0	0	1	1	0		0	1	0		0	1	1
Configuration		L		TR		L		TR			LTR			LT		R
Volume, V (veh/h)		51	459	32		12	617	40		18	0	12		30	0	15
Percent Heavy Vehicles (%)		3				3				3	3	3		3	3	3
Proportion Time Blocked																
Percent Grade (%)										0				0		
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		55				13					33			33		16
Capacity, c (veh/h)		881				1028					168			117		442
v/c Ratio		0.06				0.01					0.19			0.28		0.04
95% Queue Length, Q (veh)		0.2				0.0					0.7			1.1		0.1
Control Delay (s/veh)		9.4				8.5					31.5			47.5		13.5
Level of Service, LOS		A				A					D			E		B
Approach Delay (s/veh)		0.9				0.2				31.5				36.1		
Approach LOS										D				E		

GHA GEWALT HAMILTON ASSOCIATES, INC.
CONSULTING ENGINEERS
625 Forest Edge Drive, Vernon Hills, IL 60061
TEL 847.478.9700 ▪ FAX 847.478.9701
www.gha-engineers.com

Memorandum

To: **Chris Nichols**
City of Naperville

From: Bill Grieve, P.E., PTOE
Sr. Transportation Engineer BG

Date: May 23, 2018

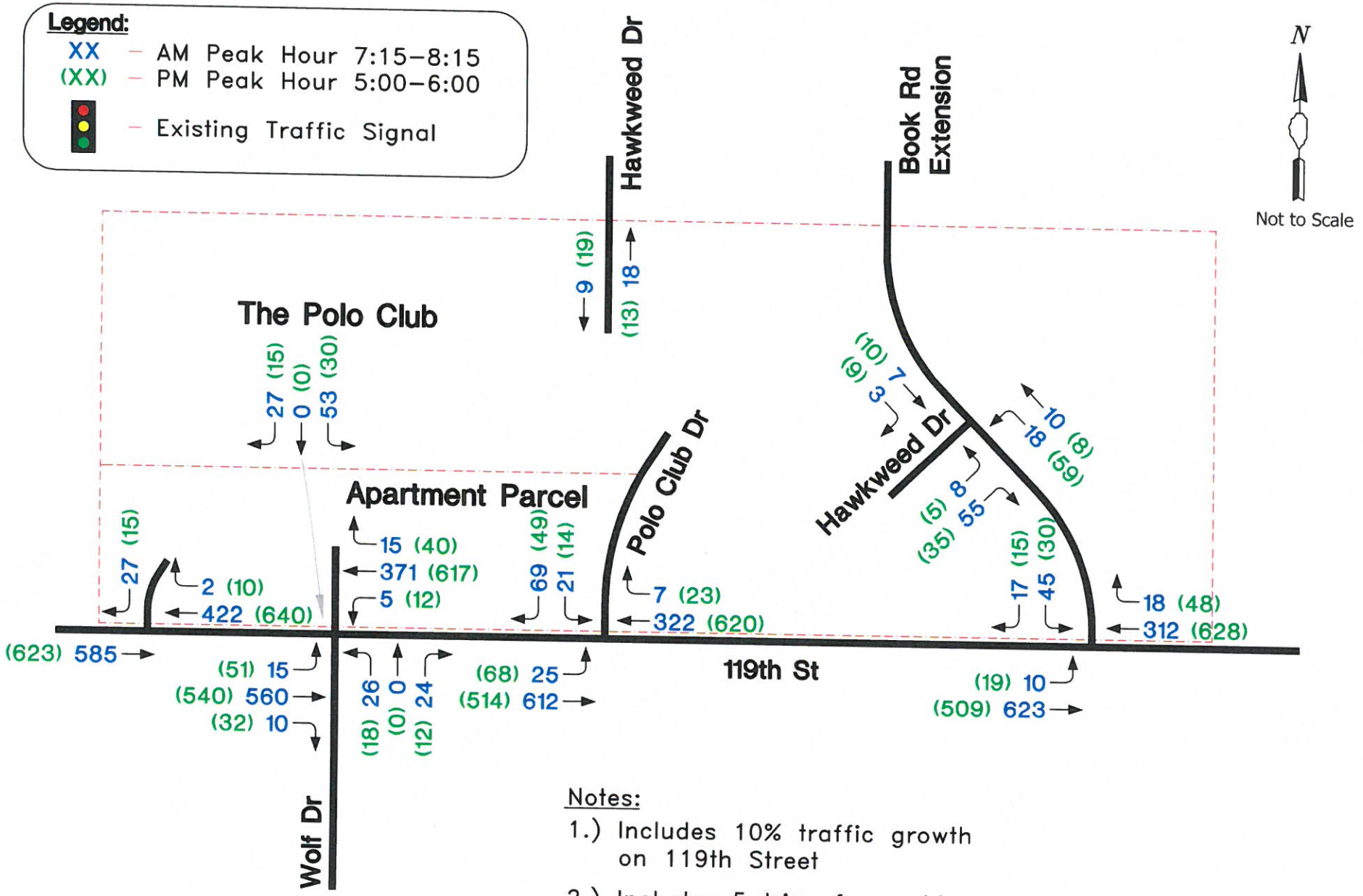
Subject: ***Polo Club***
May 15, 2018 Traffic Impact Study Addendum

