3.15 Traffic Study

CONLEY ASSOCIATES

Memorandum

To: Mr. Dennis Ring

From: Leslie Grant

CC: Jennifer Conley

Date: June 8, 2007

Re: Restaurant Addition to Quail Ridge Country Club

Conley Associates, Inc. completed a Traffic Impact Study (TIS) in March of 2007 for the proposed residential development at the Quail Ridge Country Club in Acton, Massachusetts. As part of the project, 175 units of age restricted housing (over 55 residents only) would be added to the existing Country Club and the existing 18-hole golf course would be reduced to a 9-hole golf course. Since the March 2007 TIS, the building program has been modified to include the addition of a 7,500 square foot restaurant with 35 to 50 seats (the restaurant would be accessible only with a reservation).

Conley Associates, Inc. determined the traffic impact of the restaurant addition to the Quail Ridge Country Club. The trip generation of the proposed restaurant was based on the manual, Trip Generation, 7th Edition, published by the Institute of Transportation Engineers (ITE) in 2003. The most similar Land Use Code (LUC) was LUC 931, Quality Restaurant. The trip generation for Quality Restaurant was be calculated using either square footage or using the number of seats in the restaurant. It was assumed that the restaurant would not be open during the weekday AM peak hour, so only the weekday PM peak hour and Saturday midday peak hours were analyzed.

Based on square footage, the restaurant would generate 57 vehicle trips (38 in and 19 out) during the weekday PM peak hour and 81 vehicle trips (48 in and 33 out) during the Saturday midday peak hour. If the trip generation were calculated based on the maximum number of seats expected in the restaurant (50), the restaurant would only generate 13 vehicle trips (9 in and 4 out) during the weekday PM peak hour and 17 vehicle trips (10 in and 7 out) during the Saturday midday peak hour.

With the more conservative estimate of trip generation, the restaurant would generate 57 vehicle trips during the weekday PM peak hour and 81 vehicle trips during the Saturday midday peak hour. However, not all of these trips would represent new trips to the site. It is likely that a large portion of the restaurant patrons will be club members already on site or residents of the new 175 units of age restricted housing. As mentioned previously, the restaurant would be accessible only with a reservation. Based on information from the owner, Quail Ridge Country Club operates as a non profit organization with only 15 percent of its revenues being generated from non member or outside use. Therefore, Conley Associates, Inc. assumed that only 15

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percent of the restaurant patrons would originate from points off the site. The resulting restaurant trip generation would be nine vehicle trips (six in and three out) during the weekday PM peak hour and 12 vehicle trips (seven in and five out) during the Saturday midday peak hour.

These trips were distributed to the study area roadways based on the methodology outlined in the TIS and were then added to the TIS 2012 Build networks to determine the updated 2012 Build condition (with the restaurant in place). Conley Associates, Inc. then conducted intersection operational analysis at the study area intersections for the updated 2012 Build condition.

Conley Associates, Inc. determined that the signalized intersection of Great Road at Main Street would continue to operate at LOS D during the weekday PM and Saturday midday peak hours in the updated 2012 Build condition (with the proposed restaurant in place). The increase in delay due to the proposed restaurant would be approximately one second per vehicle.

As outlined in the TIS, the stop controlled approaches at the unsignalized intersections of Great Road at Harris Street and Acorn Park Drive and Great Road at Skyline Drive are currently operating at LOS F and are expected to continue to operate at LOS F with or without the proposed residential units in place. Similarly, the stop controlled approaches at the study area unsignalized intersections are expected to continue to operate at LOS F with or without the proposed restaurant in place.

The proposed restaurant addition to the Quail Ridge Country Club is only expected to generate nine off site vehicle trips during the weekday PM peak hour and 12 off site vehicle trips during the Saturday midday peak hour. The additional trips associated with the restaurant are not expected to have a perceivable impact on the results presented in the March 2007 TIS.

CONLEY
ASSOCIATES

TRAFFIC IMPACT STUDY

THE RESIDENCES AT QUAIL RIDGE
ACTON, MASSACHUSETTS

MARCH 2007

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Introduction

Conley Associates, Inc. previously completed the transportation component of the Draft and Final Environmental Impact Report (EIR) submitted for Quail Ridge Country Club located on Skyline Drive in Acton, Massachusetts. The project was constructed and the now includes an 18-hole golf course, swimming pool, tennis courts, and a family recreational center as outlined in the FEIR. As part of the filing of the Notice of Project Change (NPC), a new building program has been proposed for the existing Quail Ridge Country Club. The new building program will include 175 units of age-restricted housing (over 55 residents only) and conversion of the existing 18-hole golf course to only a 9-hole golf course.

