

**TRAFFIC STUDY**

**RESIDENTIAL APARTMENT BUILDING  
2 FLANDERS ROAD  
BLOCK 19 – LOT 14**

**BOROUGH OF NETCONG  
MORRIS COUNTY, NEW JERSEY**

**SUBMITTED TO:**

**FLANDERS 46, LLC  
10 LAFAYETTE DRIVE  
LIVINGSTON, NJ 07039**

July 2, 2014

**PREPARED BY:**

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## I. INTRODUCTION

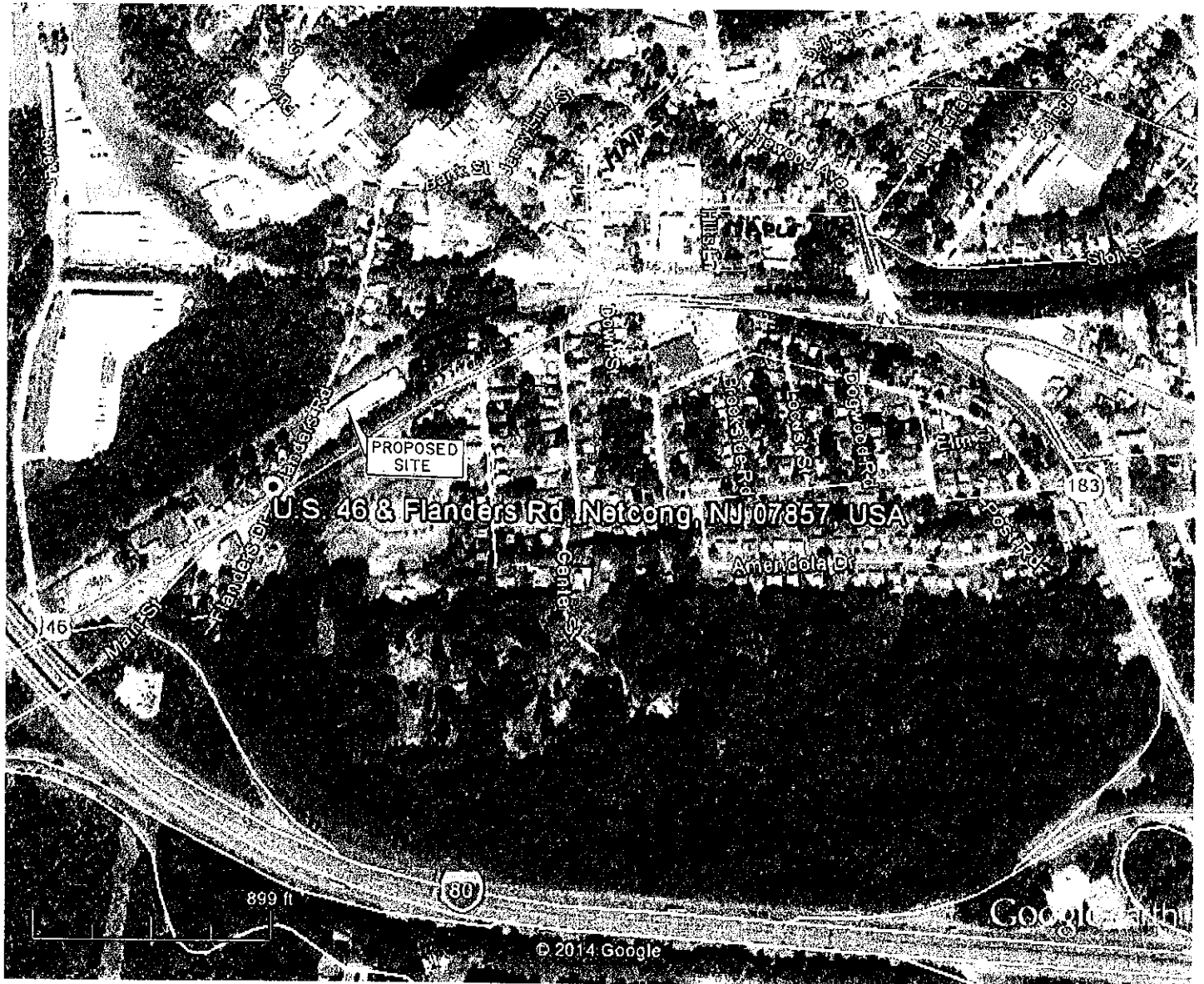
Flanders 46, LLC (Applicant) has proposed the construction of a four-story, 72 unit apartment building in the Borough of Netcong, Morris County, New Jersey. The site (Block 19, Lot 14) is located in the northeast corner of the intersection of US Route 46 and Flanders Road and is in a designated redevelopment zone of the Borough. This property is currently occupied by a vacant industrial building, which is to be demolished as part of the project. The site has 247.10 feet of frontage along Flanders Road. A total of 108 parking spaces are proposed. Access for the site is proposed through one full access driveway intersecting Flanders Road (municipal roadway).

In view of the proposed residential development, the Applicant has retained the firm of Hamal Associates, Inc. (HMA) to determine the traffic impacts of this project at the following intersections during am and pm weekday street peak hours and identify mitigation, if necessary.

1. US Route 46 & Flanders Road: and
2. The proposed site access drive intersection with Flanders Road.

An evaluation of sight distance between the site access drive and each direction of Flanders Road will also be performed.

The purpose of this report is to present the data gathered, methods of analysis and summarize the subsequent impacts and findings identified.



Google Earth



# EXHIBIT 1 PROJECT LOCATION MAP

## II. EXISTING CONDITIONS

The proposed residential apartment building is to be located along Flanders Road in the western section of the Borough of Netcong, and is within the Borough's redevelopment zone. The Netcong NJ Transit rail station is located approximately 1/3 of a mile to the east of the site, with the site within the designated transit village area. The property is bounded by Flanders Road to the west, US Route 46 to the south, and the NJ Transit rail line to the north. The site is currently occupied by a vacant industrial building, which is served by two access drives along Flanders Road and a large paved parking area. Existing conditions in the general vicinity of the site consists of single family homes, commercial/industrial uses, the Netcong business district, the passenger train station and wooded lands.

US Route 46 is a State highway that extends in an east-west alignment across the northern part of New Jersey. Within our study area, Route 46 is a two-way, two lane roadway (1 lane each way) with no shoulders present on either side of the roadway. Each Route 46 travel lane is approximately 15.5 feet wide. The roadway follows a straight alignment with a mild vertical downgrade to the west. A 40 mph speed limit is in effect on Route 46 and each side of the road is posted 'No Stopping Or Standing'. Sidewalk is present along the north side of Rt. 46 and extends east from Flanders Road to the signalized intersection of Rt. 46 & Main Street, near the train station. The NJDOT identifies Route 46 as an urban principal arterial.

Flanders Road is a limited length, municipal roadway that extends north from its 'Stop' controlled intersection with Route 46, to its terminus at a 'Stop' controlled T-intersection with Furnace Street/Bank Street, this area having commercial development. The roadway connection of Bank Street to Jenny Lind Street provides access to Main Street and the Netcong business district. Flanders Road is a two-way, two lane roadway, having a 24 foot paved width and a posted 25 mph speed limit. No parking restrictions are posted along either curblines. Proceeding north from Rt. 46, Flanders Road is on a downgrade that levels off along the north end of the development site's frontage. A signalized railroad crossing of Flanders Road is located just north of the proposed residential site property and access drive. On its approach to Rt. 46, Flanders Road is posted (with accompanying pavement markings) for right turn only to Rt. 46 WB. U-turn capability to Rt. 46 EB is provided on Rt. 46 approximately one-half mile to the west. This

U-turn location also provides access to the I-80 EB on-ramp. All traffic movements into Flanders Road, at the Rt. 46 intersection, are permitted.

Old Budd Lake road is a short, dead-end, municipal roadway that is located opposite Flanders Road at their intersection with Rt. 46. Old Budd Lake Road is 'Stop' sign posted, with all movements in/out permitted, except from Flanders Road.

### III. DATA COLLECTION AND EXISTING TRAFFIC

In order to determine the impact of any proposed development upon the identified roadway system, the present day condition must be established. To this end, the site plan and relevant statistics for the proposed project were obtained from the site engineer (FC Meola, LLC - FCM). The Borough's Master Plan was reviewed. The yearly background traffic growth rates (1.00%), for the study area roads, were obtained from the NJDOT. HMA also performed field surveys to establish geometrics, lane arrangements/widths, traffic control, parking restrictions/regulations and speed limits.

Supplementing the above, HMA conducted manual traffic counts (7-9am, 4-6pm) on Wednesday – June 4, 2014, at the intersection of US Route 46 & Flanders Road. The traffic counts were performed on a normal business day, the school year was in session, weather was good and all roadways were open. The data was compiled in 15 minute intervals by traffic movement to permit identification of the street peak hours of operation and determination of the peak hour factors required in the analysis of roadway intersection capacity. A tabulation of truck/bus traffic was also kept for use in the capacity analysis. The traffic count data was tabulated onto standard forms and is presented in the Appendix (see A-1, 2). Exhibit 2 summarizes the existing weekday 2014 peak hour vehicular volumes at the noted study intersections.

The results of these surveys indicated a weekday am peak hour of 7:15-8:15 and a pm peak hour of 4:30-5:30. Exhibit 3 expands the 2014 existing peak hour volumes by the NJDOT annual background traffic growth rate of 1.00% (see A-4) through 2016, which is the anticipated year of completion of the project.

For the peak hours noted, a review of existing traffic volumes indicated the conditions within the study area as follows:

#### AM PEAK HOUR (7:15-8:15)

1. Two-way traffic flow on Route 46, at the Flanders Road intersection, was 824 vehicles with the eastbound flow predominant (488 vehs. EB, 336 vehs. WB). Platooned traffic flow was observed



in each travel direction of Route 46, due to the presence of nearby traffic signals to the east at Main Street and to the west at International Drive. Turning movements from each direction of Route 46 to Flanders Road were light, being only 57 left and 12 right turn movements.

2. Traffic from Flanders Road to Rt. 46 WB was light in magnitude, being 129 vehicles. Observations of vehicle queues on the Flanders Road right turn only approach indicated the vast majority being only one to two cars. The longest vehicle queue observed was 5 vehicles (one occurrence). All vehicle queues cleared with only short delays experienced by drivers.
3. The Old Budd Lake Road approach had 7 exiting vehicles and none entering during this peak hour.
4. This intersection operated in a free flowing manner at all times with minimal delay to the side road approaches and Rt. 46 left turning movements.