Attached are the following materials as an addendum to the Gewalt Hamilton Associates, Inc. (GHA) Traffic Impact Study (TIS) dated May 15, 2018 for the proposed Polo Club residential development:

- Exhibit 7 – Total Traffic Year 2025 has been revised to reflect the increases in eastbound through traffic on 119th Street. The westbound volumes remain unchanged.

- Exhibit 8 – Intersection Capacity Analyses has been revised to reflect the changes in delay and Level of Service (LOS) at the 119th Street intersections with Book Road, Polo Club Drive, and Wolf Drive / apartment full access.

- The HCS printouts are attached and reflect the change in median type on 119th Street from "Undivided" to "Left Only". That change is appropriate as we understand that separate left turn lanes will be striped at the 119th Street intersections with Book Road, Polo Club Drive, and Wolf Drive / apartment full access.



Notes:

1.) Includes 10% traffic growth on 119th Street

2.) Includes 5 trips for residences to the north

GHA GEWALT HAMILTON ASSOCIATES, INC.

Exhibit 7
Total Traffic
Year 2025

Exhibit 8
Intersection Capacity Analyses
Polo Club - Naperville, Illinois

Part A. Parameters - Type of Traffic Control (Source: 2016 Highway Capacity Manual)

I. Traffic Signals

LOS	Delay (sec / veh)	Description
A	≤ 10	All signal phases clear waiting vehicles without delay
B	>10 and ≤ 20	Minimal delay experienced on select signal phases
C	>20 and ≤ 35	Some delay experienced on several phases; often used as design criteria
D	>35 and ≤ 55	Usually considered as the acceptable delay standard
E	>55 and ≤ 80	Very long delays experienced during the peak hours
F	>80	Unacceptable delays experienced throughout the peak hours

II. Stop Sign

LOS	Delay (sec / veh)
A	≤ 10
B	>10 and ≤ 15
C	>15 and ≤ 25
D	>25 and ≤ 35
E	>35 and ≤ 50
F	>50

Part B. Results

	Traffic Control & Roadway Conditions	LOS Per Movement Group By Approach (> = Shared Lane; - = Non Critical or not Allowed Movement; TRT - Shared Through/Right lane (with extra Through lane))												Intersection / Approach	
		Eastbound			Westbound			Northbound			Southbound			Delay (sec / veh)	LOS
1. 119th Street @ Book Road	**SB Stops**	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	**SB Approach Delay**	
A. Weekday Morning Peak Hour Total Traffic - Year 2025 (see *Exhibit 7*)	• As Planned	A	-	-	-	-	-	-	-	-	C	-	B	**14.6**	**B**
B. Weekday Evening Peak Hour Total Traffic	• As Planned	A	-	-	-	-	-	-	-	-	C	-	B	**16.5**	**C**
2. 119th Street @ Polo Club Dr.	**SB Stops**	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	**SB Approach Delay**	
A. Weekday Morning Peak Hour Total Traffic	• As Planned	A	-	-	-	-	-	-	-	-	C	-	B	**12.0**	**B**
B. Weekday Evening Peak Hour Total Traffic	• As Planned	A	-	-	-	-	-	-	-	-	C	-	B	**15.2**	**C**
3. 119th Street @ Wolf Dr. / Apartments	**NB/SB Stops**	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	**SB Approach Delay**	
A. Weekday Morning Peak Hour Total Traffic	• As Planned	A	-	-	A	-	-	>	C	<	C	<	B	**16.7**	**C**
B. Weekday Evening Peak Hour Total Traffic	• As Planned	A	-	-	A	-	-	>	C	<	C	<	B	**20.4**	**C**

GHA GEWALT HAMILTON ASSOCIATES, INC.