Quail Ridge Country Club is currently accessed via Skyline Drive. The proposed age restricted residential units will be accessible via Hazelnut Street, Palmer Lane, and Skyline Drive (both Hazelnut Street and Palmer Lane connect to Great Road via Acorn Park Drive).

The study area included the following intersections: Great road (Route 2A/119) at Main Street (Route 27), Great Road at Skyline Drive, and Great Road at Great Road at Harris Street and Acorn Park Drive. Operations were analyzed during the weekday AM (7:00 AM to 9:00 AM), weekday PM (4:00 PM to 6:00 PM), and Saturday midday (11:00 AM to 1:00 PM) peak periods. Both the study area and time periods analyzed are consistent with previous EIR filings.

The following NPC traffic analysis will determine the 2007 Existing, 2012 No Build, and 2012 Build condition. The 2007 Existing condition includes traffic volumes from the Quail Ridge Country Club as constructed, the 2012 No Build condition project the existing volumes for a five year horizon, and the 2012 Build condition analyzes the impact of the proposed age-restricted housing and reduction in the number of holes on the golf course.

Existing Condition

The existing transportation conditions in the study area were assessed in February of 2007. Conley Associates, Inc. staff conducted a site visit to verify roadway geometry at the study area intersections, daily and peak hour traffic volumes were collected, the seasonal variation of traffic volumes was researched, and accident data was researched. In addition, because traffic volumes were collected in February, trips associated with the existing 18-hole golf course were estimated and added to the raw traffic volumes to more accurately represent existing traffic volumes.

Roadway Geometry

Great Road runs northwest to southeast through Acton. For discussion purposes, Great Road will be considered a north-south road. Main Street runs southwest to northeast through Acton, however for the following analysis, it will be considered an east-west roadway. The detailed geometry at each of the study area intersections is detailed below.

Great Road at Main Street

The intersection of Great Road at Main Street is a four way, signalized intersection. The eastbound and westbound approaches of Main each consist of a left turn lane, a through lane, and a channelized right turn lane. The left and through movements on Main Street are under signal control while the channelized right turn movements are controlled by yield signs. The northbound and southbound approaches of Great Road each consist of a shared left and through lane as well as a shared through and right lane. Crosswalks are located across each leg of the intersection and the signal hardware includes pedestrian push buttons.

Great Road at Skyline Drive

The intersection of Great Road at Skyline Drive is a three-legged, unsignalized intersection. The northbound and southbound approaches of Great Road each consist of a single lane that allows through movements or turns onto Skyline Drive. The eastbound approach of Skyline Drive currently consists of a single, wide lane that allows turns onto Great Road. Although Skyline Drive will be striped for two exiting lanes, at this time, the final course of pavement has not been laid. A concrete island separates entering and exiting traffic at the Skyline Drive approach to Great Road.

Great Road at Harris Street and Acorn Park Drive

The intersection of Great Road at Harris Street and Acorn Park Drive is a four legged, unsignalized intersection. The northbound and southbound approaches of Great Road each consist of a single lane that allows through movements or turns onto the side streets. The eastbound approach of Acorn Park Drive consists of a separate left turn lane and a shared through and right turn lane. The westbound approach of Harris Street consists of a shared left and through lane and a channelized right turn lane, both of which are under stop sign control. A crosswalk is located on Acorn Park Drive.

Existing Public Transportation

The South Acton commuter rail station is located approximately 3.41 miles from the project site. This commuter rail station is part of the Fitchburg line, which runs between Fitchburg and North Station. During the week, this rail line runs back and forth 17 times, making 6 trips during the AM peak period and 6 trips during the PM peak period. There are no public bus lines that run through Acton.

Traffic Volume Data

Daily and peak hour traffic volumes were collected on study area roadways. Automatic traffic recorders (ATRs) collected traffic volume continuously from Thursday, February 8, 2007 through Saturday, February 10, 2007 on Great Road, just north of Skyline Drive. Daily traffic volumes were also collected on Acorn Park Drive, as the residential condominium units will be accessible via Hazelnut Street, Palmer Lane, and Skyline Drive (both Hazelnut Street and Palmer Lane connect to Great Road via Acorn Park Drive). The daily traffic volumes are shown in Table 1.