#### PM PEAK HOUR (4:30-5:30)

1. Two-way traffic flow on Route 46, at the Flanders Road intersection, was 1012 vehicles with the westbound traffic flow predominant (465 vehs. EB, 547 vehs. WB). Platooned traffic flow was again observed in each travel direction of Route 46. Turning movements to Flanders Road from Route 46 were only 70 left and 8 right turn movements.
2. The Flanders Road right turn traffic to Route 46 WB was light in magnitude, being only 69 vehicles. Observations of vehicle queues on the Flanders Road right turn only approach indicated the vast majority being only one vehicle length. The longest vehicle queue observed was 4 vehicles (one occurrence). All vehicle queues cleared with only short delays experienced by drivers.
3. The Old Budd Lake Road approach had 7 exiting and 3 entering vehicles during this peak hour.
4. This intersection operated in a free flowing manner at all times with minimal delay to the side road approaches and Rt. 46 left turning movements.

EXHIBIT 2

2014 EXISTING PEAK HOUR TRAFFIC VOLUMES

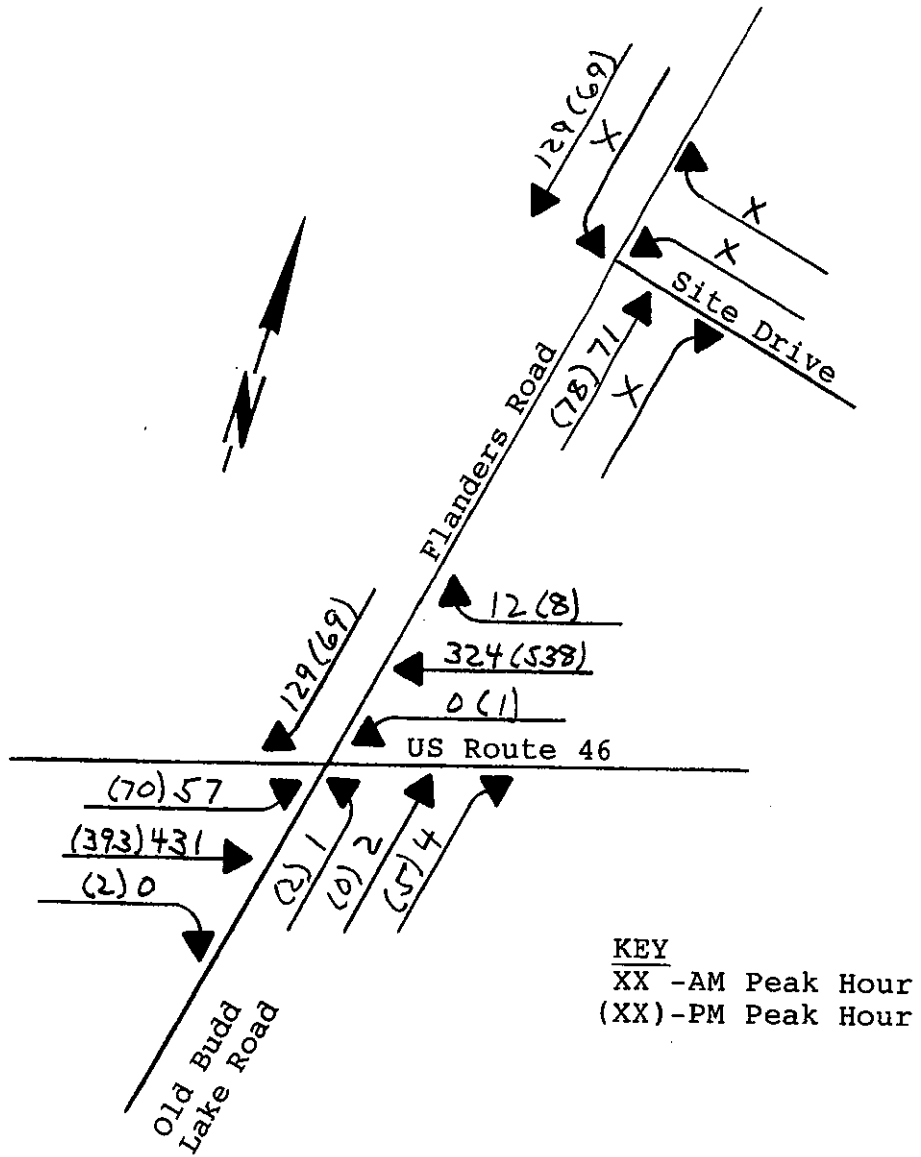
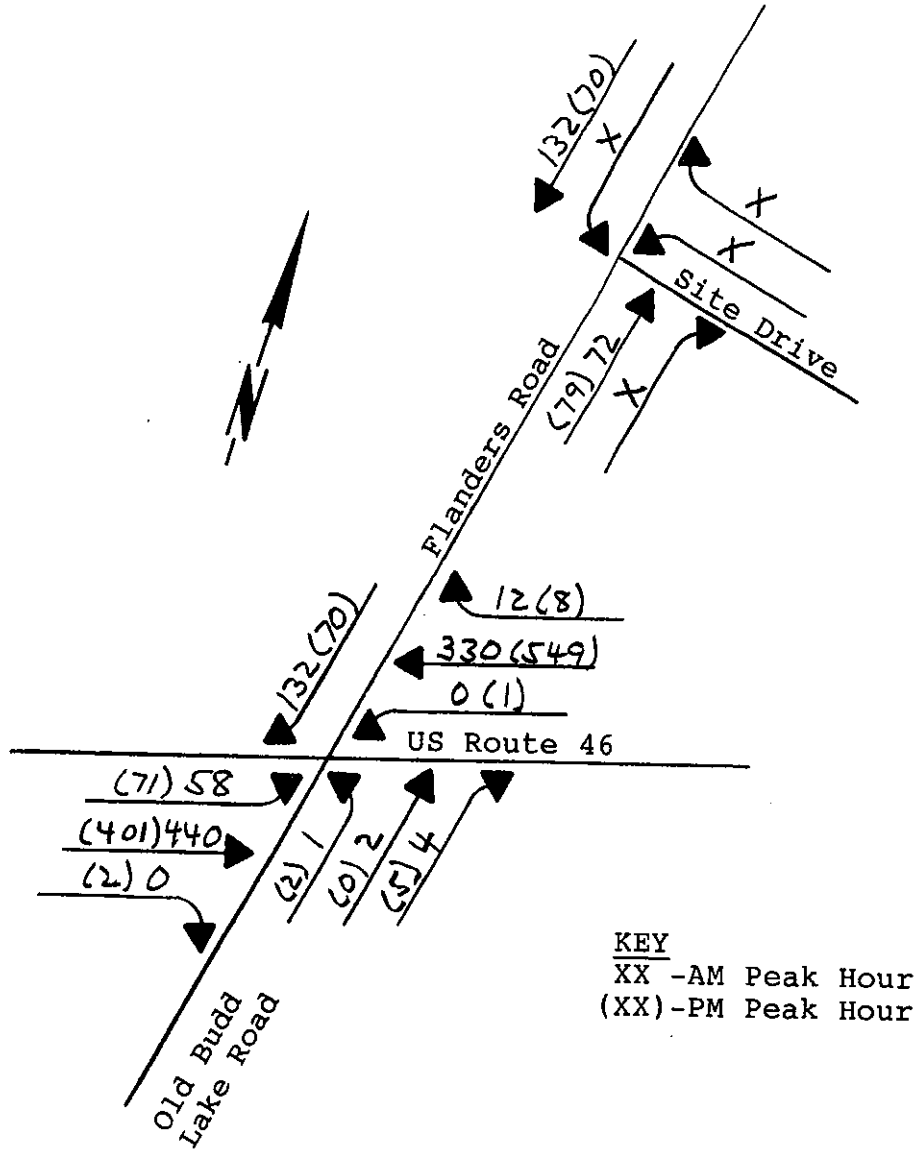


EXHIBIT 3

2016 EXISTING PEAK HOUR TRAFFIC VOLUMES  
WITH BACKGROUND TRAFFIC GROWTH



IV. TRAFFIC PROJECTIONS AND ASSIGNMENTS

As part of any analysis, site generated traffic must be assigned to the surrounding roadway system. In performing the impact analysis for this project, traffic projections were prepared based on the residential apartment use proposed for the site. These projected volumes were compiled for the am and pm weekday street peak hours of operation and inbound/outbound traffic patterns. The proposed development is to have a total of 72 apartment units. The traffic volume projections were based on trip generation rates, for the total number of units, developed by the Institute of Transportation Engineers (ITE) and as published in their text, Trip Generation-9<sup>th</sup> Edition (Land Use Code 220 Apartments – See Appendix A-3). Table 1 summarizes the very limited magnitude of projected trip generation for this site, which is 37 trips in the am peak hour and 45 trips in the pm peak hour (total two-way).