HCS7 Two-Way Stop-Control Report

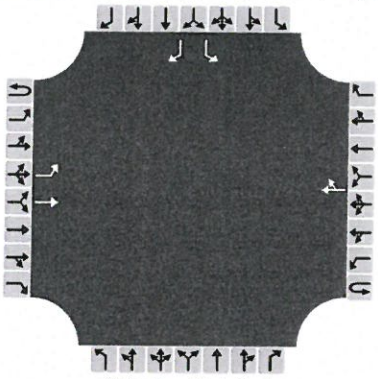
General Information

Analyst	
Agency/Co.	
Date Performed	5/23/2018
Analysis Year	2025
Time Analyzed	AM Peak
Intersection Orientation	East-West
Project Description	

Site Information

Intersection	119th Street @ Book Rd.
Jurisdiction	
East/West Street	119th Street
North/South Street	Book Rd.
Peak Hour Factor	0.92
Analysis Time Period (hrs)	0.25

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	1	1	0	0	0	1	0		0	0	0		1	0	1
Configuration		L	T					TR						L		R
Volume, V (veh/h)		10	623				312	18						45		17
Percent Heavy Vehicles (%)		3												3		3
Proportion Time Blocked																
Percent Grade (%)														0		
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Left Only								1						

Critical and Follow-up Headways

Base Critical Headway (sec)		4.1												7.1		6.2
Critical Headway (sec)		4.13												6.43		6.23
Base Follow-Up Headway (sec)		2.2												3.5		3.3
Follow-Up Headway (sec)		2.23												3.53		3.33

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		11												49		18
Capacity, c (veh/h)		1193												370		692
v/c Ratio		0.01												0.13		0.03
95% Queue Length, Q_{95} (veh)		0.0												0.5		0.1
Control Delay (s/veh)		8.0												16.2		10.3
Level of Service, LOS		A												C		B
Approach Delay (s/veh)		0.1												14.6		
Approach LOS														B		

HCS7 Two-Way Stop-Control Report

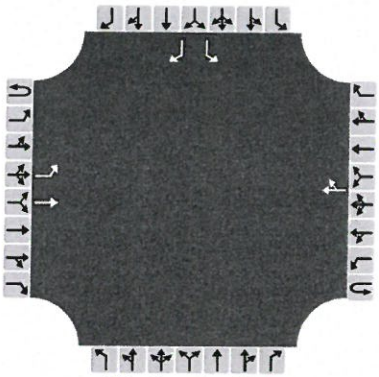
General Information

Analyst	
Agency/Co.	
Date Performed	5/23/2018
Analysis Year	2025
Time Analyzed	PM Peak
Intersection Orientation	East-West
Project Description	

Site Information

Intersection	119th Street @ Book Rd.
Jurisdiction	
East/West Street	119th Street
North/South Street	Book Rd.
Peak Hour Factor	0.92
Analysis Time Period (hrs)	0.25

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	1	1	0	0	0	1	0		0	0	0		1	0	1
Configuration		L	T					TR						L		R
Volume, V (veh/h)		19	509				628	48						30		15
Percent Heavy Vehicles (%)		3												3		3
Proportion Time Blocked																
Percent Grade (%)														0		
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Left Only								1						

Critical and Follow-up Headways

Base Critical Headway (sec)		4.1												7.1		6.2
Critical Headway (sec)		4.13												6.43		6.23
Base Follow-Up Headway (sec)		2.2												3.5		3.3
Follow-Up Headway (sec)		2.23												3.53		3.33