Table 1: Daily Traffic Volumes

Location/Day	Thursday	Friday	Saturday
Great Road (Rte 2A/119)	18,580	19,260	17,080
Acorn Park Drive	1,490	1,535	1,415

Great Road has a weekday daily traffic volume of approximately 18,920 vehicles and a Saturday daily traffic volume of approximately 17,080 vehicles. Acorn Park Drive has a weekday daily traffic volume of approximately 1,515 vehicles and a Saturday daily traffic volume of approximately 1,415 vehicles.

In addition, Turning Movement Counts (TMCs) were conducted at the study area intersections on Thursday, February 8, 2007 and Saturday, February 10, 2007 during the weekday AM (7:00 AM to 9:00 AM), weekday PM (4:00 PM to 6:00 PM), and Saturday midday (11:00 AM to 2:00 PM) peak periods. The weekday AM and weekday PM peak periods were analyzed due to the residential component of the project and the Saturday midday peak hour was included because of the golf course component. All traffic data has been included in the Appendix.

Seasonal Adjustment

In order to determine the seasonal variation in the traffic volumes in this area, Conley Associates, Inc. researched local traffic count data from the Massachusetts Highway Department (MassHighway). Continuous counting data were taken from the closest permanent count stations; #4172 located on Route 2, west of Route 27 in Acton and #403 located on Route 2 east of the Concord rotary in Concord. Based on the MassHighway data, February traffic volumes are approximately 5.4 percent lower than average month volumes. Therefore, the February traffic volumes were increased by 5.4 percent to represent average month conditions.

Golf Course Trips

The Quail Ridge Country Club has been constructed and is now operational. However, traffic volumes associated with the 18-hole golf course would not be accurately represented in a February (winter) traffic count. Therefore, Conley Associates, Inc. estimated the peak hour trip generation associated with the existing 18-hole golf course and added it in to the 2007 raw traffic volumes.

Trip generation estimates for the 18-hole golf course were based on the manual, Trip Generation, 7th Edition, published by the Institute of Transportation Engineers (ITE) in 2003, specifically Land Use Code 430, Golf Course. Based on ITE, the existing 18-hole golf course would be expected to generate 40 vehicles trips during the weekday AM peak hour (32 trips in and 8 trips out), 50 vehicle trips during the weekday PM peak hour (22 trips in and 28 trips out), and 82 vehicle trips during the Saturday midday peak hour (40 trips in and 42 trips out).

Accident Data

Conley Associates, Inc. researched the Massachusetts Highway Department (MassHighway) accident database for crashes at the study area intersections that occurred in the most recent three year period (2003-2005). A total of 50 accidents occurred at the study area intersection. Great

Road at Main Street had a total of 38 accidents, Great Road at Harris Street and Acorn Park Drive had a total of 10 accidents, and Great Road at Skyline Drive had a total of 2 accidents over the three year period.

Approximately 38 percent of the accidents involved property damage only, 22 percent involved injury (no fatalities). The remaining 40 percent of the accidents had no information on what type of damage was involved (property damage or personal injury). Of the total number of accidents, 72 percent occurred on a clear day on a dry road surface. Approximately 40 percent of the accidents were angle type and 32 percent were rear ends. The remaining 28 percent of accident types were either unknown, single vehicle, head-on, or involving a single vehicle. The majority of the accidents (72 percent) occurred during the day under clear conditions when the pavement was dry. There were no recorded fatalities at any of the study area intersections between 2003 and 2005. The accident data is summarized in Table 2.

