

TRAFFIC STUDY

**THE VILLAS AT ORANGE LAWN
305 NORTH RIDGEWOOD ROAD
BLOCK 1304 – LOT 6**

**TOWNSHIP OF SOUTH ORANGE VILLAGE
ESSEX COUNTY, NEW JERSEY**

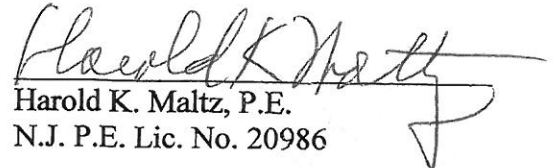
SUBMITTED TO:

**BNE REAL ESTATE GROUP
16 MICROLAB ROAD, SUITE A
LIVINGSTON, NJ 07039**

August 16, 2016

PREPARED BY:

**HAMAL ASSOCIATES, INC.
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D161301

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I. INTRODUCTION

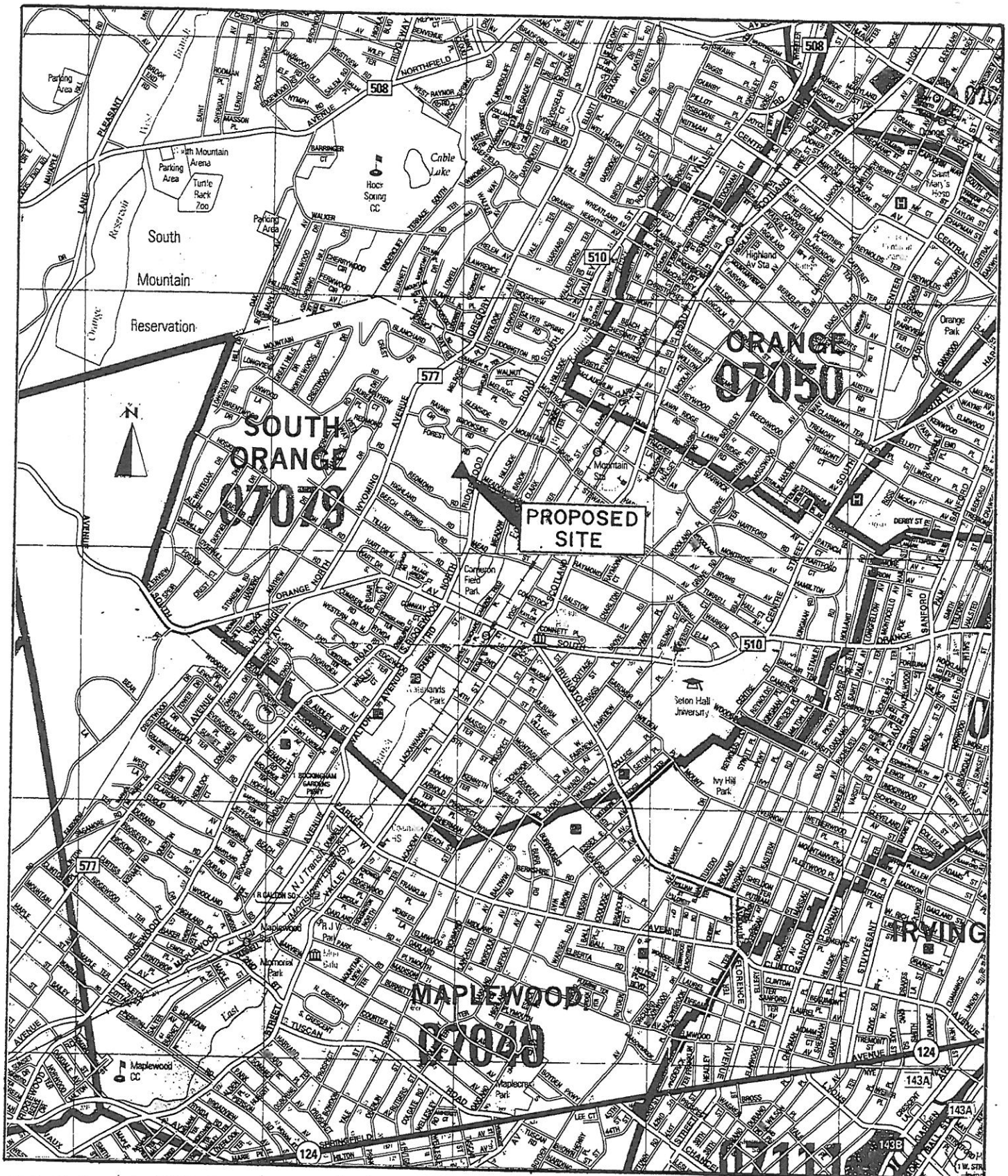
Villas at Orange Lawn, LLC (Applicant - Villas) has proposed the construction of twenty (20), three bedroom townhouse units in ten, 2.5 story buildings, located in the eastern section of the Orange Lawn Tennis Club site (Club), in the Township of South Orange Village, Essex County, New Jersey. The Club site (Block 1304, Lot 6) is situated just west of North Ridgewood Road and between Redwood Road and Forest Road. The townhouse project is to be constructed on a 4.6 acre section of land being sold/subdivided by the Club to the Villas. A total of 80 parking spaces are proposed on the residential site.

Access for the townhouse project will be through a cul-de-sac (hammerhead terminus design) roadway that will intersect the Club's existing access drive that extends to N. Ridgewood Road. As part of the project, some widening of the N. Ridgewood Road access drive will be performed between the vicinity of the townhouse site drive and N. Ridgewood Road. Roadway access is also available for the townhouse residents through another access drive traversing the Club site to Redmond Road.

The tennis club facility will continue its current operations, with no changes to events, activities, etc., that would affect site trip generation. As the Club currently uses the area where the townhouse project is to be built for event overflow parking, the site plan also identifies revised paved and overflow parking areas on the remaining Club site, to compensate for this displacement. Primarily due to the foregoing noted parking area changes, the Club is a co-applicant in this project.

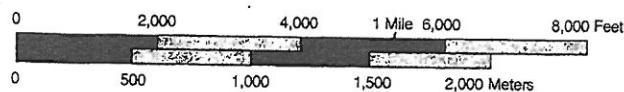
In view of the proposed residential development, the Villas has retained the firm of Hamal Associates, Inc. (HMA) to determine the traffic impacts of the proposed residential site development at the intersections of; 1) N. Ridgewood Road & the Club Drive, and 2) Redmond Road & the Club Drive, during the weekday am and pm street peak hours and identify mitigation, if necessary. HMA will also evaluate site access, on-site circulation, parking quantity and dimensions, based on the NJ Residential Site Improvement Standards (RSIS).

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



Hagstrom Map Company, Inc., 36-36 33rd Street, Long Island City, New York 11106

EXHIBIT 1 PROJECT LOCATION MAP



II. EXISTING CONDITIONS

The townhouse/Club site is located in the north-central area of the Township of South Orange Village, just west of N. Ridgewood Road and between Redwood Road and Forest Road. The Club site's two existing access drives are to remain unchanged. One access drive intersects N. Ridgewood Road, as a T-intersection, approximately 220 feet south of Forest Road. A second access drive intersects Redmond Road, as a T-intersection, approximately 725 feet west of N. Ridgewood Road. The two Club access drives are inter-accessible on-site. Existing development in the area consists of residential properties, with Cameron Field Park and South Orange Middle School located nearby to the south along the east side of N. Ridgewood Road.

Within the study area, N. Ridgewood Road is a north-south municipal roadway having a 28+/- foot wide pavement, with curbing and sidewalks along each side of the road. A posted 25 mph speed limit is in effect. The roadway alignment is generally straight and relatively level. One travel lane is provided in each direction with no parking permitted on either side of the roadway. N. Ridgewood Road extends into the Township of West Orange, to the north, where it changes name to S. Valley Street. To the south, N. Ridgewood Road crosses South Orange Avenue at a signalized intersection, and continues south eventually entering the Township of Maplewood. The Township Master Plan and the NJDOT classify N. Ridgewood Road as an urban minor arterial.

Redmond Road is a short, east-west municipal roadway that extends between 'Stop' controlled intersections at N. Ridgewood Road, to the east, and N. Wyoming Avenue, to the west. A 25 mph speed limit is in effect and curbing and sidewalk are present along each side of the road. Redmond Road traverses a downgrade to the east and has several horizontal curves along its length. Within the vicinity of the Club access drive intersection, Redmond Road is approximately 26 feet wide. Each side of Redmond Road is posted for 2 Hour Parking, 8 AM – 12 PM, Except Weekends and Holidays.

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 (Casey & Keller, Inc.) and the Applicant. The yearly background traffic growth rates (1.50%-N. Ridgewood Rd, 1.00% Redmond Rd), for the study area roads, were obtained from the NJDOT. HMA performed field surveys to establish geometrics, lane arrangements/widths, traffic control, parking restrictions/regulations and speed limits. HMA also contacted the Township Planning/Zoning Office to determine if there were any nearby projects proposed/approved that might affect our traffic study area. We were advised by the Township Engineer that there are no 'other' projects that would impact our study area.

Supplementing the above, HMA conducted manual traffic counts (7-9am, 4-6pm) on Thursday – July 28, 2016, at the intersections of N. Ridgewood Road with the Club Drive and Redmond Road with the Club Drive. The traffic counts were performed on a normal business day, 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 thru 4). The results of these surveys indicated a weekday am peak hour of 8:00-9:00 and a pm peak hour of 5:00-6:00. Exhibit 2 summarizes the existing weekday 2016 peak hour vehicular volumes at the noted intersections.

It is noted that, at the time of the traffic count surveys, there was a summer tennis camp in session at the Club site, which generated additional traffic to/from the Club drives in the morning peak hour period. HMA was advised by the tennis camp director that camp started the third week of June and will finish at the end of August. The camp operates Monday to Friday, starting at 9 am and ending at 1 pm for 4-9 year old children, and 2 pm for 10-13 year old campers. Extended care is provided for less than 5 children to 3 pm. Despite the fact that the camp is not in session for more than 9 months of the year, and only impacts the weekday am peak hour, no adjustment was made to the Club driveway traffic counts to reflect the 'normal' traffic activity.

As the traffic count program was conducted in July, when public schools were closed, HMA applied a 10% volume adjustment increase to the peak hour through traffic volumes on N. Ridgewood Road and Redmond Road to compensate for the lower summer traffic. It is noted that South Orange Middle School is located nearby to the south on N. Ridgewood Road. Exhibit 3 reflects the addition of the 10% traffic increase to the 2016 existing peak hour volumes.

Exhibit 4 expands the 2016 existing peak hour volumes, with the 10% increase, by the NJDOT annual background traffic growth rates (See A-22) through 2018, 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 (8:00-9:00)

1. Two-way traffic flow on N. Ridgewood Road, at the Club Drive intersection, was 555 vehicles with the flow slightly heavier in the southbound travel direction (268 vehs. NB, 287 vehs. SB). Numerous gaps in the traffic flow were observed in each travel direction of N. Ridgewood Road, which resulted in short delays to vehicles entering/exiting the Club Drive. Traffic flow to/from the Club Drive was very low, equaling 44 vehicles inbound and 9 vehicles outbound. This intersection operated in a free flowing manner.
2. Two-way traffic on Redmond Road, at the Club Drive intersection, was extremely light equaling only 59 vehicles (44 vehs. EB, 15 vehs. WB). Only 3 vehicles exited the Club Drive, and only 11 vehicles entered this drive. This intersection operated in a free flowing manner.