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		21												33		16
Capacity, c (veh/h)		865												311		432
v/c Ratio		0.02												0.10		0.04
95% Queue Length, Q_{95} (veh)		0.1												0.3		0.1
Control Delay (s/veh)		9.3												17.9		13.7
Level of Service, LOS		A												C		B
Approach Delay (s/veh)		0.3												16.5		
Approach LOS														C		

HCS7 Two-Way Stop-Control Report

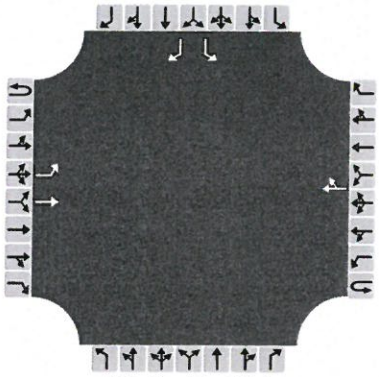
General Information

Analyst	
Agency/Co.	
Date Performed	5/23/2018
Analysis Year	2025
Time Analyzed	AM Peak
Intersection Orientation	East-West
Project Description	

Site Information

Intersection	119th Street @ Polo Club
Jurisdiction	
East/West Street	119th Street
North/South Street	Polo Club Dr.
Peak Hour Factor	0.92
Analysis Time Period (hrs)	0.25

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	1	1	0	0	0	1	0		0	0	0		1	0	1
Configuration		L	T					TR						L		R
Volume, V (veh/h)		25	612				322	7						21		69
Percent Heavy Vehicles (%)		3												3		3
Proportion Time Blocked																
Percent Grade (%)														0		
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Left Only								1						

Critical and Follow-up Headways

Base Critical Headway (sec)		4.1												7.1		6.2
Critical Headway (sec)		4.13												6.43		6.23
Base Follow-Up Headway (sec)		2.2												3.5		3.3
Follow-Up Headway (sec)		2.23												3.53		3.33

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		27												23		75
Capacity, c (veh/h)		1194												358		687
v/c Ratio		0.02												0.06		0.11
95% Queue Length, Q_{95} (veh)		0.1												0.2		0.4
Control Delay (s/veh)		8.1												15.7		10.9
Level of Service, LOS		A												C		B
Approach Delay (s/veh)		0.3												12.0		
Approach LOS														B		

HCS7 Two-Way Stop-Control Report

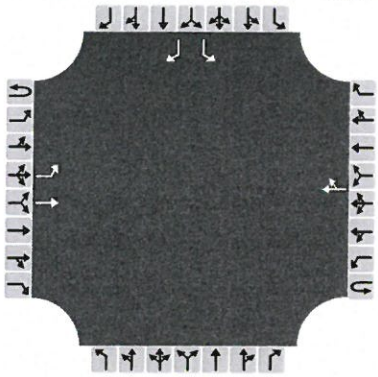
General Information

Analyst	
Agency/Co.	
Date Performed	5/23/2018
Analysis Year	2025
Time Analyzed	PM Peak
Intersection Orientation	East-West
Project Description	

Site Information

Intersection	119th Street @ Polo Club
Jurisdiction	
East/West Street	119th Street
North/South Street	Polo Club Dr.
Peak Hour Factor	0.92
Analysis Time Period (hrs)	0.25

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	1	1	0	0	0	1	0		0	0	0		1	0	1
Configuration		L	T					TR						L		R
Volume, V (veh/h)		68	514				620	23						14		49
Percent Heavy Vehicles (%)		3												3		3
Proportion Time Blocked																
Percent Grade (%)														0		
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Left Only								1						

Critical and Follow-up Headways

Base Critical Headway (sec)		4.1												7.1		6.2
Critical Headway (sec)		4.13												6.43		6.23
Base Follow-Up Headway (sec)		2.2												3.5		3.3
Follow-Up Headway (sec)		2.23												3.53		3.33

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		74												15		53
Capacity, c (veh/h)		892												280		446
v/c Ratio		0.08												0.05		0.12
95% Queue Length, Q_{95} (veh)		0.3												0.2		0.4
Control Delay (s/veh)		9.4												18.6		14.2
Level of Service, LOS		A												C		B
Approach Delay (s/veh)		1.1												15.2		
Approach LOS														C		