TABLE 1  
TRAFFIC PROJECTIONS

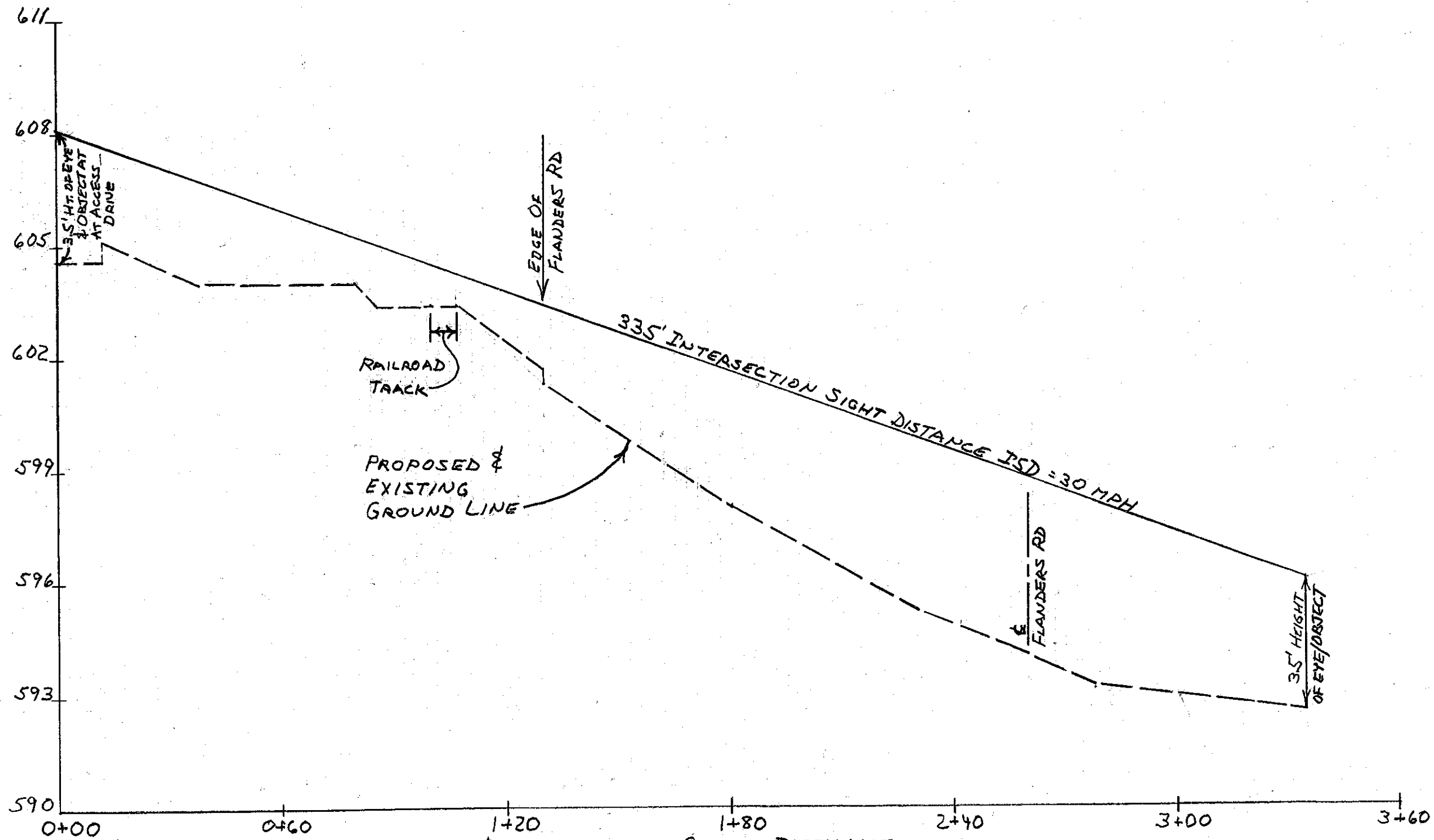
<u>USE</u>	<u>VEHICLE TRIPS GENERATED</u>					
	<u>AM PEAK HOUR</u>			<u>PM PEAK HOUR</u>		
	<u>IN</u>	<u>OUT</u>	<u>TOTAL</u>	<u>IN</u>	<u>OUT</u>	<u>TOTAL</u>
72 Units Apartments	7	30	37	29	16	45

It should be remembered that this site is being redeveloped and is not undeveloped land that had no prior history of traffic generation. The site is currently occupied by a 40,000 sf (approx.) industrial building. Based on the ITE Trip Generation – 9<sup>th</sup> Edition trip rates for Land Use Code 110 – General Light Industrial, the existing 40,000 sf building would generate 37 and 39 trips in the respective am and pm peak hours. These trip numbers are almost identical to the peak hour trips to be generated by the residential use.

Having determined the trip generation for the residential apartment building, the trips developed were assigned to the surrounding roadway system based on existing peak hour travel patterns identified from the field traffic counts, and with consideration of accessibility to area roads and the nearby Netcong business district. From this analysis, the peak hour percentile orientations for the residential site generated traffic were identified, as follows and as illustrated on Exhibit 4.

Flanders Rd to/from the north = 20%  
Flanders Rd SB (outbound) to Rt. 46 WB = 80%  
    32% proceeds to Rt. 46 WB  
    24% proceeds to U-turn to I-80 EB  
    24% proceeds to U-turn to Rt. 46 EB  
Rt. 46 WB (inbound) to Flanders Rd NB = 48%  
Rt. 46 EB (inbound) to Flanders Rd NB = 32%

Applying the noted orientation percentages to the site peak hour generated traffic resulted in the site trip assignments shown on Exhibit 5. Exhibit 6 summarizes the 2016 Full Build peak hour traffic volumes (Exh. 3 + 5 = Exh. 6).



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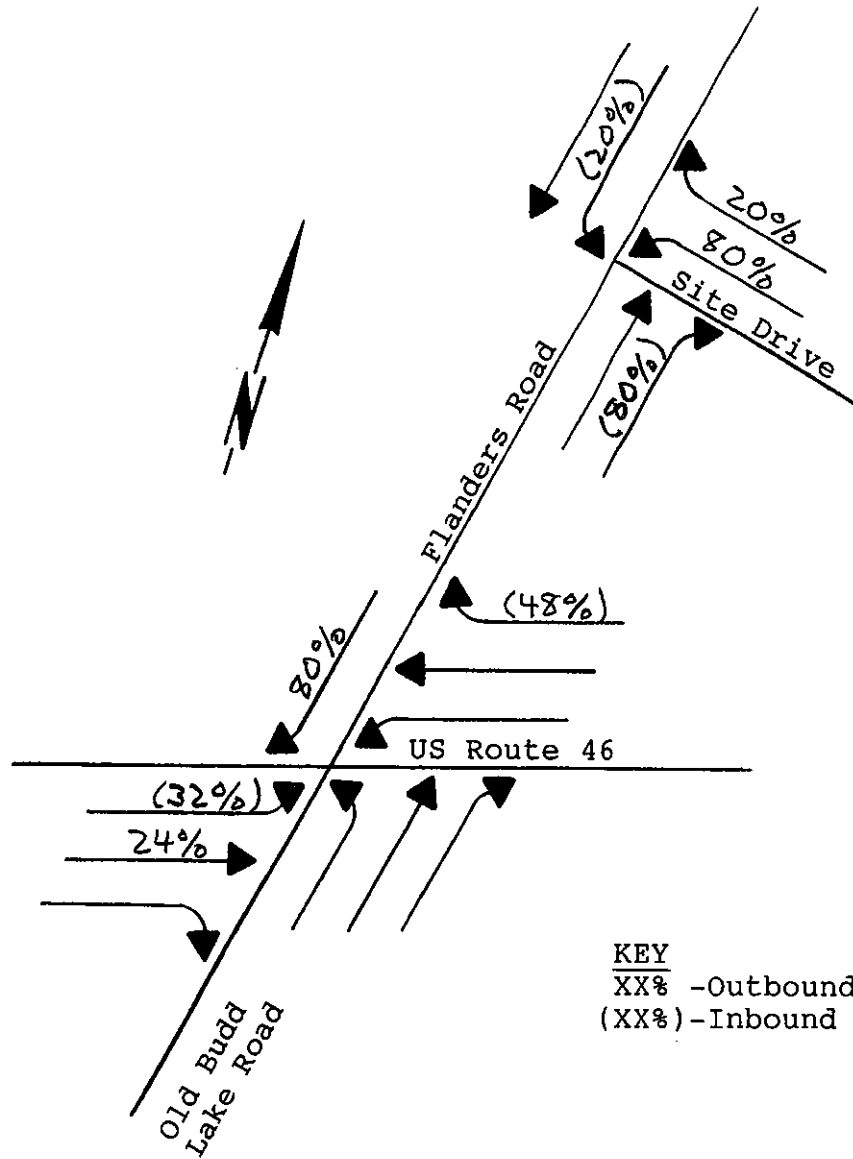
INTERSECTION SIGHT DISTANCE  
 SIGHT LINE PROFILE LOOKING NORTH FROM 14.5' SET BACK IN  
 THE SITE ACCESS DRIVE EXIT LANE TO FLANDERS RD SOUTHBOUND