PM PEAK HOUR (5:00-6:00)

1. Two-way traffic flow on N. Ridgewood Road, at the Club Drive intersection, was 692 vehicles with the flows more heavily oriented northbound (440 vehs. NB, 252 vehs. SB). Numerous gaps in the traffic flow were again observed in each travel direction of N. Ridgewood Road. Traffic

flow to/from the Club Drive was very low, with only 9 vehicles outbound and none entering. This intersection operated in a free flowing manner.

2. Two-way traffic activity on Redmond Road, at the Club Drive intersection, was again extremely light, equaling only 44 vehicles (24 vehs. EB, 20 vehs. WB). Only 5 vehicles exited the Club Drive, and only 4 vehicles entered this drive, in the entire peak hour. This intersection operated in a free flowing manner.

EXHIBIT 2

2016 EXISTING PEAK HOUR TRAFFIC VOLUMES

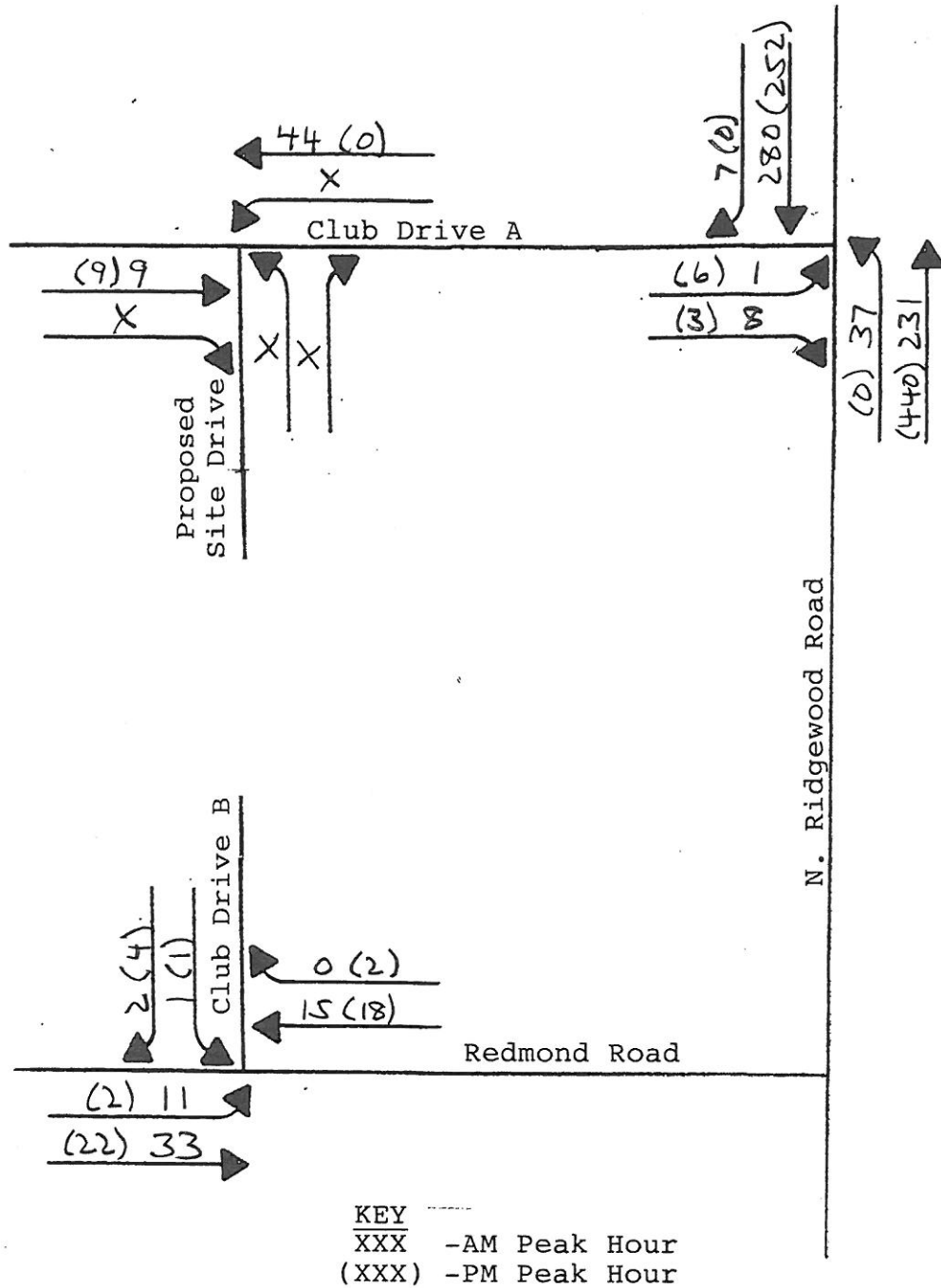


EXHIBIT 3

2016 EXISTING PEAK HOUR TRAFFIC VOLUMES WITH 10% VOLUME ADJUSTMENT ADDED

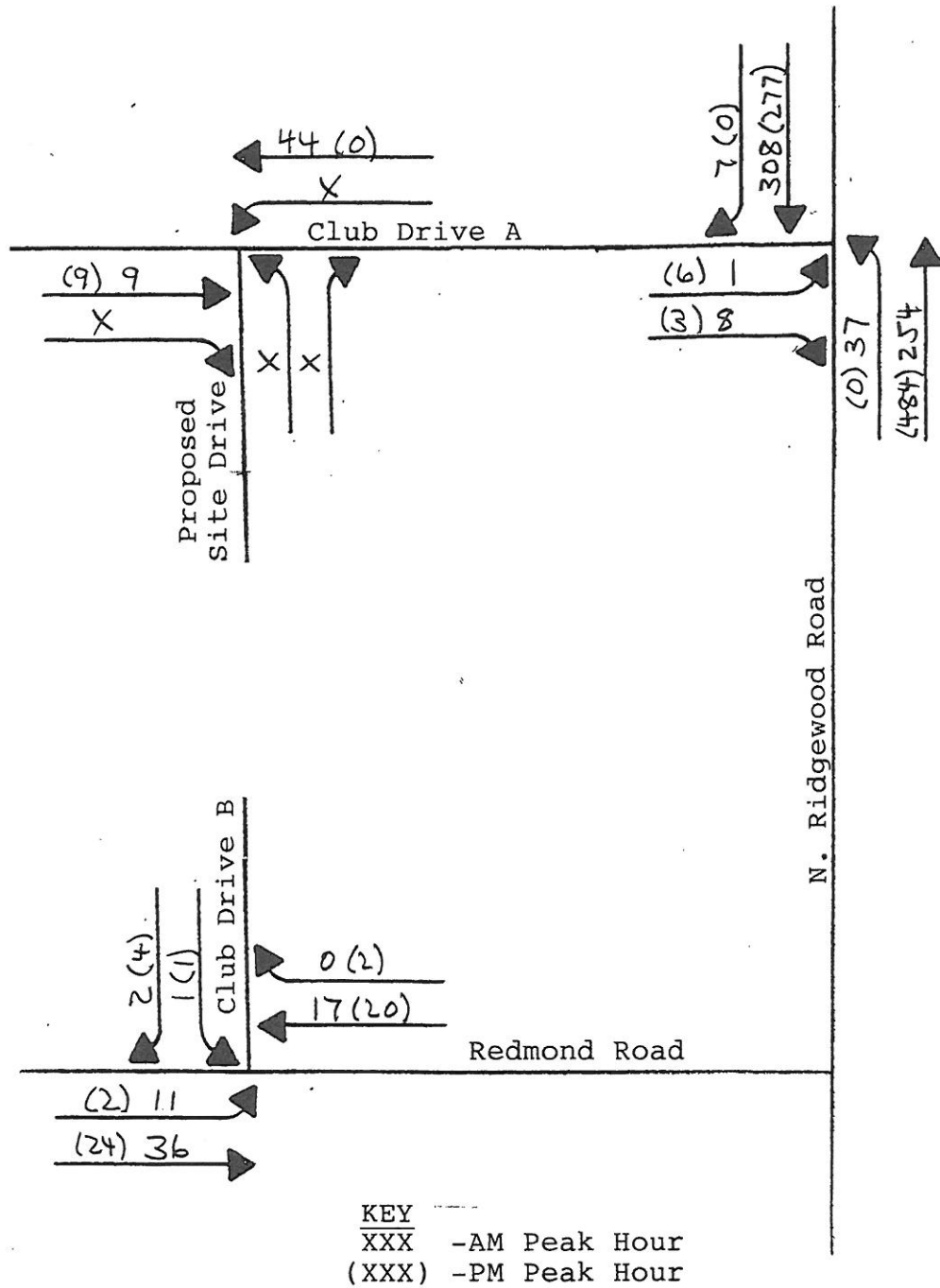
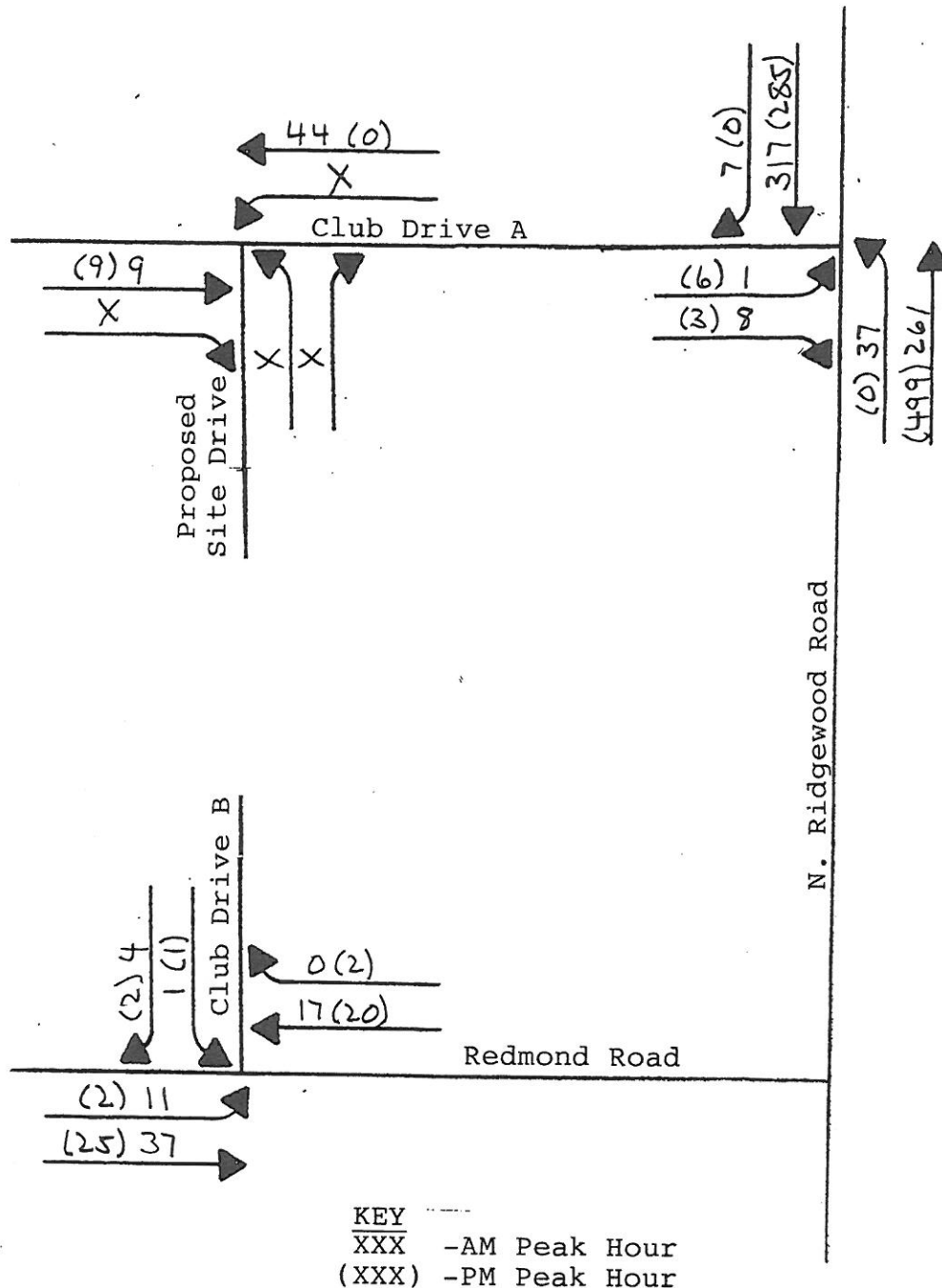