HCS7 Two-Way Stop-Control Report

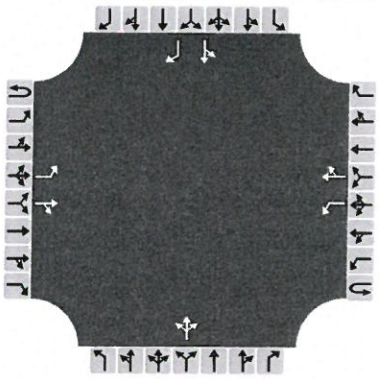
General Information

Analyst	
Agency/Co.	
Date Performed	5/23/2018
Analysis Year	2025
Time Analyzed	AM Peak
Intersection Orientation	East-West
Project Description	

Site Information

Intersection	119th St. @ Wolf Dr./Site
Jurisdiction	
East/West Street	119th Street
North/South Street	Wolf Dr./Site
Peak Hour Factor	0.92
Analysis Time Period (hrs)	0.25

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	1	1	0	0	1	1	0		0	1	0		0	1	1
Configuration		L		TR		L		TR			LTR			LT		R
Volume, V (veh/h)		15	560	10		5	371	15		26	0	24		53	0	27
Percent Heavy Vehicles (%)		3				3				3	3	3		3	3	3
Proportion Time Blocked																
Percent Grade (%)									0				0			
Right Turn Channelized	No				No				No				No			
Median Type/Storage	Left Only								1							

Critical and Follow-up Headways

Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		16				5					54			58		29
Capacity, c (veh/h)		1133				955					375			303		638
v/c Ratio		0.01				0.01					0.15			0.19		0.05
95% Queue Length, Q_{95} (veh)		0.0				0.0					0.5			0.7		0.1
Control Delay (s/veh)		8.2				8.8					16.2			19.7		10.9
Level of Service, LOS		A				A					C			C		B
Approach Delay (s/veh)	0.2				0.1				16.2				16.7			
Approach LOS									C				C			

HCS7 Two-Way Stop-Control Report

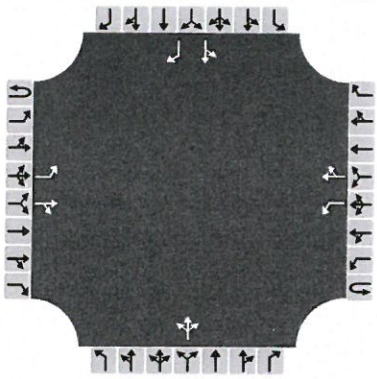
General Information

Analyst	
Agency/Co.	
Date Performed	5/23/2018
Analysis Year	2025
Time Analyzed	PM Peak
Intersection Orientation	East-West
Project Description	

Site Information

Intersection	119th St. @ Wolf Dr./Site
Jurisdiction	
East/West Street	119th Street
North/South Street	Wolf Dr./Site
Peak Hour Factor	0.92
Analysis Time Period (hrs)	0.25

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	1	1	0	0	1	1	0		0	1	0		0	1	1
Configuration		L		TR		L		TR			LTR			LT		R
Volume, V (veh/h)		51	540	32		12	617	40		18	0	12		30	0	15
Percent Heavy Vehicles (%)		3				3				3	3	3		3	3	3
Proportion Time Blocked																
Percent Grade (%)										0				0		
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Left Only								1						

Critical and Follow-up Headways

Base Critical Headway (sec)		4.1				4.1				7.1	6.5	6.2		7.1	6.5	6.2
Critical Headway (sec)		4.13				4.13				7.13	6.53	6.23		7.13	6.53	6.23
Base Follow-Up Headway (sec)		2.2				2.2				3.5	4.0	3.3		3.5	4.0	3.3
Follow-Up Headway (sec)		2.23				2.23				3.53	4.03	3.33		3.53	4.03	3.33

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		55				13					33			33		16
Capacity, c (veh/h)		881				953					274			223		442
v/c Ratio		0.06				0.01					0.12			0.15		0.04
95% Queue Length, Q_{95} (veh)		0.2				0.0					0.4			0.5		0.1
Control Delay (s/veh)		9.4				8.8					19.9			23.9		13.5
Level of Service, LOS		A				A					C			C		B
Approach Delay (s/veh)		0.8				0.2				19.9				20.4		
Approach LOS										C				C		