SCALE: 1" = 30' HORIZONTAL  
 1" = 3' VERTICAL

**EXHIBIT 8**

EXHIBIT 4

SITE GENERATED TRIP PERCENTILE ORIENTATION PATTERNS



24% Outbound Assigned to I-80 eastbound

EXHIBIT 5

SITE GENERATED PEAK HOUR TRIP ASSIGNMENTS

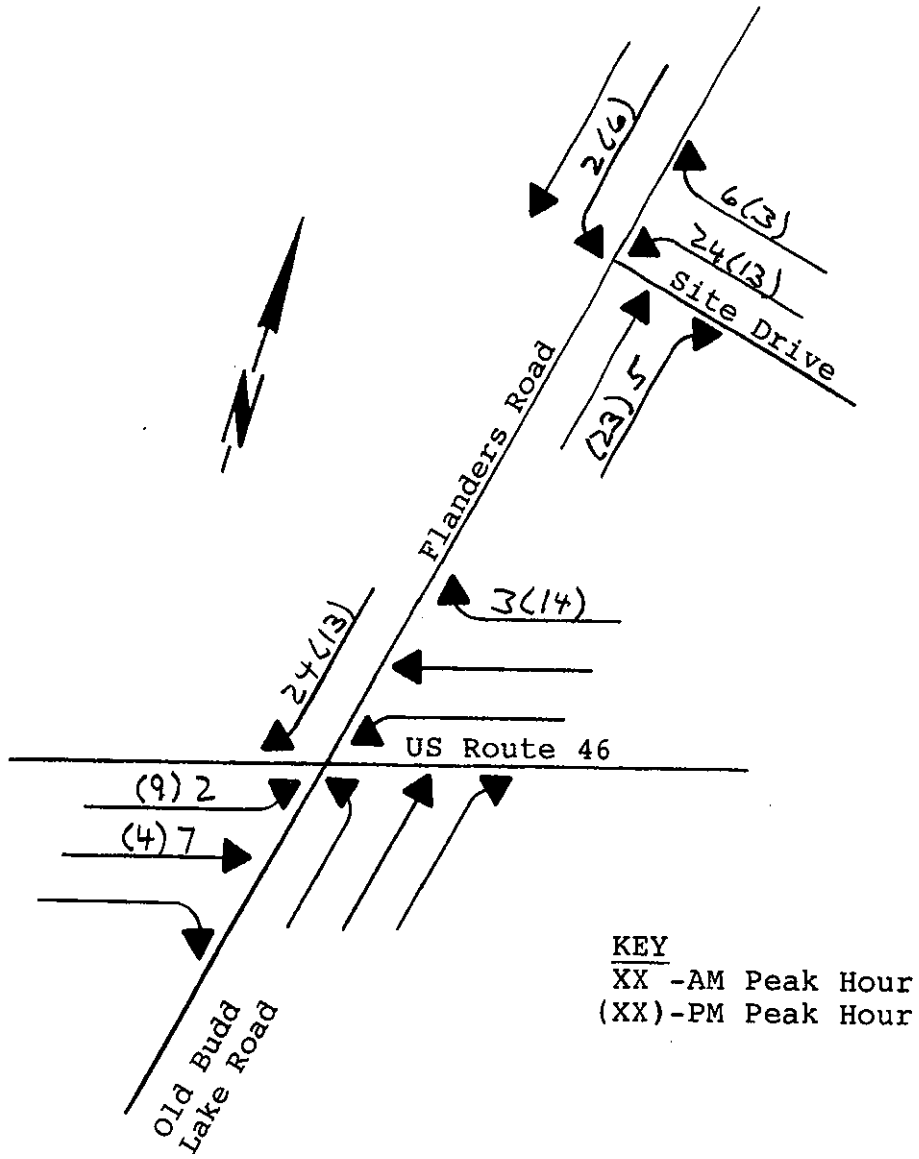
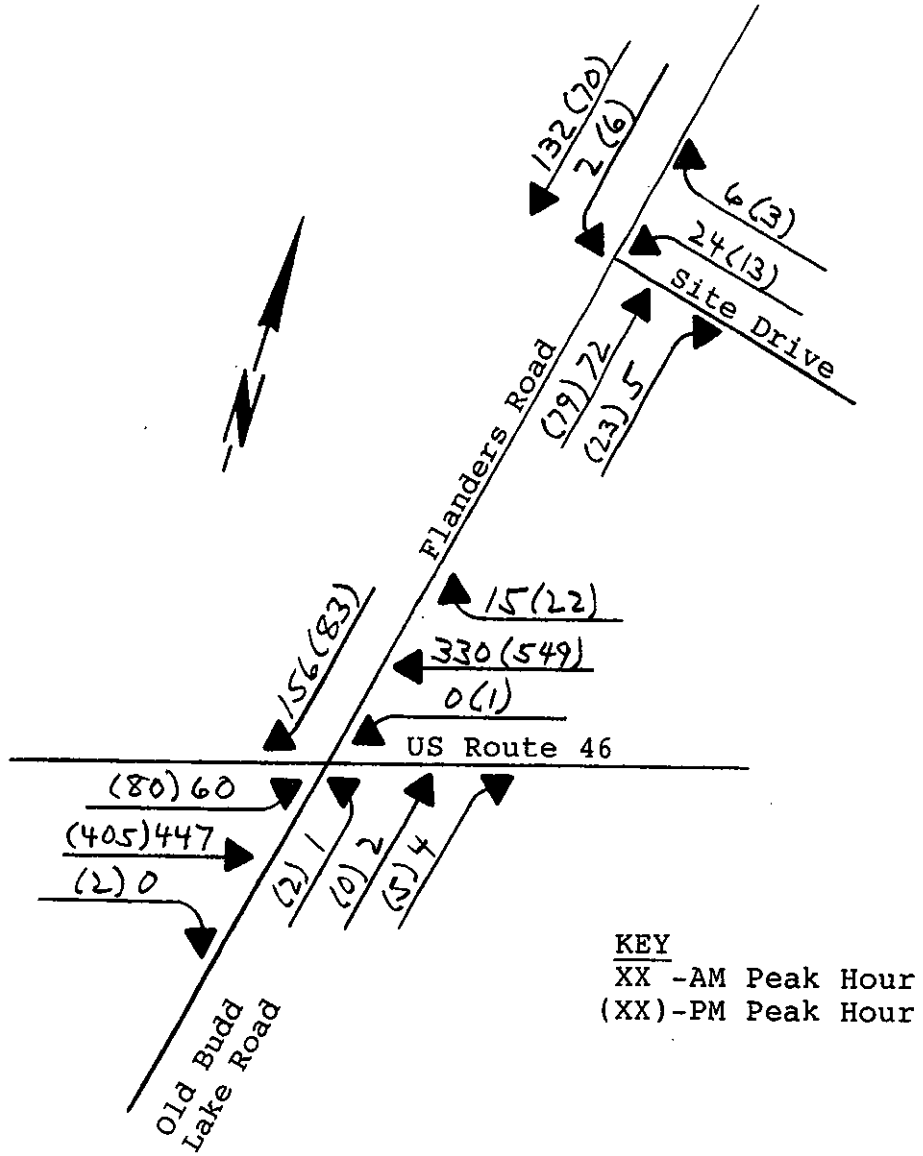




EXHIBIT 6

2016 FULL BUILD PEAK HOUR TRAFFIC VOLUMES



## V. ANALYSIS

Based on the data gathered, traffic projections performed and directional assignments made, the subject intersections of this study were analyzed as to capacity and levels of service (LOS) during the weekday am and pm street peak hours. The Flanders Road and site drive intersection was analyzed for the 2016 Proposed condition only. Capacity analyses were based on unsignalized intersection procedures, as published in the 2010 Highway Capacity Manual (HCM) and associated Highway Capacity Software (HCS). The various time periods and conditions analyzed were as follows:

1. 2014 Existing Conditions;
2. 2016 Existing No Build Conditions with background traffic growth; and
3. 2016 Proposed Full Build Conditions.

The efficiency with which an intersection operates is a function of volume and capacity. The capacity of an intersection is the volume of vehicles it can accommodate during a peak hour and is described in terms of Level of Service (LOS). Levels of Service range from 'A' through 'F', with 'A' representing excellent conditions with little or no delays, while 'F' has long delays and possible flow breakdown. A more in-depth description of Levels of Service for unsignalized intersections can be found in the Appendix to this report (see A-5), as well as the analysis computations (A-6 thru 13). Accordingly, the following findings were established and conclusions drawn relating to traffic capacity impacts to be generated by the proposed residential development.

### A. US Route 46 & Flanders Road

Table 2 summarizes the results of HCM capacity analysis procedures for unsignalized intersections, based on existing geometrics, traffic control, and existing/proposed volumes (see A-6 thru 11).

For 2014 existing conditions, and both peak hours, the Route 46 EB & WB critical left turn movements function at a LOS 'A', this being a superior performance condition. The Flanders Road SB approach right turn operates at LOS 'B' in both peak hours. The Old Budd Lake Road approach operates at LOS 'C' in each peak hour. All the foregoing are very good peak hour operating conditions, indicative of short delays and short vehicle queues.

With inclusion of background traffic growth to 2016, there were no changes in the LOS 'A', 'B' or 'C' identified for the several roadway approaches. Impacts were in the form of a fraction of a second increase in delay.

With construction of the residential apartment project in the 2016 Full Build scenario, there was again no changes in the LOS 'A', 'B' or 'C' identified for the several roadway approaches in either peak hour. The noted intersection movements will experience increases in delay of approximately one second or less. This impact is essentially imperceptible to motorists, with the intersection continuing to operate at excellent conditions. No mitigation is required at this intersection due to the proposed project.

TABLE 2  
PEAK HOUR CAPACITY ANALYSIS  
US ROUTE 46 & FLANDERS ROAD  
UNSIGNALIZED

<u>MOVEMENT</u>	<u>2014 EXISTING CONDITIONS LOS/AVG DEL</u>	<u>2016 EXISTING CONDITIONS LOS/AVG DEL</u>	<u>2016 PROPOSED CONDITIONS LOS/AVG DEL</u>
<u>WEEKDAY AM PEAK HOUR</u>			
US Route 46			
EB Left	A/ 8.2	A/ 8.2	A/ 8.3
WB Left	A/8.3	A/8.3	A/8.4
Flanders Road			
SB Right	B/11.9	B/12.0	B/12.5
Old Budd Lake Road			
NB Left/Thru/Right	C/16.6	C/17.0	C/17.5
<u>WEEKDAY PM PEAK HOUR</u>			
US Route 46			
EB Left	A/ 9.0	A/ 9.1	A/ 9.2
WB Left	A/8.2	A/8.2	A/8.2
Flanders Road			
SB Right	B/14.0	B/14.2	B/14.7
Old Budd Lake Road			
NB Left/Thru/Right	C/18.3	C/18.8	C/20.1

Key: LOS = Level of Service  
 Avg Del = Average Vehicle Delay

**B. Flanders Road & Site Drive**

There is one site drive proposed for the residential site along Flanders Road. The site drive will form a T-intersection with Flanders Road. The drive will be 'STOP' sign posted with an accompanying painted stop line on its approach to Flanders Road. All movements are to be permitted to/from the site drive.

Capacity analyses (see A-12, 13) performed for unsignalized conditions with construction of the proposed residential apartment project, in the 2016 Full Build scenario, identified a LOS 'A' for the Flanders Road SB left turn and a LOS 'A' for the site drive approach, in each peak hour. These are superior performance levels reflective of the very small traffic volumes generated by the project, as well as the minor volumes along Flanders Road.

### C. Sight Distance Analysis

The proposed residential apartment building is to be served by one access drive with Flanders Road. The drive is approximately 350 feet from the north side of Route 46 and is approximately at the same location as the industrial building's north drive.

An evaluation of sight distance was performed at the proposed site access drive intersection with Flanders Road. The 2011 AASHTO stopping sight distance for a speed limit of 25 mph on the through road, which corresponds to a minimum 30 mph design speed, identifies a stopping sight distance (SSD) of 200 feet and an intersection sight distance (ISD) of 335 feet (see A-14). Intersection sight distance provides for the main road driver to decelerate to approximately 70% of his initial operating speed, but not stopping, to accommodate the side road vehicle maneuver. It is noted that AASHTO identifies SSD as the required distance for safety, whereas ISD is noted as a desirable distance.

In consideration of the existing vertical downgrade in Flanders Road, from Rt. 46 to the area of the proposed site drive, AASHTO identifies an increase in the minimum SSD to 210 feet. The SSD standard of 200 feet is unchanged looking to the right (north) from the site access drive across the railroad track on Flanders Road.

Based on a 14.5 foot setback into the proposed site access drive exit lane, looking left (south) towards the northbound Flanders Road travel lane, the line of sight is completely unobstructed with an open view extending to the Rt. 46 intersection. This distance was field measured as 375

feet to the center of the intersection, which accommodates left turns from Rt. 46 EB, and meets both SSD and ISD standards.