EXHIBIT 4

2018 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 townhouse 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 20 townhouse 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-9th Edition (Land Use Code 230 - Residential Condominium/Townhouse – See Appendix A-5). Table 1 summarizes the very small magnitude of projected trip generation for this site, which is 14 trips in the am peak hour and 16 trips in the pm peak hour (total two-way). It is noted that the NJ Residential Site Improvement Standards (RSIS) require the use of the ITE Trip Generation publication for calculating peak hour trips for any residential land use.

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>
20 Units Townhouse	2	12	14	11	5	16

Having determined the trip generation for the residential townhouse site, the trips developed were assigned to the surrounding roadway system based on existing peak hour travel patterns identified from the field traffic counts, site and area roadway accessibility, and with consideration of the Orange Lawn Redevelopment Plan Ordinance #2016-08.

The Redevelopment Ordinance states (p. 9) that the 20 townhouses "...shall be accessed from Ridgewood Road via the existing Orange Lawn Tennis Club driveway." Based on the preceding, an analysis of N. Ridgewood Road traffic volumes identified peak hour percentile orientations, for the residential site, of 60% to/from the south and 40% to/from the north on N. Ridgewood Road.

Although the Redevelopment Ordinance has all residential site traffic to/from N. Ridgewood Road, the Club's second access drive at Redmond Road affords a more favorable routing for residential generated vehicles destined to/from the southwest of the site, though the South Orange Avenue & N. Wyoming Avenue intersection. This orientation pattern is not only shorter than traveling N. Ridgewood Road to South Orange Avenue, but also avoids the traffic signal at the N. Ridgewood Road & South Orange Avenue intersection. HMA has assumed 20% of the townhouse peak hour trips would use the secondary travel route, which adjusts the peak hour trip assignments at the N. Ridgewood Road & Club Drive intersection to 40% to/from each direction of N. Ridgewood Road. It is noted that the 20% trip assignment to the Club Drive at Redmond Road is nominal in magnitude, equaling only 2-3 trips in either peak hour. 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 2018 Proposed Full Build peak hour traffic volumes (Exh. 4+5 = Exh. 6).

EXHIBIT 5

SITE GENERATED PEAK HOUR TRIP ASSIGNMENTS

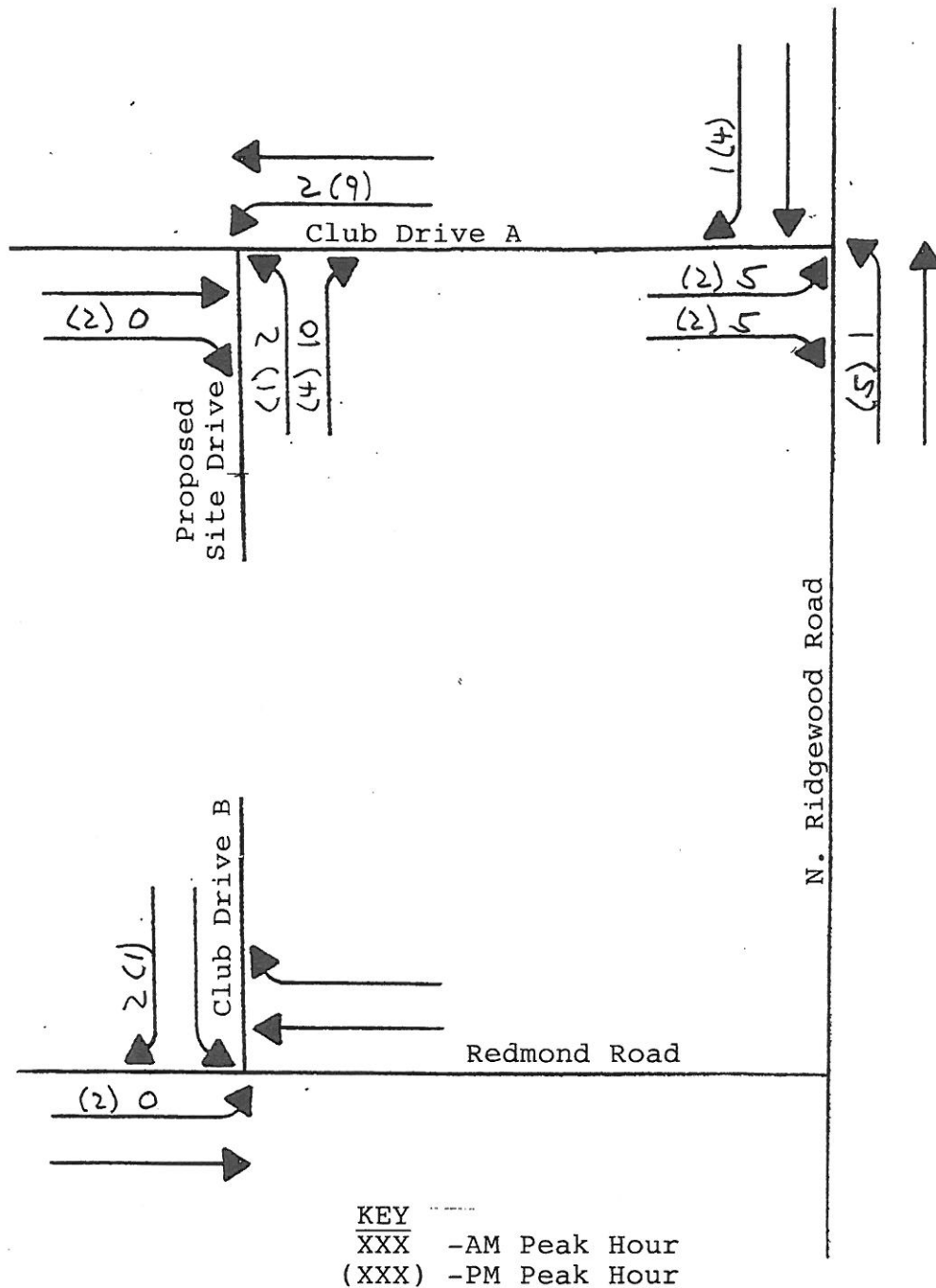
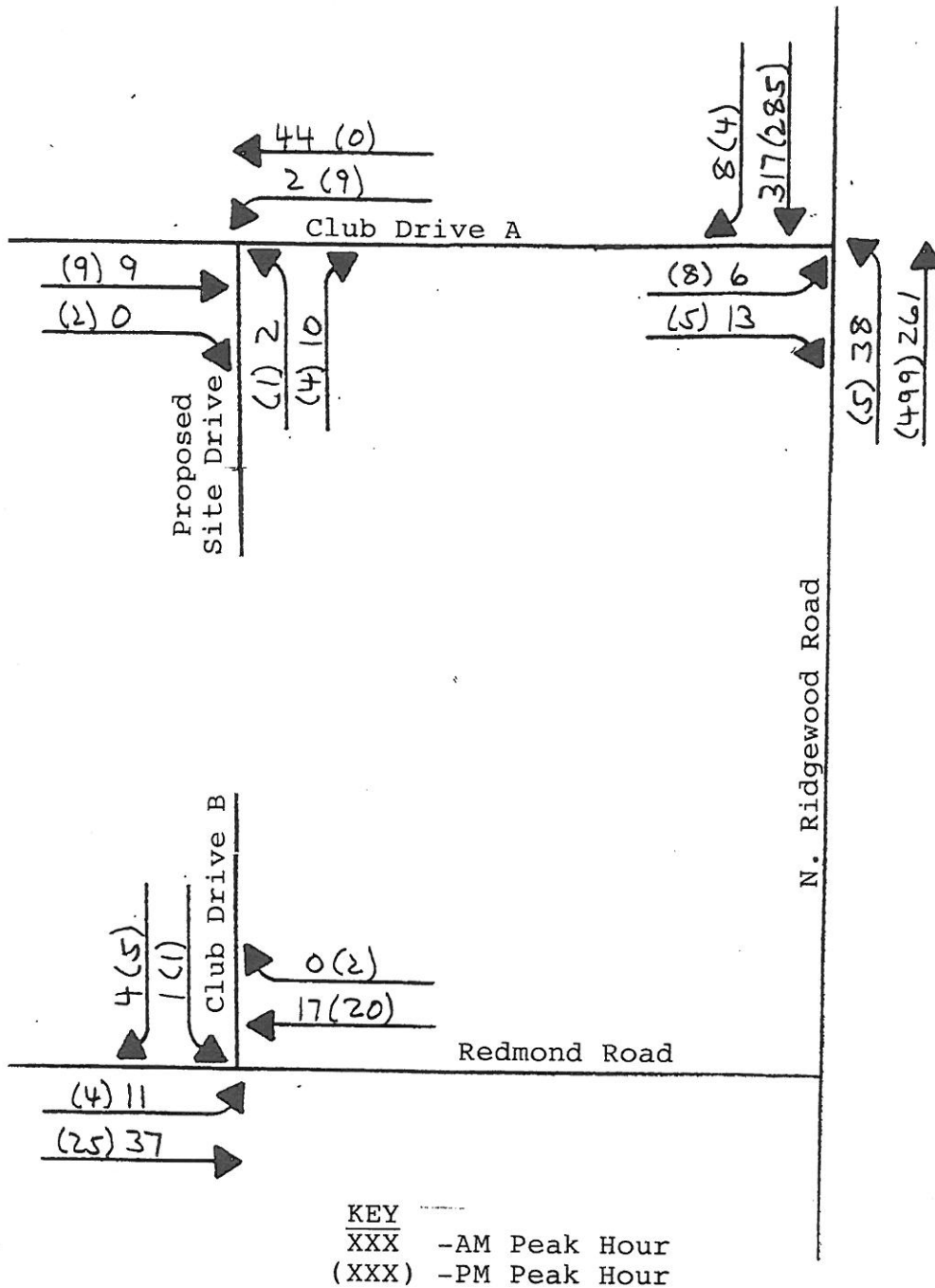


EXHIBIT 6

2018 PROPOSED 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. 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. 2016 Existing Conditions with 10% volume adjustment added;
2. 2018 Existing No Build Conditions with background traffic growth; and
3. 2018 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-7), as well as the analysis computations (A-8 thru 21). Accordingly, the following findings were established and conclusions drawn relating to traffic capacity impacts to be generated by the proposed residential development.

A. N. Ridgewood Road & Club Drive

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-8 thru 13).

For 2016 existing conditions, and both peak hours, the N. Ridgewood Road NB left turn movement to the Club Drive functions at LOS 'A'. The Club Drive EB approach left/right movements operate at LOS 'B' in both peak hours. 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 2018 (existing condition), there were no changes in the LOS 'A' or 'B' identified for the several roadway approaches. Impacts were in the form of a fraction of a second or less increase in delay.

With construction of the residential townhouse project, in the 2018 Full Build scenario, there were again no changes in the levels of service 'A' or 'B' identified for the several roadway approaches in either peak hour. The only increase in average vehicle delay identified was on the Club Drive approach in the am peak hour, which will experience an increase in delay of just less than two seconds. This impact is essentially imperceptible to motorists, with the intersection continuing to operate at very good conditions. No mitigation is required at this intersection due to the proposed project.

If all townhouse generated traffic was restricted to using the Club Drive to/from N. Ridgewood Road only, the 2018 Full Build capacity analyses would remain unchanged at LOS 'A' and 'B' with no increase in average vehicle delay (see A-14, 15). This is reflective of the nominal volumes affected and generated by the townhouse project.

TABLE 2
PEAK HOUR CAPACITY ANALYSIS
N. RIDGEWOOD ROAD & CLUB DRIVE
UNSIGNALIZED

<u>MOVEMENT</u>	<u>2016 EXISTING CONDITIONS LOS/AVG DEL</u>	<u>2018 EXISTING CONDITIONS LOS/AVG DEL</u>	<u>2018 PROPOSED CONDITIONS LOS/AVG DEL</u>
<u>WEEKDAY AM PEAK HOUR</u>			
N. Ridgewood Road NB Left/Thru	A/ 8.3	A/ 8.3	A/ 8.3
Club Drive EB Left/Right	B/11.3	B/11.4	B/13.1
<u>WEEKDAY PM PEAK HOUR</u>			
N. Ridgewood Road NB Left/Thru	A/ 7.8	A/ 7.9	A/ 7.9
Club Drive EB Left/Right	B/13.8	B/14.0	B/13.9

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

B. Redmond Road & Club Drive

Table 3 summarizes the results of HCM capacity analysis procedures for unsignalized intersections, based on existing geometrics, traffic control, and existing/proposed volumes (see A-16 thru 21).

For 2016 existing conditions, and both peak hours, the Redmond Road EB left turn movement to the Club Drive functions at LOS 'A'. The Club Drive SB approach left/right movements operate at LOS 'A' in both peak hours. 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 2018 (existing condition), there were no changes in the LOS 'A' identified for the several roadway approaches. There were no identifiable increases in average vehicle delay.

With construction of the residential townhouse project, in the 2018 Full Build scenario, there were again no changes in the LOS 'A' identified for the several roadway approaches in either peak hour. The critical intersection movements will experience no increases in delay, which is due to the nominal increase in site generated traffic through this location and which will be imperceptible to motorists. The intersection will continue to operate at very good conditions. No mitigation is required at this intersection due to the proposed project.

TABLE 3
PEAK HOUR CAPACITY ANALYSIS
REDMOND ROAD & CLUB DRIVE
UNSIGNALIZED

<u>MOVEMENT</u>	<u>2016 EXISTING CONDITIONS LOS/AVG DEL</u>	<u>2018 EXISTING CONDITIONS LOS/AVG DEL</u>	<u>2018 PROPOSED CONDITIONS LOS/AVG DEL</u>
<u>WEEKDAY AM PEAK HOUR</u>			
Redmond Road EB Left/Thru	A/ 7.3	A/ 7.3	A/ 7.3
Club Drive SB Left/Right	A/ 8.7	A/ 8.7	A/ 8.6
<u>WEEKDAY PM PEAK HOUR</u>			
Redmond Road EB Left/Thru	A/ 7.2	A/ 7.2	A/ 7.3
Club Drive SB Left/Right	A/ 8.5	A/ 8.5	A/ 8.5

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

C. Townhouse Site Circulation & Parking

The proposed townhouse project is located in the eastern section of the Orange Lawn Tennis Club property. Access to the townhouse site is through a cul-de-sac (hammerhead design terminus) roadway that will intersect the Club's existing N. Ridgewood Road access drive, as a 'Stop' controlled T-intersection approach on the latter's south side. As part of this project, some widening of the Club Drive will be performed between the townhouse site drive and N. Ridgewood Road, so as to provide a uniform 20 foot wide pavement. No parking will be permitted on either side of the Club Drive, within the noted length of road. Access to local roads is available for the townhouse site through the Club's access drives to N. Ridgewood Road and Redmond Road.

Being a residential development, the townhouse project is subject to the NJ Residential Site Improvement Standards (RSIS). Based on the RSIS guidelines, we note the following related to parking and traffic volumes:

- a. There are 80 parking spaces provided for the 20 townhouse units. Each townhouse has a two-car garage and driveway combination which counts as 3.5 off-street parking spaces, based on the RSIS Sect. 5:21-4.14(d)3. This equals 70 spaces for the 20 townhouse units. In addition, there are ten (10) on-street parking spaces provided, distributed as five (5) perpendicular spaces by the hammerhead turnaround terminus, and five (5) parallel spaces along the east side of the site access road. The RSIS Table 4.4 Parking Requirements For Residential Land Uses, requires 2.4 spaces per 3 bedroom townhouse, or 48 spaces for the 20 units proposed. The RSIS parking standard is more than adequately met, with 80 spaces provided (4.0 spaces per unit).
- b. The proposed site access road is 28 feet wide and provides 7 foot wide parallel parking spaces, as well as a sidewalk on one side of the road. This conforms with RSIS Table 4.3 Cartway and Right-of-Way Widths and Illustration 1 of 14, for a Residential Access-a. Parallel Parking Low Intensity.

- c. The five on-street, perpendicular parking spaces are 9'x18' in size, which conforms with RSIS Sect. 5:21-4.15. The five on-street parallel parking spaces are 23 feet long, which conforms with RSIS Sect. 5:21-4.14(f).
- d. Based on RSIS Table 4.2, the maximum average daily traffic (ADT) for a multi-family access cul-de-sac that provides a means for vehicles to turn around (hammerhead design), is 1000 trips. For the 20 townhouse units proposed, the ADT is 116 trips, which is well within the RSIS maximum of 1000 ADT limit.
- e. Sect. 5:21-4.14 – Table 4.4 Parking Requirements For Residential Land Uses – Table 4.4 Note b states: “Requirements for attached units (apartment/condominium/townhouse) include provisions for guest parking (0.5 spaces per dwelling unit). Guest parking must either be provided for on street or in common parking areas.”

With 20 townhouse units proposed, a total of 10 visitor parking spaces would be required, based on the 0.5 spaces per unit for visitors (included within the 2.4 spaces per unit). As 10 on-street perpendicular/parallel parking spaces are provided, the RSIS guideline is met.

- f. RSIS Sect. 5:21-4.14(d)3. – “A two car garage and driveway combination shall count as 3.5 off-street spaces, provided a minimum parking area width of 20 feet is provided for a length of 18 feet, as specified for a one-car garage and driveway combination.”

The site plan provides 20 foot wide drives that are a minimum of 20 feet long, thereby conforming to the RSIS.

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.

D. Orange Lawn Tennis Club Parking and Improvements Summary

As part of the site plan application, there are several changes being made to the Club's portion of the property, as follows:

1. The townhouse development is being constructed in a field area where the Club currently valet parks overflow vehicles for major events. Consequently, This valet parking is being relocated onto the Club's remaining portion of the property. Secondly, Club valet overflow parking along the N. Ridgewood Road access drive will no longer be allowed and is also being relocated onto the Club's remaining property.
2. To accommodate the relocated valet overflow parking, the site plan has reconfigured and added some paved parking spaces and identified areas for overflow (valet) parking. A total of 150 parking spaces are provided in this redesign, distributed as 104 paved spaces and 46 overflow spaces. It is noted that the 150 parking spaces exceeds the required minimum of 146 spaces for the Club site, the latter number established in a prior municipal Board application approval.
3. Two (2) tennis courts, located in the rear of the Club site, are proposed to have 'bubble domes' placed over them, so as to accommodate winter play. Trip generation related to this proposal is minimal, as it affects only two courts that would allow tennis play during winter months when there is minimal use of the recreational portion of the Club site.

There are no modifications being proposed to the Club's operations, including maximum number of catered events, which are identified and restricted according to the terms of a previous Resolution of the South Orange Planning Board (Case No. 204A – July 17, 2008), related to an addition to the clubhouse ballroom.

VI. CONCLUSIONS

From the analysis performed and as presented herein, it is the conclusion of this report that the proposed 20 unit residential townhouse project will have no significant or detrimental traffic impacts at either of the Club Drive intersections with N. Ridgewood Road or Redmond Road. The capacity analyses identified very good levels of service, in the LOS 'A' – 'B' range at each intersection in each peak hour studied. Impacts will essentially be imperceptible to motorists. The project's projected weekday peak hour trip generation is very small in magnitude, being only 14 trips in the am and 16 trips in the pm peak hours.

Being a residential development, the townhouse project is subject to the NJ Residential Site Improvement Standards (RSIS). Based on the RSIS guidelines, the 20 proposed 3 bedroom units require a minimum of 48 parking spaces, with 80 spaces being provided on-site. Seventy (70) of the parking spaces are provided in garages and driveways, with the remaining 10 spaces located on-street as perpendicular (5) and parallel (5) parking spaces. The ten on-street spaces meet the RSIS requirement for ten on-street visitor spaces.

The maximum average daily traffic (ADT) permitted by the RSIS, for a multi-family cul-de-sac that provides a means of turnaround, is 1000 trips. For the 20 townhouse units proposed, the ADT is 116 trips, which is well within the RSIS maximum 1000 ADT limit.

Signage and pavement markings should be provided as noted on the site plans.

As part of the site plan application, there are several changes being made to the Club's portion of the property. The townhouse development is being constructed in a field area where the Club currently valet parks overflow vehicles for major events. Secondly, Club valet overflow parking along the N. Ridgewood Road access drive will no longer be permitted. The noted overflow parking is being relocated onto the Club's remaining property in reconfigured and paved parking areas. The 150 parking spaces provided in the redesign exceed the 146 spaces required for the Club site, the latter number established in a prior municipal Board application approval. Lastly, two (2) tennis courts, located in the rear of the Club site, are proposed to have 'bubble domes' placed over them, so as to accommodate

winter play. Trip generation related to this proposal is minimal, as it affects only two courts that would allow tennis play during winter months when there is minimal use of the recreational portion of the Club site. There are no modifications being proposed to the Club's operations.