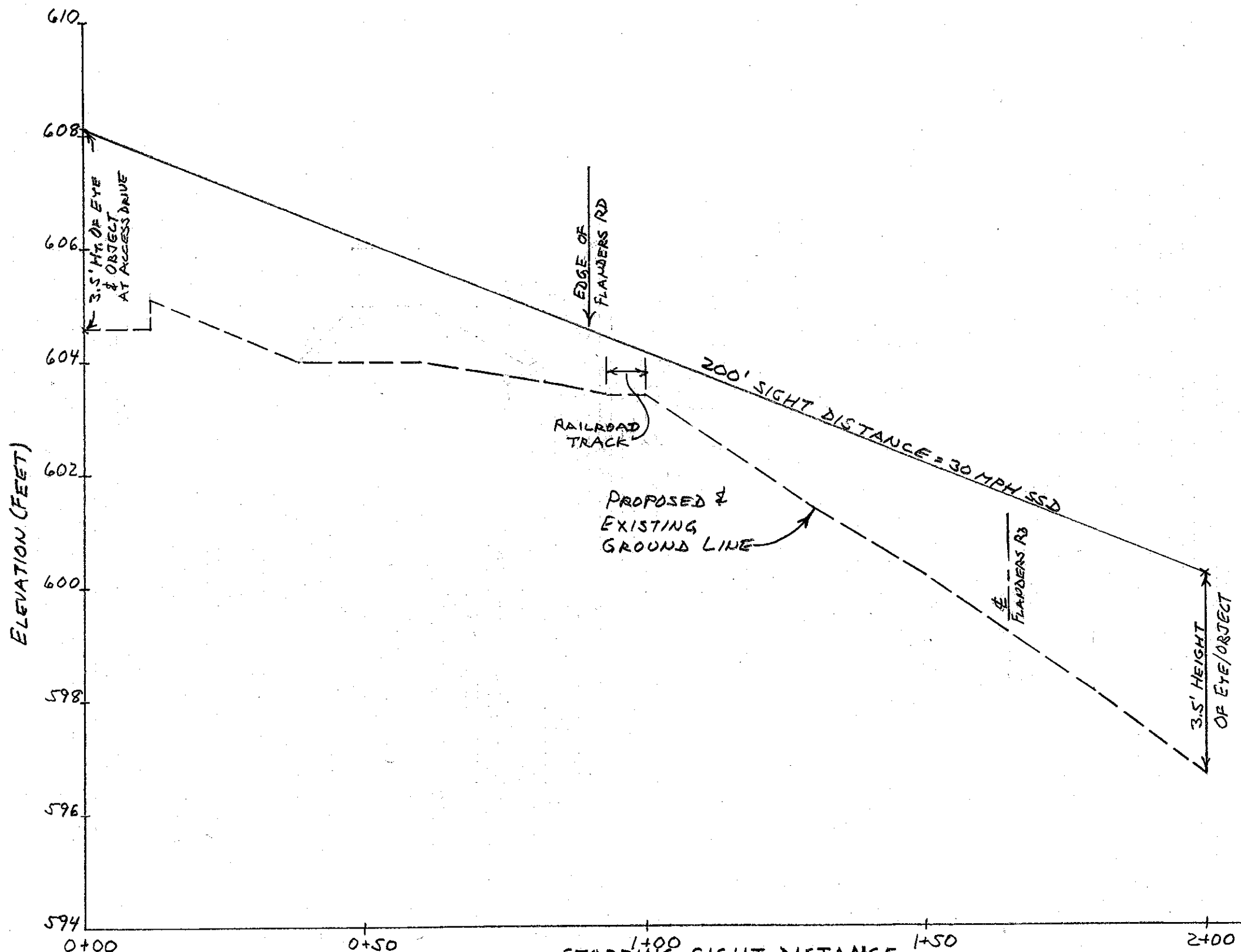
For a vehicle making the 145 degree right turn from Rt. 46 WB to Flanders Road, the field measured distance was 250 feet from a point where the right turning driver could see a vehicle stopped in the site drive. This distance exceeds the 30 mph SSD criteria (210'), but is below the ISD value. Relating to ISD, it was field observed that, due to the very large angle of turn and the vertical downgrade present, vehicle speeds in this turn were approximately 10-15 mph. The ISD for a 250 foot distance is between 20-25 mph. Consequently, the SSD and ISD standards would both be satisfied for the right turn vehicle maneuver. The aforementioned lines of sight are not obstructed by the proposed site parking lot area fronting Flanders Road.

Looking to the right (north) from a 14.5 foot setback in the proposed site access drive exit lane, towards the southbound Flanders Road travel lane, the line of sight extends across the railroad tracks into a vertical roadway downgrade. As the proposed site drive is to be regraded to at least one foot higher than the existing ground line, a field measured sight line could not be accurately obtained. HMA has therefore prepared sight line profiles utilizing FCM's proposed site elevations and their field measured spot elevations along Flanders Road in the affected area. As shown on Exhibit 7, based on a 3.5 foot height of eye/object, the 200 foot minimum SSD (30 mph design speed) is provided in this direction. As shown on Exhibit 8, based on a 3.5 foot height of eye/object, the 335 foot minimum ISD (30 mph design speed) is also provided in this direction. It should be remembered that SSD is the required distance for safety. Related to these lines of sight, it was field identified that there are several small shrubs planted next to the railroad crossing signal assembly located on the east side of Flanders Road. These small shrubs are in the vicinity of the sight lines and cause some obstruction of same. It is recommended that the shrubs be removed.

To further alert drivers traveling Flanders Road as to the presence of the site drive, it is recommended that a 'DRIVE AHEAD' warning sign be posted in each travel direction of Flanders Road, in advance of the site drive intersection. A supplemental distance sign plate should be posted under the warning sign, to advise motorists of the distance to the drive location.

It is required that the sight lines and corner sight triangles be maintained clear of any vegetation or man-made objects.

Ingress and egress to and from the site is designed and will function in a safe and efficient manner, in accordance with sound engineering practice and considering reasonable and prudent driving behavior.



STOPPING SIGHT DISTANCE  
 SIGHT LINE PROFILE LOOKING NORTH FROM 14.5' SET BACK IN  
 THE SITE ACCESS DRIVE EXIT LANE TO FLANDERS RD SOUTHBOUND  
EXHIBIT 7

PREPARED BY:  
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 WEST ORANGE, NJ 07052  
 H. MALTZ  
 JULY 2, 2014

SCALE: 1" = 20' HORIZONTAL  
 1" = 2' VERTICAL



## VI. CONCLUSIONS

From the analysis performed and as presented herein, it is the conclusion of this report that the proposed 72 unit residential apartment building project will have no significant or detrimental traffic impacts at the US Route 46 intersection with Flanders Road. The capacity analyses identified excellent levels of service at this intersection in each peak hour studied, as well as the proposed site drive intersection with Flanders Road. Impacts will essentially be imperceptible to motorists.

The project's projected weekday peak hour trip generation is very small in magnitude, being only 37 trips in the am and 45 trips in the pm peak hours. It is noted that the proposed property is being redeveloped and is not undeveloped land that had no prior history of traffic generation. The site is currently occupied by a 40,000 sf (approx.) industrial building (vacant), which could potentially generate 37 and 39 trips in the respective am and pm peak hours, based on ITE trip generation rates.

The site has one access drive proposed along Flanders Road. An evaluation of stopping sight distance (SSD) and intersection sight distance (ISD), at the drive location with Flanders Road, indicated that AASHTO minimum SSD and ISD standards were more than adequately met looking to the south from the site drive. Looking to the north on Flanders Road, from the site drive, sight line profiles were drawn utilizing FCM's proposed site elevations and their field measured spot elevations. These sight line profiles indicated that the 200 foot minimum SSD and 335 foot minimum ISD are provided in this direction. It is noted that AASHTO identifies SSD as the required distance for safety. Related to the north looking line of sight, it was field identified that there are several small shrubs planted next to the railroad crossing signal assembly located on the east side of Flanders Road. These small shrubs are in the vicinity of the sight line and cause some obstruction of same. It is recommended that the shrubs be removed. To further alert drivers traveling Flanders Road as to the presence of the site drive, it is recommended that a 'DRIVE AHEAD' warning sign be posted in each travel direction of Flanders Road, in advance of the site drive intersection. A supplemental distance sign plate should be posted under the warning sign, to advise motorists of the distance to the drive location.

It is required that the sight lines and corner sight triangles be maintained clear of any vegetation or man-made objects.

Signage and pavement markings should be provided as noted on the site plans. It is recommended that a 'STOP' sign with accompanying stop line be installed at the exit end of the access drive to Flanders Road.

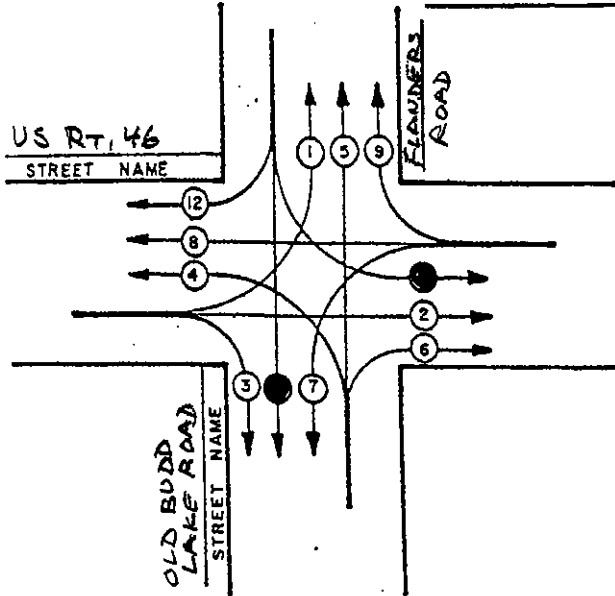
Ingress and egress to and from the site is designed and will function in a safe and efficient manner, in accordance with sound engineering practice and considering reasonable and prudent driving behavior.

# **APPENDIX**

HAMAL ASSOCIATES, INC.  
19 PORTER ROAD  
WEST ORANGE, NJ 07052

LOCATION US RT. 46 & FLANDERS RD -  
OLD BUDD LAKE RD  
MUNICIPALITY BROOKH OF NETCONG  
COUNTY MORRIS  
DATE JUNE 4, 2014 SMT  TFS  
TIME: FROM 7 A.M. TO 9 A.M. (INDICATE DAY)

### SUMMARY SHEET



PROJECT NO. 114-12

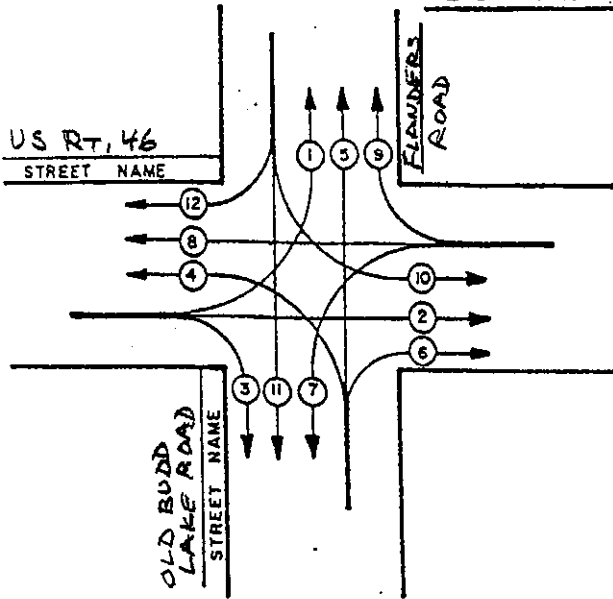
WEATHER CLEAR RECORDER HKM

TIME AM or PM	1	2	3	TOTAL 1-2-3	4	5	6	TOTAL 4-5-6	7	8	9	TOTAL 7-8-9	10	11	12	TOTAL 10-11-12	TOTAL
7:00	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
7:15	10	131	0	141	0	0	1	1	0	52	0	52			28	28	222
7:30	12	103	0	115	1	0	0	1	0	75	4	79			29	29	224
7:45	15	111	0	126	0	0	0	0	0	74	1	75			32	32	233
8:00	16	117	0	133	0	1	3	4	0	92	5	97			36	36	270
8:15	14	100	0	114	0	1	1	2	0	83	2	85			32	32	233
8:30	6	88	0	94	0	0	0	0	0	84	2	86			34	34	214
8:45	5	69	0	74	0	0	0	0	1	83	3	87			24	24	185
9:00	14	76	0	90	0	0	1	1	0	89	2	91			24	24	206
7:15-8:15	57	431	0	488	1	2	4	7	0	324	12	336	—	—	129	129	960
PHF																	0.89
HVV TR %				29%				0%				4%				1%	
TOTAL																	