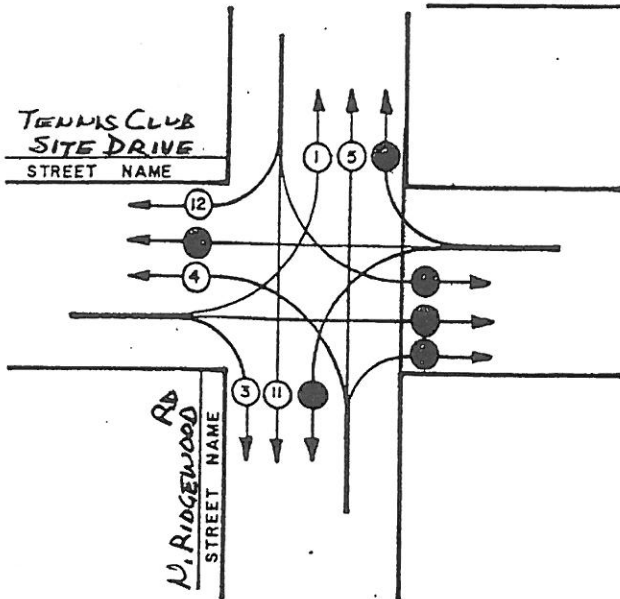
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APPENDIX

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

LOCATION N. RIDGEWOOD ROAD &
ORANGE LAWN TENNIS CLUB DRIVE
MUNICIPALITY TWP. OF SOUTH ORANGE VILLAGE
COUNTY ESSEX
DATE JULY 28, 2016 SMTWTFSS
TIME: FROM 7 A.M. TO 9 A.M. (INDICATE DAY)

SUMMARY SHEET



PROJECT NO. 116-13

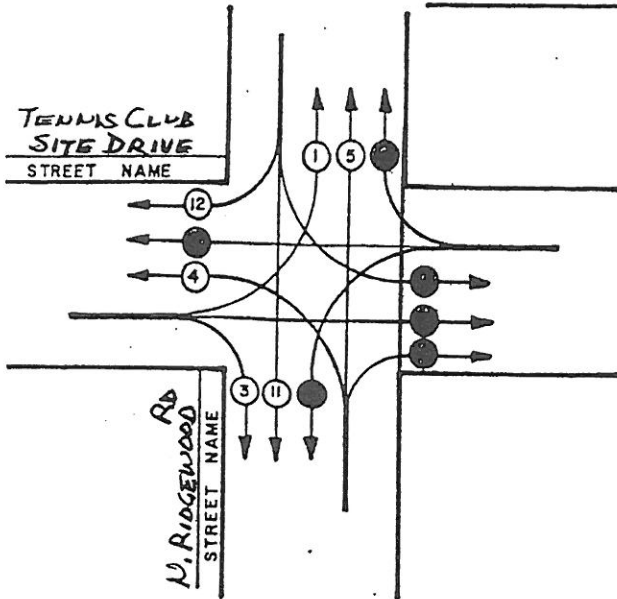
WEATHER CLEAR RECORDER HKM

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	0		0	0	1	21		22						36	0	36	58
7:30	1		0	1	0	42		42						82	0	82	125
7:45	0		0	0	0	40		40						59	0	59	99
8:00	0		0	0	0	53		53						95	0	95	148
8:15	0		0	0	0	56		56						57	0	57	113
8:30	0		0	0	6	58		64						79	2	81	145
8:45	0		1	1	6	52		58						55	1	56	115
9:00	1		7	8	25	65		90						89	4	93	191
8-9	1	—	8	9	37	231	—	268					—	280	7	287	564
PLF																	
% HVY TRUCKS				0%				2%								1%	0.74
TOTAL																	

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

LOCATION N. RIDGEWOOD ROAD &
ORANGE LAWN TENNIS CLUB DRIVE
MUNICIPALITY TWP. OF SOUTH ORANGE VILLAGE
COUNTY ESSEX
DATE JULY 28, 2016 SMTWTFSS
TIME: FROM 4 P.M. TO 6 P.M. (INDICATE DAY)

SUMMARY SHEET



PROJECT NO. 116-13

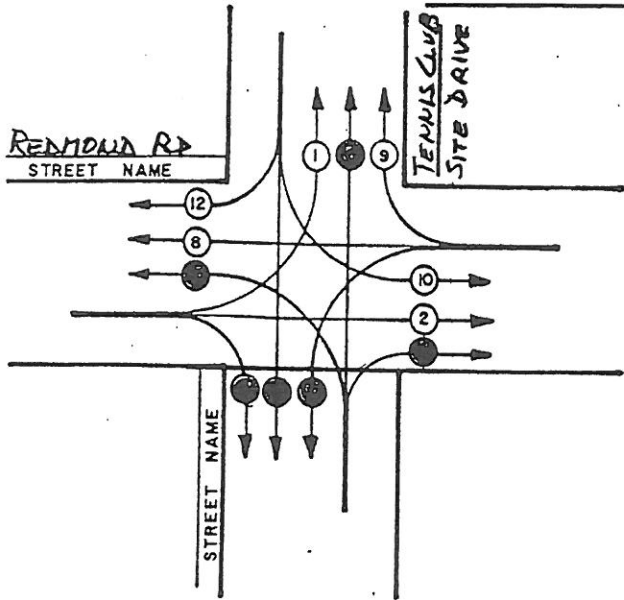
WEATHER CLOUDY RECORDER HKM

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	2		0	2	2	83		85						55	0	55	142
4:30	0		0	0	0	68		68						64	1	65	133
4:45	0		1	1	0	98		98						61	1	62	161
5:00	0		2	2	0	83		83						50	0	50	135
5:15	0		0	0	0	124		124						55	0	55	179
5:30	1		1	2	0	105		105						63	0	63	170
5:45	2		0	2	0	92		92						68	0	68	162
6:00	3		2	5	0	119		119						66	0	66	190
5-6	6	—	3	9	0	440	—	440					—	252	0	252	701
PHF																	0.92
% HVY TRUCKS				0%				2%								0%	
TOTAL																	

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

LOCATION REDMOND ROAD & ORANGE LAWN
TENNIS CLUB DRIVE
MUNICIPALITY TWP. OF SOUTH ORANGE VILLAGE
COUNTY ESSEX
DATE JULY 28, 2016 SMTWTFSS
TIME: FROM 7 A.M. TO 9 A.M. (INDICATE DAY)

SUMMARY SHEET



PROJECT NO. 116-13

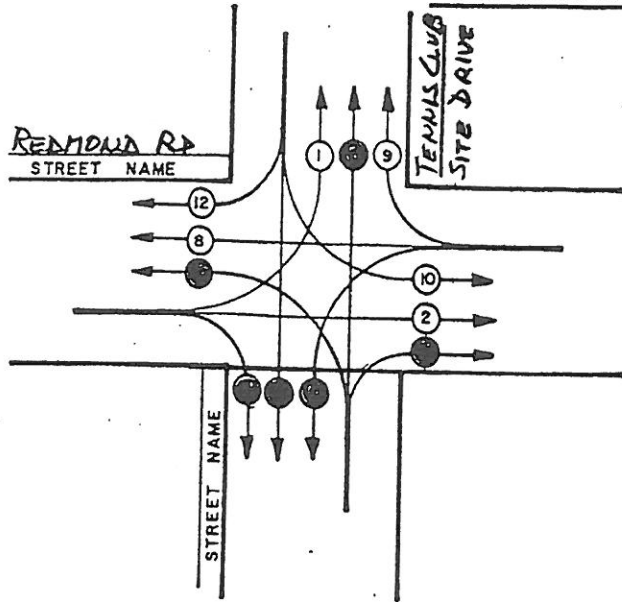
WEATHER CLEAR RECORDER EM

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	0	4		4						3	0	3	0		0	0	7
7:30	0	7		7						3	0	3	0		0	0	10
7:45	0	4		4						6	0	6	0		0	0	10
8:00	1	9		10						4	0	4	0		0	0	14
8:15	0	6		6						3	0	3	0		0	0	9
8:30	2	6		8						4	0	4	0		0	0	12
8:45	3	6		9						1	0	1	0		1	1	11
9:00	6	15		21						7	0	7	1		1	2	30
8-9	11	33	—	44					—	15	0	15	1	—	2	3	62
PHF																	0.52
% HVY TR				0%								0%				0%	
TOTAL																	

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

LOCATION REDMOND ROAD & ORANGE LAWN
TENNIS CLUB DRIVE
MUNICIPALITY TWP. OF SOUTH ORANGE VILLAGE
COUNTY ESSEX
DATE JULY 28, 2016 SMTWTFSS
TIME: FROM 4 P.M. TO 6 P.M. (INDICATE DAY)

SUMMARY SHEET



PROJECT NO. 116-13

WEATHER CLOUDY RECORDER EM

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	2	7		9						5	0	5	0		2	2	16
4:30	3	10		13						7	0	7	0		1	1	21
4:45	0	9		9						6	1	7	1		0	1	17
5:00	0	8		8						2	1	3	1		1	2	13
5:15	1	4		5						5	1	6	0		3	3	14
5:30	0	4		4						6	0	6	0		1	1	11
5:45	0	8		8						5	0	5	1		0	1	14
6:00	1	6		7						2	1	3	0		0	0	10
5-6	2	22	—	24					—	18	2	20	1	—	4	5	49
PHF																	0.88
4-5	5	34	—	39					—	20	2	22	2	—	4	6	67
PHF																	0.80
% Hvy TR				0%								0%				0%	
TOTAL																	

Residential Condominium/Townhouse (230)

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: 59

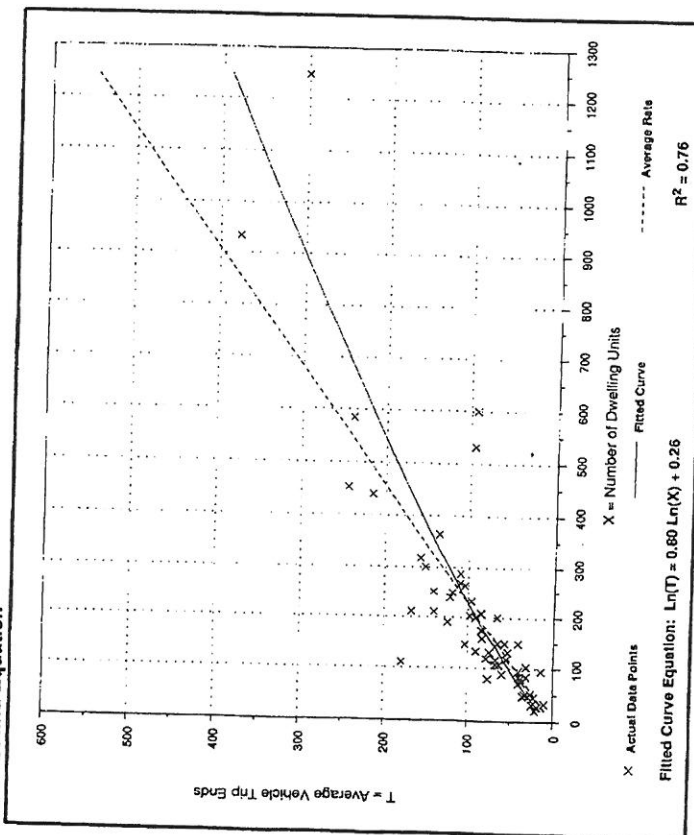
Avg. Number of Dwelling Units: 213

Directional Distribution: 17% entering, 83% exiting

Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
0.44	0.15 - 1.61	0.69

Data Plot and Equation



Residential Condominium/Townhouse (230)

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: 62

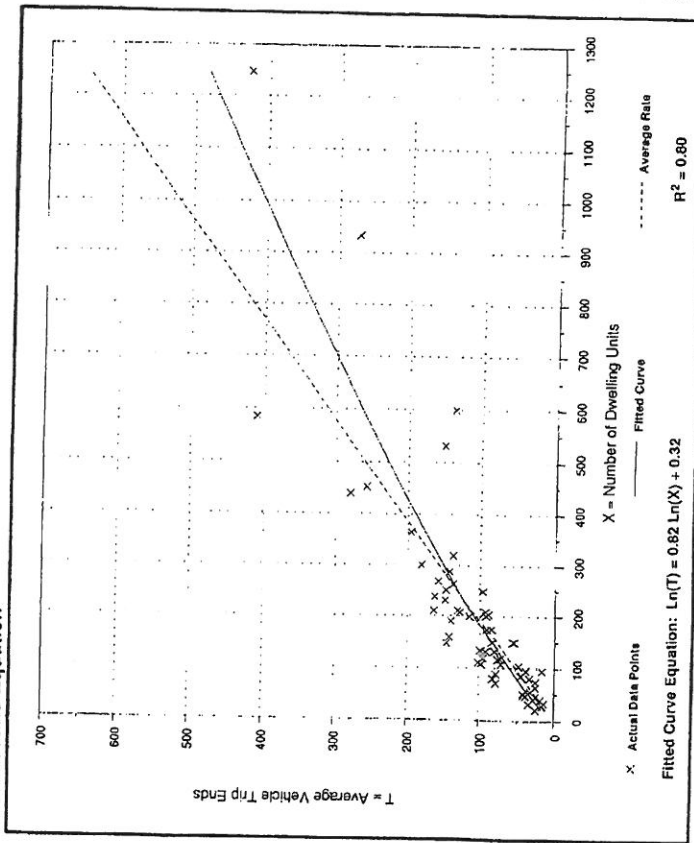
Avg. Number of Dwelling Units: 205

Directional Distribution: 67% entering, 33% exiting

Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
0.52	0.18 - 1.24	0.75

Data Plot and Equation



Residential Condominium/Townhouse (230)

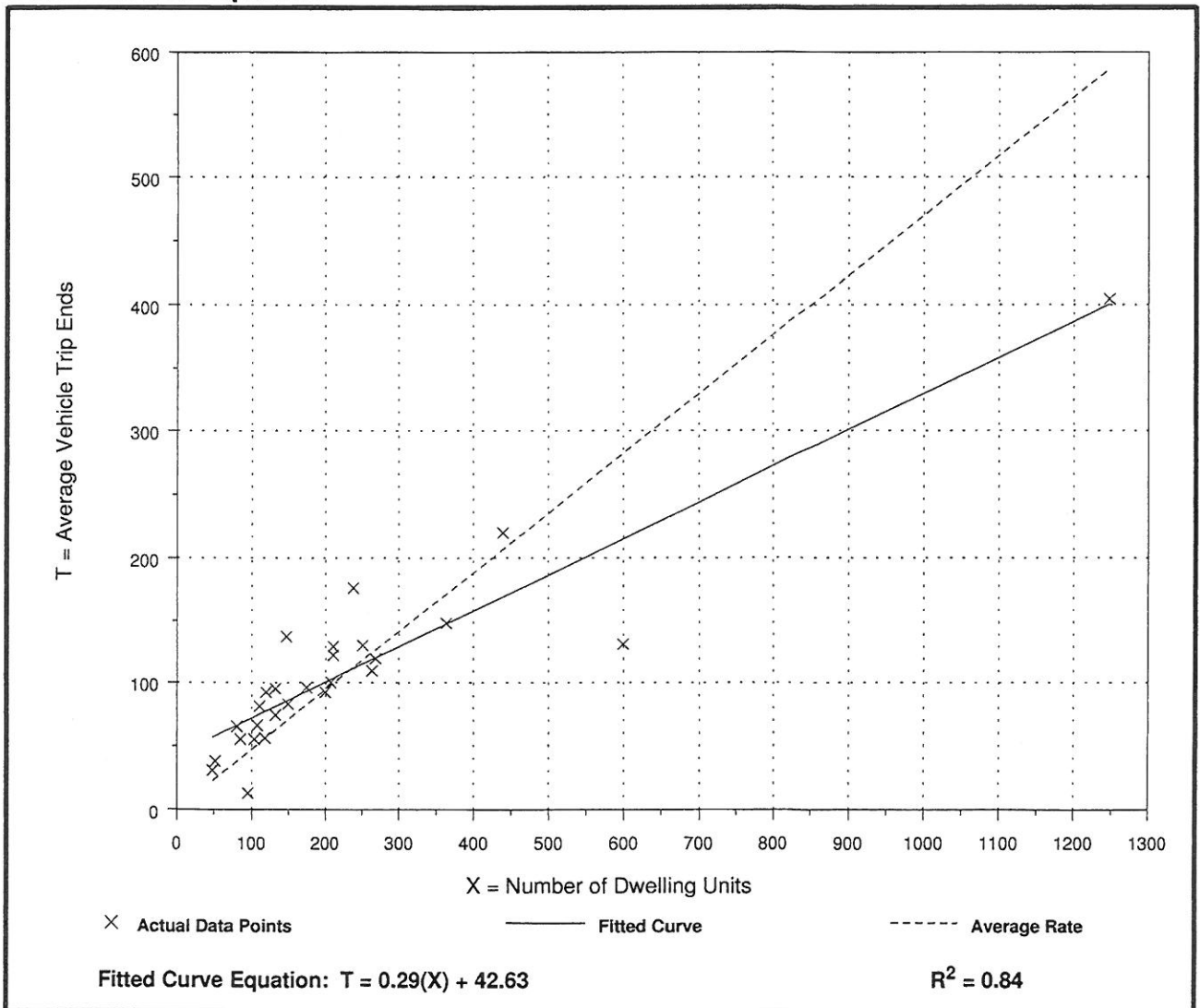
Average Vehicle Trip Ends vs: Dwelling Units
On a: Saturday,
Peak Hour of Generator

Number of Studies: 27
 Avg. Number of Dwelling Units: 228
 Directional Distribution: 54% entering, 46% exiting

Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
0.47	0.14 - 0.93	0.71

Data Plot and Equation



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 ^{ten} ~~ten~~ seconds) to 'F' (delays greater than ⁵⁰ ~~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: 8/12/2016
 Analysis Time Period: AM PEAK HOUR
 Intersection: N. RIDGEWOOD RD & CLUB DRIVE
 Jurisdiction: TWP OF SOUTH ORANGE VILLAGE
 Units: U. S. Customary
 Analysis Year: 2016 EXISTING W/10%
 Project ID: 2016 EXISTING VOLUMES W/10%-AM PEAK HOUR-1613E01
 East/West Street: CLUB DRIVE
 North/South Street: N. RIDGEWOOD 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		37	254			308	7		
Peak-Hour Factor, PHF		0.74	0.74			0.74	0.74		
Hourly Flow Rate, HFR		49	343			416	9		
Percent Heavy Vehicles		0	--	--		--	--		
Median Type/Storage		Undivided				/			
RT Channelized?									
Lanes		0	1			1	0		
Configuration		LT				TR			
Upstream Signal?		No				No			
Minor Street:	Approach Movement	Westbound				Eastbound			
		7 L	8 T	9 R	10 L	11 T	12 R		
Volume					1		8		
Peak Hour Factor, PHF					0.74		0.74		
Hourly Flow Rate, HFR					1		10		
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		NB	SB	Westbound				Eastbound			
		1	4	7	8	9	10	11	12		
Lane Config		LT						LR			
v (vph)		49						11			
C(m) (vph)		1145						584			
v/c		0.04						0.02			
95% queue length		0.13						0.06			
Control Delay		8.3						11.3			
LOS		A						B			
Approach Delay								11.3			
Approach LOS								B			

TWO-WAY STOP CONTROL SUMMARY

Analyst: HKM
 Agency/Co.: HAMAL ASSOCIATES
 Date Performed: 8/12/2016
 Analysis Time Period: PM PEAK HOUR
 Intersection: N. RIDGEWOOD RD & CLUB DRIVE
 Jurisdiction: TWP OF SOUTH ORANGE VILLAGE
 Units: U. S. Customary
 Analysis Year: 2016 EXISTING W/10%
 Project ID: 2016 EXISTING VOLUMES W/10%-PM PEAK HOUR-1613E02
 East/West Street: CLUB DRIVE
 North/South Street: N. RIDGEWOOD 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		0	484			277	0
Peak-Hour Factor, PHF		0.92	0.92			0.92	0.92
Hourly Flow Rate, HFR		0	526			301	0
Percent Heavy Vehicles		0	--	--		--	--
Median Type/Storage		Undivided				/	
RT Channelized?							
Lanes		0	1			1	0
Configuration		LT				TR	
Upstream Signal?		No				No	

Minor Street:	Approach Movement	Westbound				Eastbound	
		7 L	8 T	9 R	10 L	11 T	12 R
Volume					6		3
Peak Hour Factor, PHF					0.92		0.92
Hourly Flow Rate, HFR					6		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 Movement	NB		SB		Westbound			Eastbound	
	1	4	7	8	9	10	11	12	
Lane Config	LT						LR		
v (vph)	0						9		
C(m) (vph)	1272						419		
v/c	0.00						0.02		
95% queue length	0.00						0.07		
Control Delay	7.8						13.8		
LOS	A						B		
Approach Delay							13.8		
Approach LOS							B		

HCS+: Unsignalized Intersections Release 5.6

TWO-WAY STOP CONTROL SUMMARY

Analyst: HKM
 Agency/Co.: HAMAL ASSOCIATES
 Date Performed: 8/12/2016
 Analysis Time Period: AM PEAK HOUR
 Intersection: N. RIDGEWOOD RD & CLUB DRIVE
 Jurisdiction: TWP OF SOUTH ORANGE VILLAGE
 Units: U. S. Customary
 Analysis Year: 2018 EXISTING
 Project ID: 2018 EXISTING VOLUMES-AM PEAK HOUR-1613E03
 East/West Street: CLUB DRIVE
 North/South Street: N. RIDGEWOOD 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		37	261			317	7
Peak-Hour Factor, PHF		0.74	0.74			0.74	0.74
Hourly Flow Rate, HFR		49	352			428	9
Percent Heavy Vehicles		0	--	--		--	--
Median Type/Storage		Undivided			/		
RT Channelized?							
Lanes		0	1			1	0
Configuration		LT				TR	
Upstream Signal?		No				No	
Minor Street:	Approach Movement	Westbound				Eastbound	
		7 L	8 T	9 R	10 L	11 T	12 R
Volume					1		8
Peak Hour Factor, PHF					0.74		0.74
Hourly Flow Rate, HFR					1		10
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	
<hr/>										
v (vph)	49								11	
C(m) (vph)	1134								573	
v/c	0.04								0.02	
95% queue length	0.14								0.06	
Control Delay	8.3								11.4	
LOS	A								B	
Approach Delay									11.4	
Approach LOS									B	