HAMAL ASSOCIATES, INC.  
19 PORTER ROAD  
WEST ORANGE, NJ 07052

LOCATION US RT. 46 & FLANDERS RD -  
OLD BUDD LAKE RD  
MUNICIPALITY BOROUGH OF NETCONG  
COUNTY MORRIS  
DATE JUNE 4, 2014 SMT  TFS  
TIME: FROM 4 P.M. TO 6 P.M. (INDICATE DAY)

SUMMARY SHEET



PROJECT NO. 114-12

WEATHER PT, CLDY, RECORDER HKM

TIME AM or PM	1	2	3	TOTAL 1-2-3	4	5	6	TOTAL 4-5-6	7	8	9	TOTAL 7-8-9	10	11	12	TOTAL 10-11-12	TOTAL
4:00	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
4:15	25	107	0	132	0	0	0	0	0	141	1	142			15	15	289
4:30	21	97	0	118	0	11	0	1	0	129	2	131			7	7	257
4:45	13	98	0	111	0	0	1	1	0	132	2	134			14	14	260
5:00	16	98	0	114	0	0	0	0	1	137	3	141			22	22	277
5:15	21	78	0	99	1	0	3	4	0	127	0	127			16	16	246
5:30	20	119	2	141	1	0	1	2	0	142	3	145			17	17	305
5:45	11	79	0	90	0	0	0	0	2	137	3	142			23	23	255
6:00	21	90	0	111	0	0	0	0	0	134	2	136			12	12	259
4:30 - 5:30	70	393	2	465	2	0	5	7	1	538	8	547	—	—	69	69	1088
PHF																	0.89
HV% TR %				1%				0%				1%				4%	
TOTAL																	

## Apartment (220)

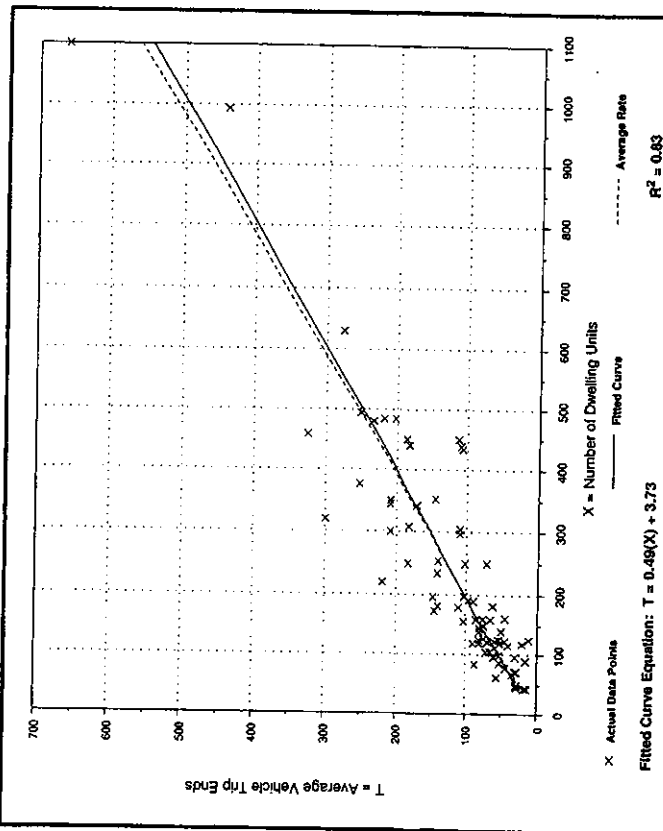
**Average Vehicle Trip Ends vs: Dwelling Units**  
 On a: Weekday,  
 Peak Hour of Adjacent Street Traffic,  
 One Hour Between 7 and 9 a.m.

Number of Studies: 78  
 Avg. Number of Dwelling Units: 235  
 Directional Distribution: 20% entering, 80% exiting

### Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
0.51	0.10 - 1.02	0.73

### Data Plot and Equation



## Apartment (220)

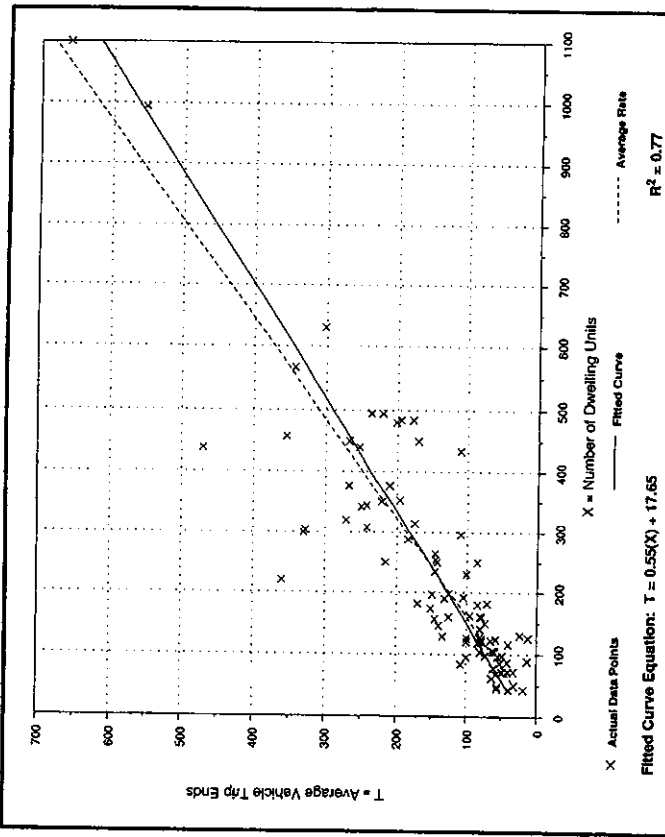
**Average Vehicle Trip Ends vs: Dwelling Units**  
 On a: Weekday,  
 Peak Hour of Adjacent Street Traffic,  
 One Hour Between 4 and 6 p.m.

Number of Studies: 90  
 Avg. Number of Dwelling Units: 233  
 Directional Distribution: 65% entering, 35% exiting

### Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
0.62	0.10 - 1.64	0.82

### Data Plot and Equation



# New Jersey Department of Transportation

## NJDOT ACCESS PERMIT

### ANNUAL BACKGROUND GROWTH RATE TABLE

Valid for NJDOT Access Permits submitted April 2013 - April 2015

COUNTY	Functional Classification													
	RURAL							URBAN						
	Interstate	Other Principal Arterial	Minor Arterial	Major Collector	Minor Collector	Local	Interstate	Freeway	Principal Arterial	Minor Arterial	Collector	Local		
Atlantic	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	N/A	1.00%	1.00%	1.00%	1.00%	1.00%		
Bergen	N/A	N/A	N/A	N/A	N/A	N/A	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%		
Burlington	N/A	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%		
Camden	N/A	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%		
Cape May	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	N/A	1.00%	1.00%	1.00%	1.00%	1.00%		
Cumberland	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	N/A	1.00%	1.00%	1.00%	1.00%	1.00%		
Essex	N/A	N/A	N/A	N/A	N/A	N/A	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%		
Gloucester	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.25%		
Hudson	N/A	N/A	N/A	N/A	N/A	N/A	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%		
Hunterdon	1.00%	1.25%	1.50%	1.25%	1.75%	1.00%	1.00%	1.00%	1.25%	1.00%	1.25%	1.00%		
Mercer	1.00%	1.00%	1.00%	1.00%	1.25%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%		
Middlesex	1.00%	1.25%	1.25%	1.25%	2.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%		
Monmouth	1.50%	1.25%	1.25%	1.50%	1.00%	1.00%	1.75%	1.00%	1.00%	1.00%	1.25%	1.00%		
Morris	1.25%	1.00%	1.00%	1.00%	1.50%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%		
Ocean	1.50%	1.00%	1.25%	1.50%	1.00%	1.00%	1.75%	1.00%	1.00%	1.25%	2.00%	1.00%		
Passaic	N/A	N/A	N/A	N/A	N/A	N/A	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%		
Salem	1.50%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	N/A	1.00%	1.00%	1.00%	1.00%		
Somerset	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	N/A	1.00%	1.00%	1.25%	1.00%		
Sussex	1.25%	1.50%	1.25%	2.50%	3.25%	2.00%	N/A	1.00%	1.00%	1.00%	1.00%	1.00%		
Union	N/A	N/A	N/A	N/A	N/A	N/A	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%		
Warren	1.50%	1.00%	1.25%	1.25%	1.75%	1.00%	1.00%	1.00%	1.00%	1.25%	1.25%	1.00%		

NOTE: For use in short term (within 1-3 years) background growth ONLY.

**Example:** Assume existing condition is 1,500 peak hour trips and the applicable growth rate is 2%. The multiplication factor for 2% compounded for 3 years is 1.0612. The three-year peak hour forecast is 1,591.8, or 1,592 peak hour trips.  $[1592 = 1500(1 + 0.02)^3 = 1500(1.0612)]$

Future Growth (compounded) = Present Growth \* (1+Growth Rate)<sup># of years</sup>


## LEVEL OF SERVICE ANALYSIS

While traffic volumes provide a measure of activity on the area roadway system, it is also important to evaluate how well that system can accommodate those volumes – i.e., a comparison of peak hour traffic volumes with available roadway capacity. By definition capacity represents the maximum number of vehicles that can be accommodated given the constraints of roadway geometry, environment, traffic characteristics, and controls. Intersections are usually the critical point in any road network since it is at such points that conflicts exist between through, crossing, and turning traffic. It is at these locations where congestion is most likely to occur.