HCS+: Unsignalized Intersections Release 5.6

TWO-WAY STOP CONTROL SUMMARY

Analyst: HKM
 Agency/Co.: HAMAL ASSOCIATES
 Date Performed: 8/12/2016
 Analysis Time Period: PM PEAK HOUR
 Intersection: N. RIDGEWOOD RD & CLUB DRIVE
 Jurisdiction: TWP OF SOUTH ORANGE VILLAGE
 Units: U. S. Customary
 Analysis Year: 2018 EXISTING
 Project ID: 2018 EXISTING VOLUMES-PM PEAK HOUR-1613E04
 East/West Street: CLUB DRIVE
 North/South Street: N. RIDGEWOOD 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		0	499			285	0
Peak-Hour Factor, PHF		0.92	0.92			0.92	0.92
Hourly Flow Rate, HFR		0	542			309	0
Percent Heavy Vehicles		0	--	--		--	--
Median Type/Storage		Undivided				/	
RT Channelized?							
Lanes		0	1			1	0
Configuration		LT				TR	
Upstream Signal?		No				No	
Minor Street:	Approach	Westbound				Eastbound	
	Movement	7	8	9	10	11	12
		L	T	R	L	T	R
Volume					6		3
Peak Hour Factor, PHF					0.92		0.92
Hourly Flow Rate, HFR					6		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)	0						9
C(m) (vph)	1263						407
v/c	0.00						0.02
95% queue length	0.00						0.07
Control Delay	7.9						14.0
LOS	A						B
Approach Delay							14.0
Approach LOS							B

HCS+: Unsignalized Intersections Release 5.6

TWO-WAY STOP CONTROL SUMMARY

Analyst: HKM
 Agency/Co.: HAMAL ASSOCIATES
 Date Performed: 8/12/2016
 Analysis Time Period: AM PEAK HOUR
 Intersection: N. RIDGEWOOD RD & CLUB DRIVE
 Jurisdiction: TWP OF SOUTH ORANGE VILLAGE
 Units: U. S. Customary
 Analysis Year: 2018 PROPOSED
 Project ID: 2018 PROPOSED VOLUMES-AM PEAK HOUR-1613P01-20% REDMOND
 East/West Street: CLUB DRIVE
 North/South Street: N. RIDGEWOOD ROAD
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments							
Major Street:	Approach Movement	Northbound				Southbound	
		1	2	3	4	5	6
		L	T	R	L	T	R
Volume		38	261			317	8
Peak-Hour Factor, PHF		0.74	0.74			0.74	0.74
Hourly Flow Rate, HFR		51	352			428	10
Percent Heavy Vehicles		0	--	--		--	--
Median Type/Storage		Undivided			/		
RT Channelized?							
Lanes		0	1			1	0
Configuration		LT				TR	
Upstream Signal?		No				No	

Minor Street:	Approach Movement	Westbound				Eastbound	
		7 L	8 T	9 R	10 L	11 T	12 R
Volume					6		13
Peak Hour Factor, PHF					0.74		0.74
Hourly Flow Rate, HFR					8		17
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	NB	SB	Westbound				Eastbound		
	1	4	7	8	9	10	11	12	
Lane Config	LT						LR		
v (vph)	51						25		
C(m) (vph)	1133						467		
v/c	0.05						0.05		
95% queue length	0.14						0.17		
Control Delay	8.3						13.1		
LOS	A						B		
Approach Delay							13.1		
Approach LOS							B		

HCS+: Unsignalized Intersections Release 5.6

TWO-WAY STOP CONTROL SUMMARY

Analyst: HKM
 Agency/Co.: HAMAL ASSOCIATES
 Date Performed: 8/12/2016
 Analysis Time Period: PM PEAK HOUR
 Intersection: N. RIDGEWOOD RD & CLUB DRIVE
 Jurisdiction: TWP OF SOUTH ORANGE VILLAGE
 Units: U. S. Customary
 Analysis Year: 2018 PROPOSED
 Project ID: 2018 PROPOSED VOLUMES-PM PEAK HOUR-1613P02-20% REDMOND
 East/West Street: CLUB DRIVE
 North/South Street: N. RIDGEWOOD 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		5	499			285	4
Peak-Hour Factor, PHF		0.92	0.92			0.92	0.92
Hourly Flow Rate, HFR		5	542			309	4
Percent Heavy Vehicles		0	--	--		--	--
Median Type/Storage		Undivided				/	
RT Channelized?							
Lanes		0	1			1	0
Configuration		LT				TR	
Upstream Signal?		No				No	
Minor Street:	Approach Movement	Westbound				Eastbound	
		7 L	8 T	9 R	10 L	11 T	12 R
Volume					8		5
Peak Hour Factor, PHF					0.92		0.92
Hourly Flow Rate, HFR					8		5
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	NB	SB	Westbound			Eastbound	
	1	4	7	8	9	10	11 12
Lane Config	LT						LR
v (vph)	5						13
C(m) (vph)	1259						416
v/c	0.00						0.03
95% queue length	0.01						0.10
Control Delay	7.9						13.9
LOS	A						B
Approach Delay							13.9
Approach LOS							B

HCS+: Unsignalized Intersections Release 5.6

TWO-WAY STOP CONTROL SUMMARY

Analyst: HKM
 Agency/Co.: HAMAL ASSOCIATES
 Date Performed: 8/12/2016
 Analysis Time Period: AM PEAK HOUR
 Intersection: N. RIDGEWOOD RD & CLUB DRIVE
 Jurisdiction: TWP OF SOUTH ORANGE VILLAGE
 Units: U. S. Customary
 Analysis Year: 2018 PROPOSED
 Project ID: 2018 PROPOSED VOLUMES-AM PEAK HOUR-1613P03-100% RIDGEWOOD
 East/West Street: CLUB DRIVE
 North/South Street: N. RIDGEWOOD 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		38	261			317	8
Peak-Hour Factor, PHF		0.74	0.74			0.74	0.74
Hourly Flow Rate, HFR		51	352			428	10
Percent Heavy Vehicles		0	--	--		--	--
Median Type/Storage		Undivided				/	
RT Channelized?							
Lanes		0	1			1	0
Configuration		LT				TR	
Upstream Signal?		No				No	
Minor Street:	Approach Movement	Westbound				Eastbound	
		7 L	8 T	9 R	10 L	11 T	12 R
Volume					6		15
Peak Hour Factor, PHF					0.74		0.74
Hourly Flow Rate, HFR					8		20
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	NB	SB	Westbound				Eastbound	
	1	4	7	8	9	10	11	12
Lane Config	LT						LR	
v (vph)	51						28	
C(m) (vph)	1133						480	
v/c	0.05						0.06	
95% queue length	0.14						0.19	
Control Delay	8.3						13.0	
LOS	A						B	
Approach Delay							13.0	
Approach LOS							B	

HCS+: Unsignalized Intersections Release 5.6

TWO-WAY STOP CONTROL SUMMARY

Analyst: HKM
 Agency/Co.: HAMAL ASSOCIATES
 Date Performed: 8/12/2016
 Analysis Time Period: PM PEAK HOUR
 Intersection: N. RIDGEWOOD RD & CLUB DRIVE
 Jurisdiction: TWP OF SOUTH ORANGE VILLAGE
 Units: U. S. Customary
 Analysis Year: 2018 PROPOSED
 Project ID: 2018 PROPOSED VOLUMES-PM PEAK HOUR-1613P04-100% RIDGEWOOD
 East/West Street: CLUB DRIVE
 North/South Street: N. RIDGEWOOD 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		7	499			285	4
Peak-Hour Factor, PHF		0.92	0.92			0.92	0.92
Hourly Flow Rate, HFR		7	542			309	4
Percent Heavy Vehicles		0	--	--		--	--
Median Type/Storage		Undivided			/		
RT Channelized?							
Lanes		0	1			1	0
Configuration		LT				TR	
Upstream Signal?		No				No	
Minor Street:	Approach Movement	Westbound				Eastbound	
		7 L	8 T	9 R	10 L	11 T	12 R
Volume					8		6
Peak Hour Factor, PHF					0.92		0.92
Hourly Flow Rate, HFR					8		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	NB	SB	Westbound			Eastbound	
			4	7	8	9	10
Lane Config	LT						11
							12
							LR
v (vph)	7						14
C(m) (vph)	1259						426
v/c	0.01						0.03
95% queue length	0.02						0.10
Control Delay	7.9						13.7
LOS	A						B
Approach Delay							13.7
Approach LOS							B

HCS+: Unsignalized Intersections Release 5.6

TWO-WAY STOP CONTROL SUMMARY

Analyst: HKM
 Agency/Co.: HAMAL ASSOCAITES
 Date Performed: 8/12/2016
 Analysis Time Period: AM PEAK HOUR
 Intersection: REDMOND ROAD & CLUB DRIVE
 Jurisdiction: TWP OF SOUTH ORANGE VILLAGE
 Units: U. S. Customary
 Analysis Year: 2016 EXISTING W/10%
 Project ID: 2016 EXISTING VOLUMES W/10%-AM PEAK HOUR-1613E05
 East/West Street: REDMOND ROAD
 North/South Street: CLUB DRIVE
 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		11	36			17	0
Peak-Hour Factor, PHF		0.52	0.52			0.52	0.52
Hourly Flow Rate, HFR		21	69			32	0
Percent Heavy Vehicles		0	--	--		--	--
Median Type/Storage		Undivided			/		
RT Channelized?							
Lanes		0	1			1	0
Configuration		LT				TR	
Upstream Signal?		No				No	
Minor Street:	Approach Movement	Northbound			Southbound		
		7 L	8 T	9 R	10 L	11 T	12 R
Volume					1		2
Peak Hour Factor, PHF					0.52		0.52
Hourly Flow Rate, HFR					1		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 Movement	Lane Config	EB	WB	Northbound			Southbound		
		1 LT	4 	7 	8	9	10 	11 LR	12
v (vph)		21						4	
C(m) (vph)		1593						988	
v/c		0.01						0.00	
95% queue length		0.04						0.01	
Control Delay		7.3						8.7	
LOS		A						A	
Approach Delay								8.7	
Approach LOS								A	

HCS+: Unsignalized Intersections Release 5.6

TWO-WAY STOP CONTROL SUMMARY

Analyst: HKM
 Agency/Co.: HAMAL ASSOCAITES
 Date Performed: 8/12/2016
 Analysis Time Period: PM PEAK HOUR
 Intersection: REDMOND ROAD & CLUB DRIVE
 Jurisdiction: TWP OF SOUTH ORANGE VILLAGE
 Units: U. S. Customary
 Analysis Year: 2016 EXISTING W/10%
 Project ID: 2016 EXISTING VOLUMES W/10%-PM PEAK HOUR-1613E06
 East/West Street: REDMOND ROAD
 North/South Street: CLUB DRIVE
 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		2	24			20	2
Peak-Hour Factor, PHF		0.88	0.88			0.88	0.88
Hourly Flow Rate, HFR		2	27			22	2
Percent Heavy Vehicles		0	--	--		--	--
Median Type/Storage		Undivided			/		
RT Channelized?							
Lanes		0	1			1	0
Configuration		LT				TR	
Upstream Signal?		No				No	
Minor Street:	Approach Movement	Northbound			Southbound		
		7 L	8 T	9 R	10 L	11 T	12 R
Volume					1		4
Peak Hour Factor, PHF					0.88		0.88
Hourly Flow Rate, HFR					1		4
Percent Heavy Vehicles					0		0
Percent Grade (%)		0				0	
Flared Approach: Exists?/Storage					/	No	/
Lanes					0	0	
Configuration					LR		

	Delay, Queue Length, and Level of Service									
Approach	EB	WB	Northbound				Southbound			
Movement	1	4		7	8	9		10	11	12
Lane Config	LT								LR	
<hr/>										
v (vph)	2								5	
C(m) (vph)	1604								1038	
v/c	0.00								0.00	
95% queue length	0.00								0.01	
Control Delay	7.2								8.5	
LOS	A								A	
Approach Delay									8.5	
Approach LOS									A	

HCS+: Unsignalized Intersections Release 5.6

TWO-WAY STOP CONTROL SUMMARY

Analyst: HKM
 Agency/Co.: HAMAL ASSOCAITES
 Date Performed: 8/12/2016
 Analysis Time Period: AM PEAK HOUR
 Intersection: REDMOND ROAD & CLUB DRIVE
 Jurisdiction: TWP OF SOUTH ORANGE VILLAGE
 Units: U. S. Customary
 Analysis Year: 2018 EXISTING
 Project ID: 2018 EXISTING VOLUMES-AM PEAK HOUR-1613E07
 East/West Street: REDMOND ROAD
 North/South Street: CLUB DRIVE
 Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments								
Major Street:	Approach Movement	Eastbound			Westbound			
		1	2	3	4	5	6	
		L	T	R	L	T	R	
Volume		11	37			17	0	
Peak-Hour Factor, PHF		0.52	0.52			0.52	0.52	
Hourly Flow Rate, HFR		21	71			32	0	
Percent Heavy Vehicles		0	--	--		--	--	
Median Type/Storage		Undivided			/			
RT Channelized?								
Lanes		0	1			1	0	
Configuration		LT			TR			
Upstream Signal?		No			No			
Minor Street:	Approach Movement	Northbound			Southbound			
		7	8	9	10	11	12	
		L	T	R	L	T	R	
Volume					1		2	
Peak Hour Factor, PHF					0.52		0.52	
Hourly Flow Rate, HFR					1		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	EB	WB	Northbound			Southbound			
Movement	1	4	7	8	9	10	11	12	
Lane Config	LT						LR		
v (vph)	21						4		
C(m) (vph)	1593						987		
v/c	0.01						0.00		
95% queue length	0.04						0.01		
Control Delay	7.3						8.7		
LOS	A						A		
Approach Delay							8.7		
Approach LOS							A		

HCS+: Unsignalized Intersections Release 5.6

TWO-WAY STOP CONTROL SUMMARY

Analyst: HKM
 Agency/Co.: HAMAL ASSOCAITES
 Date Performed: 8/12/2016
 Analysis Time Period: PM PEAK HOUR
 Intersection: REDMOND ROAD & CLUB DRIVE
 Jurisdiction: TWP OF SOUTH ORANGE VILLAGE
 Units: U. S. Customary
 Analysis Year: 2018 EXISTING
 Project ID: 2018 EXISTING VOLUMES-PM PEAK HOUR-1613E08
 East/West Street: REDMOND ROAD
 North/South Street: CLUB DRIVE
 Intersection Orientation: EW

Study period (hrs): 0.25

Vehicle Volumes and Adjustments							
Major Street:	Approach	Eastbound				Westbound	
	Movement	1	2	3	4	5	6
		L	T	R	L	T	R
Volume		2	25			20	2
Peak-Hour Factor, PHF		0.88	0.88			0.88	0.88
Hourly Flow Rate, HFR		2	28			22	2
Percent Heavy Vehicles		0	--	--		--	--
Median Type/Storage		Undivided			/		
RT Channelized?							
Lanes		0	1			1	0
Configuration		LT				TR	
Upstream Signal?		No				No	
Minor Street:	Approach	Northbound				Southbound	
	Movement	7	8	9	10	11	12
		L	T	R	L	T	R
Volume					1		4
Peak Hour Factor, PHF					0.88		0.88
Hourly Flow Rate, HFR					1		4
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	EB 1 LT	WB 4 	Northbound			Southbound	
			7 	8 	9 	10 	11 LR
Lane Config	LT						
v (vph)	2						5
C(m) (vph)	1604						1038
v/c	0.00						0.00
95% queue length	0.00						0.01
Control Delay	7.2						8.5
LOS	A						A
Approach Delay							8.5
Approach LOS							A

HCS+: Unsignalized Intersections Release 5.6

TWO-WAY STOP CONTROL SUMMARY

Analyst: HKM
 Agency/Co.: HAMAL ASSOCAITES
 Date Performed: 8/12/2016
 Analysis Time Period: AM PEAK HOUR
 Intersection: REDMOND ROAD & CLUB DRIVE
 Jurisdiction: TWP OF SOUTH ORANGE VILLAGE
 Units: U. S. Customary
 Analysis Year: 2018 PROPOSED
 Project ID: 2018 PROPOSED VOLUMES-AM PEAK HOUR-1613P05-20% REDMOND
 East/West Street: REDMOND ROAD
 North/South Street: CLUB DRIVE
 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		11	37			17	0	
Peak-Hour Factor, PHF		0.52	0.52			0.52	0.52	
Hourly Flow Rate, HFR		21	71			32	0	
Percent Heavy Vehicles		0	--	--		--	--	
Median Type/Storage		Undivided				/		
RT Channelized?								
Lanes		0	1			1	0	
Configuration		LT				TR		
Upstream Signal?		No				No		
Minor Street:	Approach Movement	Northbound				Southbound		
		7 L	8 T	9 R	10 L	11 T	12 R	
Volume					1		4	
Peak Hour Factor, PHF					0.52		0.52	
Hourly Flow Rate, HFR					1		7	
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	EB	WB	Northbound				Southbound			
			4	7	8	9	10	11	12	
Lane Config	LT							LR		
v (vph)	21							8		
C(m) (vph)	1593							1017		
v/c	0.01							0.01		
95% queue length	0.04							0.02		
Control Delay	7.3							8.6		
LOS	A							A		
Approach Delay								8.6		
Approach LOS								A		

TWO-WAY STOP CONTROL SUMMARY

Analyst: HKM
 Agency/Co.: HAMAL ASSOCAITES
 Date Performed: 8/12/2016
 Analysis Time Period: PM PEAK HOUR
 Intersection: REDMOND ROAD & CLUB DRIVE
 Jurisdiction: TWP OF SOUTH ORANGE VILLAGE
 Units: U. S. Customary
 Analysis Year: 2018 PROPOSED
 Project ID: 2018 PROPOSED VOLUMES-PM PEAK HOUR-1613P06-20% REDMOND
 East/West Street: REDMOND ROAD
 North/South Street: CLUB DRIVE
 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		4	25			20	2
Peak-Hour Factor, PHF		0.88	0.88			0.88	0.88
Hourly Flow Rate, HFR		4	28			22	2
Percent Heavy Vehicles		0	--	--		--	--
Median Type/Storage		Undivided			/		
RT Channelized?							
Lanes		0	1			1	0
Configuration		LT				TR	
Upstream Signal?		No				No	
Minor Street:	Approach Movement	Northbound				Southbound	
		7 L	8 T	9 R	10 L	11 T	12 R
Volume					1		5
Peak Hour Factor, PHF					0.88		0.88
Hourly Flow Rate, HFR					1		5
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	EB 1 LT	WB 4 	Northbound			Southbound	
			7 	8 	9 	10 	11 LR
Lane Config							
v (vph)	4						6
C(m) (vph)	1604						1040
v/c	0.00						0.01
95% queue length	0.01						0.02
Control Delay	7.3						8.5
LOS	A						A
Approach Delay							8.5
Approach LOS							A

NJDOT ACCESS PERMIT ANNUAL BACKGROUND GROWTH RATE TABLE

Valid for NJDOT Access Permits submitted April 2015 - April 2017

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	N/A	2.00%	1.50%	1.50%	1.00%	1.00%	N/A	2.50%	1.50%	1.00%	1.50%	1.50%
Bergen	N/A	N/A	N/A	N/A	N/A	N/A	2.00%	1.50%	1.00%	1.50%	1.00%	1.00%
Burlington	N/A	2.00%	2.00%	2.50%	1.50%	3.25%	1.00%	1.00%	1.50%	1.00%	1.50%	2.00%
Camden	N/A	2.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%
Cape May	N/A	1.50%	1.00%	1.00%	1.50%	1.00%	N/A	1.50%	1.00%	1.00%	1.00%	1.00%
Cumberland	N/A	1.00%	1.00%	1.00%	1.00%	1.00%	N/A	1.00%	2.00%	1.00%	1.00%	1.00%
Essex	N/A	N/A	N/A	N/A	N/A	N/A	2.00%	1.00%	2.00%	1.50%	2.00%	1.00%
Gloucester	1.75%	1.00%	1.00%	1.50%	1.00%	1.00%	2.00%	1.00%	2.00%	1.50%	2.00%	1.00%
Hudson	N/A	N/A	N/A	N/A	N/A	N/A	2.00%	1.00%	1.00%	1.00%	1.00%	1.00%
Hunterdon	1.00%	1.50%	1.50%	2.00%	2.50%	1.00%	1.50%	1.00%	1.50%	1.50%	1.50%	1.00%
Mercer	1.50%	1.00%	1.00%	1.00%	1.50%	1.50%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%
Middlesex	1.50%	1.50%	1.50%	1.00%	1.25%	1.00%	1.50%	1.50%	1.50%	1.50%	1.50%	1.00%
Monmouth	1.50%	1.50%	1.00%	2.00%	2.00%	1.00%	1.50%	1.50%	1.00%	1.00%	1.50%	1.00%
Morris	1.00%	1.50%	1.50%	2.00%	2.00%	1.00%	1.50%	1.00%	1.50%	2.00%	2.50%	1.00%
Ocean	2.00%	1.50%	1.50%	2.50%	3.25%	1.00%	1.50%	1.00%	1.00%	1.50%	1.50%	1.00%
Passaic	N/A	N/A	N/A	N/A	N/A	N/A	2.00%	1.50%	1.00%	1.50%	2.00%	3.25%
Salem	2.50%	1.00%	1.50%	1.00%	1.00%	1.50%	2.00%	1.00%	1.00%	1.50%	1.00%	1.00%
Somerset	1.50%	1.50%	1.50%	2.00%	1.50%	1.00%	1.50%	N/A	1.00%	1.50%	2.00%	1.00%
Sussex	1.00%	2.00%	1.50%	3.00%	3.25%	1.00%	N/A	1.00%	1.50%	1.00%	2.50%	1.75%
Union	N/A	N/A	N/A	N/A	N/A	N/A	2.00%	1.50%	1.50%	1.50%	1.50%	3.25%
Warren	1.50%	2.00%	2.00%	2.00%	2.50%	1.00%	1.50%	1.00%	1.50%	2.00%	2.00%	3.00%

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)^{# of years}

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