### Unsignalized Intersections

An unsignalized (i.e., "YIELD" or "STOP" sign controlled) driveway or side street along a through route is seldom critical from an overall capacity standpoint, however, it may be of great significance to the capacity of the minor cross-route, and it may influence the quality of traffic flow on both. In analyzing unsignalized intersections, it is assumed that both the through traffic movements and right turn movements on the major street approaches are unimpeded and have the right-of-way over the minor street approaches and left turns from the major street. All other turning movements at the intersection cross, merge with, or are otherwise impeded by the major street movements.

The concept in determining traffic delays at an unsignalized intersection is to process these impeded movements in a sequential manner. For each impeded movement, all conflicting flows are summed, and an initial critical 'gap' in traffic is determined with a "follow-up" gap determined for subsequent vehicles waiting in a queue. Based upon the number of available gaps in the passing traffic stream, the potential capacity of that movement can be calculated.

However, since operation at capacity is usually unsatisfactory to most drivers, a descriptive mechanism (Level of Service) has been developed to describe traffic operations as a function of average total delay. Unsignalized Levels of Service range from 'A' (delays less than five seconds) to 'F' (delays greater than 45 seconds). Table I summarizes the relationship between capacity and Level of Service for unsignalized intersections:

**TABLE I**

**Levels of Service and Expected Delay  
For Unsignalized Intersections**

Level of Service	Average Total Delay (Seconds/Vehicle)
a	<10
b	>10 and ≤ 15
c	>15 and ≤ 25
d	> 25 and ≤ 35
e	> 35 and < 50
f	>50

Source: Transportation Research Board, Highway Capacity Manual 2000, published by the Transportation Research Board, Wash., D.C.



HCS+: Unsignalized Intersections Release 5.6

TWO-WAY STOP CONTROL SUMMARY

Analyst: HKM  
 Agency/Co.: HAMAL ASSOCIATES  
 Date Performed: 6/18/2014  
 Analysis Time Period: AM PEAK HOUR  
 Intersection: US RT 46 & FLANDERS RD/OLD BUD  
 Jurisdiction: BORO OF NETCONG  
 Units: U. S. Customary  
 Analysis Year: 2014 EXISTING  
 Project ID: 2014 EXISTING VOLUMES-AM PEAK HOUR-1412E01  
 East/West Street: US RT 46  
 North/South Street: FLANDERS RD/OLD BUDD LAKE RD  
 Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments							
Major Street:	Approach Movement	Eastbound			Westbound		
		1 L	2 T	3 R	4 L	5 T	6 R
Volume		57	431	0	0	324	12
Peak-Hour Factor, PHF		0.89	0.89	0.89	0.89	0.89	0.89
Hourly Flow Rate, HFR		64	484	0	0	364	13
Percent Heavy Vehicles		2	--	--	0	--	--
Median Type/Storage		Undivided			/		
RT Channelized?							
Lanes		0	1	0	0	1	0
Configuration		LTR			LTR		
Upstream Signal?		No			No		

Minor Street:	Approach Movement	Northbound			Southbound		
		7 L	8 T	9 R	10 L	11 T	12 R
Volume		1	2	4			129
Peak Hour Factor, PHF		0.89	0.89	0.89			0.89
Hourly Flow Rate, HFR		1	2	4			144
Percent Heavy Vehicles		0	0	0			1
Percent Grade (%)		0			2		
Flared Approach: Exists?/Storage		No			/		
Lanes		0	1	0			1
Configuration		LTR			R		

Approach Movement	Delay, Queue Length, and Level of Service							
	EB 1	WB 4	Northbound 7 8 9			Southbound 10 11 12		
Lane Config	LTR	LTR	LTR			LTR		
v (vph)	64	0	7			144		
C(m) (vph)	1181	1089	317			664		
v/c	0.05	0.00	0.02			0.22		
95% queue length	0.17	0.00	0.07			0.82		
Control Delay	8.2	8.3	16.6			11.9		
LOS	A	A	C			B		
Approach Delay			16.6			11.9		
Approach LOS			C			B		

HCS+: Unsignalized Intersections Release 5.6

TWO-WAY STOP CONTROL SUMMARY

Analyst: HKM  
 Agency/Co.: HAMAL ASSOCIATES  
 Date Performed: 6/18/2014  
 Analysis Time Period: PM PEAK HOUR  
 Intersection: US RT 46 & FLANDERS RD/OLD BUD  
 Jurisdiction: BORO OF NETCONG  
 Units: U. S. Customary  
 Analysis Year: 2014 EXISTING  
 Project ID: 2014 EXISTING VOLUMES-PM PEAK HOUR-1412E02  
 East/West Street: US RT 46  
 North/South Street: FLANDERS RD/OLD BUDD LAKE RD  
 Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments							
Major Street:	Approach Movement	Eastbound			Westbound		
		1 L	2 T	3 R	4 L	5 T	6 R
Volume		70	393	2	1	538	8
Peak-Hour Factor, PHF		0.89	0.89	0.89	0.89	0.89	0.89
Hourly Flow Rate, HFR		78	441	2	1	604	8
Percent Heavy Vehicles		1	--	--	0	--	--
Median Type/Storage		Undivided			/		
RT Channelized?							
Lanes		0	1	0	0	1	0
Configuration		LTR			LTR		
Upstream Signal?		No			No		
Minor Street:	Approach Movement	Northbound			Southbound		
		7 L	8 T	9 R	10 L	11 T	12 R
Volume		2	0	5			69
Peak Hour Factor, PHF		0.89	0.89	0.89			0.89
Hourly Flow Rate, HFR		2	0	5			77
Percent Heavy Vehicles		0	0	0			4
Percent Grade (%)		0			2		
Flared Approach: Exists?/Storage		No			/		/
Lanes		0	1	0		1	
Configuration		LTR				R	

Delay, Queue Length, and Level of Service							
Approach Movement	EB	WB	Northbound			Southbound	
			4	7	8	9	10
Lane Config	LTR	LTR		LTR			R
v (vph)	78	1		7			77
C(m) (vph)	972	1128		278			476
v/c	0.08	0.00		0.03			0.16
95% queue length	0.26	0.00		0.08			0.57
Control Delay	9.0	8.2		18.3			14.0
LOS	A	A		C			B
Approach Delay				18.3			14.0
Approach LOS				C			B

HCS+: Unsignalized Intersections Release 5.6

TWO-WAY STOP CONTROL SUMMARY

Analyst: HKM  
 Agency/Co.: HAMAL ASSOCIATES  
 Date Performed: 6/18/2014  
 Analysis Time Period: AM PEAK HOUR  
 Intersection: US RT 46 & FLANDERS RD/OLD BUD  
 Jurisdiction: BORO OF NETCONG  
 Units: U. S. Customary  
 Analysis Year: 2016 EXISTING  
 Project ID: 2016 EXISTING VOLUMES-AM PEAK HOUR-1412E03  
 East/West Street: US RT 46  
 North/South Street: FLANDERS RD/OLD BUDD LAKE RD  
 Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach Movement	Eastbound				Westbound		
	1 L	2 T	3 R	4 L	5 T	6 R	
Volume	58	440	0	0	330	12	
Peak-Hour Factor, PHF	0.89	0.89	0.89	0.89	0.89	0.89	
Hourly Flow Rate, HFR	65	494	0	0	370	13	
Percent Heavy Vehicles	2	--	--	0	--	--	
Median Type/Storage	Undivided			/			
RT Channelized?							
Lanes	0	1	0		0	1	
Configuration	LTR				LTR		
Upstream Signal?	No				No		

Minor Street: Approach Movement	Northbound			Southbound		
	7 L	8 T	9 R	10 L	11 T	12 R
Volume	1	2	4			132
Peak Hour Factor, PHF	0.89	0.89	0.89			0.89
Hourly Flow Rate, HFR	1	2	4			148
Percent Heavy Vehicles	0	0	0			1
Percent Grade (%)	0				2	
Flared Approach: Exists?/Storage			No	/		/
Lanes	0	1	0			1
Configuration	LTR					R

Delay, Queue Length, and Level of Service

Approach Movement	EB	WB	Northbound			Southbound		
	1	4	7	8	9	10	11	12
Lane Config	LTR	LTR		LTR				R
v (vph)	65	0		7				148
C(m) (vph)	1175	1080		308				659
v/c	0.06	0.00		0.02				0.22
95% queue length	0.18	0.00		0.07				0.86
Control Delay	8.2	8.3		17.0				12.0
LOS	A	A		C				B
Approach Delay				17.0				12.0
Approach LOS				C				B

HCS+: Unsignalized Intersections Release 5.6

TWO-WAY STOP CONTROL SUMMARY

Analyst: HKM  
 Agency/Co.: HAMAL ASSOCIATES  
 Date Performed: 6/18/2014  
 Analysis Time Period: PM PEAK HOUR  
 Intersection: US RT 46 & FLANDERS RD/OLD BUD  
 Jurisdiction: BORO OF NETCONG  
 Units: U. S. Customary  
 Analysis Year: 2016 EXISTING  
 Project ID: 2016 EXISTING VOLUMES-PM PEAK HOUR-1412E04  
 East/West Street: US RT 46  
 North/South Street: FLANDERS RD/OLD BUDD LAKE RD  
 Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach Movement	Eastbound			Westbound		
	1 L	2 T	3 R	4 L	5 T	6 R
Volume	71	401	2	1	549	8
Peak-Hour Factor, PHF	0.89	0.89	0.89	0.89	0.89	0.89
Hourly Flow Rate, HFR	79	450	2	1	616	8
Percent Heavy Vehicles	1	--	--	0	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes	0	1	0	0	1	0
Configuration	LTR			LTR		
Upstream Signal?	No			No		

Minor Street: Approach Movement	Northbound			Southbound		
	7 L	8 T	9 R	10 L	11 T	12 R
Volume	2	0	5			70
Peak Hour Factor, PHF	0.89	0.89	0.89			0.89
Hourly Flow Rate, HFR	2	0	5			78
Percent Heavy Vehicles	0	0	0			4
Percent Grade (%)	0			2		
Flared Approach: Exists?/Storage	No			/		
Lanes	0	1	0			1
Configuration	LTR			R		

Delay, Queue Length, and Level of Service

Approach Movement Lane Config	EB	WB	Northbound			Southbound		
	1 LTR	4 LTR	7 L	8 LTR	9 L	10 L	11 T	12 R
v (vph)	79	1		7				78
C(m) (vph)	962	1119		267				468
v/c	0.08	0.00		0.03				0.17
95% queue length	0.27	0.00		0.08				0.59
Control Delay	9.1	8.2		18.8				14.2
LOS	A	A		C				B
Approach Delay				18.8				14.2
Approach LOS				C				B

HCS+: Unsignalized Intersections Release 5.6

TWO-WAY STOP CONTROL SUMMARY

Analyst: HKM  
 Agency/Co.: HAMAL ASSOCIATES  
 Date Performed: 6/18/2014  
 Analysis Time Period: AM PEAK HOUR  
 Intersection: US RT 46 & FLANDERS RD/OLD BUD  
 Jurisdiction: BORO OF NETCONG  
 Units: U. S. Customary  
 Analysis Year: 2016 PROPOSED  
 Project ID: 2016 PROPOSED VOLUMES-AM PEAK HOUR-1412P01  
 East/West Street: US RT 46  
 North/South Street: FLANDERS RD/OLD BUDD LAKE RD  
 Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments							
Major Street: Approach Movement	Eastbound				Westbound		
	1 L	2 T	3 R	4   L	5 T	6 R	
Volume	60	447	0	0	330	15	
Peak-Hour Factor, PHF	0.89	0.89	0.89	0.89	0.89	0.89	
Hourly Flow Rate, HFR	67	502	0	0	370	16	
Percent Heavy Vehicles	2	--	--	0	--	--	
Median Type/Storage	Undivided				/		
RT Channelized?							
Lanes	0	1	0		0	1	0
Configuration	LTR				LTR		
Upstream Signal?	No				No		

Minor Street: Approach Movement	Northbound				Southbound		
	7 L	8 T	9 R	10   L	11 T	12 R	
Volume	1	2	4			156	
Peak Hour Factor, PHF	0.89	0.89	0.89			0.89	
Hourly Flow Rate, HFR	1	2	4			175	
Percent Heavy Vehicles	0	0	0			1	
Percent Grade (%)	0				2		
Flared Approach: Exists?/Storage	No			/		/	
Lanes	0	1	0			1	
Configuration	LTR					R	

Delay, Queue Length, and Level of Service							
Approach Movement Lane Config	EB	WB	Northbound			Southbound	
	1 LTR	4 LTR	7 	8 LTR	9 	10 	11 12 R
v (vph)	67	0		7			175
C(m) (vph)	1172	1073		295			657
v/c	0.06	0.00		0.02			0.27
95% queue length	0.18	0.00		0.07			1.07
Control Delay	8.3	8.4		17.5			12.5
LOS	A	A		C			B
Approach Delay				17.5			12.5
Approach LOS				C			B

HCS+: Unsignalized Intersections Release 5.6

TWO-WAY STOP CONTROL SUMMARY

Analyst: HKM  
 Agency/Co.: HAMAL ASSOCIATES  
 Date Performed: 6/18/2014  
 Analysis Time Period: PM PEAK HOUR  
 Intersection: US RT 46 & FLANDERS RD/OLD BUD  
 Jurisdiction: BORO OF NETCONG  
 Units: U. S. Customary  
 Analysis Year: 2016 PROPOSED  
 Project ID: 2016 PROPOSED VOLUMES-PM PEAK HOUR-1412P02  
 East/West Street: US RT 46  
 North/South Street: FLANDERS RD/OLD BUDD LAKE RD  
 Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments							
Major Street:	Approach Movement	Eastbound				Westbound	
		1 L	2 T	3 R	4 L	5 T	6 R
Volume		80	405	2	1	549	22
Peak-Hour Factor, PHF		0.89	0.89	0.89	0.89	0.89	0.89
Hourly Flow Rate, HFR		89	455	2	1	616	24
Percent Heavy Vehicles		1	--	--	0	--	--
Median Type/Storage		Undivided			/		
RT Channelized?							
Lanes		0	1	0		0	1
Configuration		LTR				LTR	
Upstream Signal?		No				No	

Minor Street:	Approach Movement	Northbound				Southbound	
		7 L	8 T	9 R	10 L	11 T	12 R
Volume		2	0	5			83
Peak Hour Factor, PHF		0.89	0.89	0.89			0.89
Hourly Flow Rate, HFR		2	0	5			93
Percent Heavy Vehicles		0	0	0			4
Percent Grade (%)		0				2	
Flared Approach: Exists?/Storage				No	/		/
Lanes		0	1	0			1
Configuration		LTR					R

Delay, Queue Length, and Level of Service							
Approach Movement	EB	WB	Northbound			Southbound	
	1	4	7	8	9	10	11
Lane Config	LTR	LTR		LTR			R
v (vph)	89	1		7			93
C(m) (vph)	949	1114		246			463
v/c	0.09	0.00		0.03			0.20
95% queue length	0.31	0.00		0.09			0.74
Control Delay	9.2	8.2		20.1			14.7
LOS	A	A		C			B
Approach Delay				20.1			14.7
Approach LOS				C			B

HCS+: Unsignalized Intersections Release 5.6

TWO-WAY STOP CONTROL SUMMARY

Analyst: HKM  
 Agency/Co.: HAMAL ASSOCIATES  
 Date Performed: 6/18/2014  
 Analysis Time Period: AM PEAK HOUR  
 Intersection: FLANDERS ROAD & SITE DRIVE  
 Jurisdiction: BORO OF NETCONG  
 Units: U. S. Customary  
 Analysis Year: 2016 PROPOSED  
 Project ID: 2016 PROPOSED VOLUMES-AM PEAK HOUR-1412P03  
 East/West Street: SITE DRIVE  
 North/South Street: FLANDERS ROAD  
 Intersection Orientation: NS Study period (hrs): 0.25

		Vehicle Volumes and Adjustments					
Major Street:	Approach Movement	Northbound			Southbound		
		1 L	2 T	3 R	4   L	5 T	6 R
Volume		72	5	2	132		
Peak-Hour Factor, PHF		0.86	0.86	0.86	0.86		
Hourly Flow Rate, HFR		83	5	2	153		
Percent Heavy Vehicles		--	--	0	--	--	
Median Type/Storage		Undivided			/		
RT Channelized?							
Lanes		1	0		0	1	
Configuration			TR		LT		
Upstream Signal?		No			No		

Minor Street:	Approach Movement	Westbound			Eastbound		
		7 L	8 T	9 R	10   L	11 T	12 R
Volume		24		6			
Peak Hour Factor, PHF		0.86		0.86			
Hourly Flow Rate, HFR		27		6			
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 Movement	Lane Config	NE	SB	Westbound		Eastbound	
		1	4   7	8	9   10	11	12
v (vph)		2		33			
C(m) (vph)		1520		782			
v/c		0.00		0.04			
95% queue length		0.00		0.13			
Control Delay		7.4		9.8			
LOS		A		A			
Approach Delay				9.8			
Approach LOS				A			

HCS+: Unsignalized Intersections Release 5.6

TWO-WAY STOP CONTROL SUMMARY

Analyst: HKM  
 Agency/Co.: HAMAL ASSOCIATES  
 Date Performed: 6/18/2014  
 Analysis Time Period: PM PEAK HOUR  
 Intersection: FLANDERS ROAD & SITE DRIVE  
 Jurisdiction: BORO OF NETCONG  
 Units: U. S. Customary  
 Analysis Year: 2016 PROPOSED  
 Project ID: 2016 PROPOSED VOLUMES-PM PEAK HOUR-1412P04  
 East/West Street: SITE DRIVE  
 North/South Street: FLANDERS ROAD  
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments							
Major Street:	Approach	Northbound				Southbound	
Movement		1	2	3	4	5	6
		L	T	R	L	T	R
Volume			79	23	6	70	
Peak-Hour Factor, PHF			0.90	0.90	0.90	0.90	
Hourly Flow Rate, HFR			87	25	6	77	
Percent Heavy Vehicles			--	--	0	--	--
Median Type/Storage		Undivided			/		
RT Channelized?							
Lanes			1	0		0	1
Configuration			TR			LT	
Upstream Signal?			No			No	

Minor Street:	Approach	Westbound				Eastbound	
Movement		7	8	9	10	11	12
		L	T	R	L	T	R
Volume		13		3			
Peak Hour Factor, PHF		0.90		0.90			
Hourly Flow Rate, HFR		14		3			
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	NB	SB	Westbound			Eastbound	
Movement	1	4	7	8	9	10	11 12
Lane Config		LT		LR			
v (vph)		6		17			
C(m) (vph)		1490		826			
v/c		0.00		0.02			
95% queue length		0.01		0.06			
Control Delay		7.4		9.4			
LOS		A		A			
Approach Delay				9.4			
Approach LOS				A			



intersection is located on a 4 percent upgrade, then the time gap selected for intersection sight distance design for left turns should be increased from 8.0 to 8.8 s, equivalent to an increase of 0.2 s for each percent grade.

The design values for intersection sight distance for passenger cars are shown in Table 9-6. Figure 9-17 includes design values, based on the time gaps for the design vehicles included in Table 9-5.

No adjustment of the recommended sight distance values for the major-road grade is generally needed because both the major- and minor-road vehicle will be on the same grade when departing from the intersection. However, if the minor-road design vehicle is a heavy truck and the intersection is located near a sag vertical curve with grades over 3 percent, then an adjustment to extend the recommended sight distance based on the major-road grade should be considered.

**Table 9-6. Design Intersection Sight Distance—Case B1, Left Turn from Stop**

Design Speed (km/h)	Stopping Sight Distance (m)	Intersection Sight Distance for Passenger Cars		Design Speed (mph)	Stopping Sight Distance (ft)	Intersection Sight Distance for Passenger Cars	
		Calculated (m)	Design (m)			Calculated (ft)	Design (ft)
20	20	41.7	45	15	80	165.4	170
30	35	62.6	65	20	115	220.5	225
40	50	83.4	85	25	155	275.6	280
50	65	104.3	105	30	200	330.8	335
60	85	125.1	130	35	250	385.9	390
70	105	146.0	150	40	305	441.0	445
80	130	166.8	170	45	360	496.1	500
90	160	187.7	190	50	425	551.3	555
100	185	208.5	210	55	495	606.4	610
110	220	229.4	230	60	570	661.5	665
120	250	250.2	255	65	645	716.6	720
130	285	271.1	275	70	730	771.8	775
—	—	—	—	75	820	826.9	830
—	—	—	—	80	910	882.0	885

Note: Intersection sight distance shown is for a stopped passenger car to turn left onto a two-lane highway with no median and grades 3 percent or less. For other conditions, the time gap should be adjusted and the sight distance recalculated.

Sight distance design for left turns at divided-highway intersections should consider multiple design vehicles and median width. If the design vehicle used to determine sight distance for a divided-highway intersection is larger than a passenger car, then sight distance for left turns will need to be checked for that selected design vehicle and for smaller design vehicles as well. If the divided-highway median is wide enough to store the design vehicle with a clearance to the through lanes of approximately 1 m [3 ft] at both ends of the vehicle, no separate analysis for the departure sight triangle for left turns is needed on the minor-road approach for the near roadway to the left. In most cases, the departure sight triangle for right