Table 2: Accident History 2003 – 2005

Location/Type	Total	Great Road at		
		Main St	Harris St/Acorn Pk Dr	Skyline Dr
Year				
2003	19	12	7	1
2004	14	11	2	1
2005	16	15	1	0
Total	50	38	10	2
Manner of Collision				
Fatality	0	0	0	0
Injury	11	6	4	1
Property Only	19	17	2	0
Not Reported	20	15	4	1
Weather Condition				
Clear	36	29	5	2
Cloudy	4	2	2	0
Rain	4	3	1	0
Snow	4	2	2	0
Sleet	1	1	0	0
Unknown	1	1	0	0
Road Surface				
Dry	37	30	5	2
Wet	6	3	3	0
Icy	2	2	0	0
Snowy	4	2	2	0
Unknown	1	1	0	0
Ambient Light				
Daylight	39	30	7	2
Dark-Lit	9	6	3	0
Dawn/Dusk	1	1	0	0
Unknown	1	1	0	0
Manner of Collision				
Angle	20	14	6	0
Head-On	2	2	0	0
Rear end	16	13	2	1
Unknown	4	3	0	1
Single Vehicle	3	1	2	0
Sideswipe	5	5	0	0

Conley Associates, Inc. then calculated the accident rate for the study area intersections using the MassHighway Crash Rate Worksheet. The accident rate is calculated in terms of accidents per million vehicles entering the intersection. The accident rates are then compared to the district wide rates generated by MassHighway. Acton is located in MassHighway District 3, which has an average accident rate of 0.84 for signalized intersections and an average accident rate of 0.79 for unsignalized intersections. The accident rates for the study area intersections are summarized in Table 3.

Table 3: Accident Rates

Signalized Intersections (District 3 Average 0.84)	**Crash Rate***
Great Road at Main Street	1.23
Unsignalized Intersections (District 3 Average 0.79)	**Crash Rate***
Great Road at Harris Street and Acorn Park Drive	0.50
Great Road at Skyline Drive	0.11

*Accident rates are in accidents per million entering vehicles.

The accident rate at the signalized intersection of Great Road at Main Street was calculated to be 1.23, which is higher than the MassHighway District 3 average accident rate. The accident rates at the unsignalized intersections of Great Road at Harris Street and Great Road at Skyline Drive were calculated to be 0.50 and 0.11, respectively. The accident rates for both of the unsignalized intersections are below the MassHighway average accident rate for unsignalized intersections.

2007 Existing Condition Traffic Volumes

The raw traffic volumes were balanced between the intersections of Great Road at Main Street and Great Road at Skyline Drive. Traffic volumes between the intersections of Great Road at Skyline Drive and Great Road at Acorn Park Drive and Harris Street were not balanced due to the large number of retail and residential units in between those two intersections. The balanced TMC data were than adjusted upwards by 5.4 percent to adjust for seasonal variation in traffic volumes. In addition, because traffic volumes collected in February would not accurately reflect existing trips to the golf course, Conley Associates, Inc. estimated the trip generation of the 18-hole golf course currently onsite. The 2007 Existing condition traffic volumes can be found in the Appendix.

No Build Condition

As mentioned previously, the building program outlined in the FEIR has been constructed; the Quail Ridge Country Club is open and operational. However, as part of the filing of the Notice of Project Change (NPC), a new building program has been proposed. Therefore, as part of the standard procedure for traffic analysis, the transportation conditions expected in the study area for a five year horizon were determined. Background traffic growth was projected and site specific traffic was researched. The traffic associated with each of these components was added to the 2007 Existing Condition traffic volumes to determine the 2012 No Build Condition.

Background Traffic Growth

Conley Associates, Inc. researched traffic growth rates for the Town of Acton. Conley Associates, Inc. researched data from MassHighway permanent count stations #4172 (located on Route 2, west of Route 27 in Acton) and #403 (located on Route 2 east of the Concord rotary in Concord). Conley Associates, Inc. also researched traffic volume data from a number of temporary count stations including; station #4002 located on Route 2A/119 at the Littleton town line, #4001 located on Route 27 north of Route 2A, #4167 located on School Street west of Parker Street, all in Acton, and #4166 located on the Cambridge Turnpike east of Route 24 and #4003 located on Route 62 at the Acton town line, both in Concord. The data from the permanent and temporary count stations showed a range of growth rates from negative 0.27 percent to a positive 2.55 percent, or an average growth rate of negative 0.06 percent per year.

Conley Associates, Inc. also reviewed MassHighway statewide growth rates for each district. District 3 showed a negative 1.4 percent growth rate between 2004 and 2005 (the most recent year of data available). In addition to the MassHighway data, the daily traffic volumes along Great Road from 2001 (from the EIR) and 2007 were compared. After adjusting the February traffic volumes for seasonal variation, the weekday daily traffic volume data showed a negative growth rate of 0.58 percent per year. Given the range of growth rates both positive and negative, Conley Associates, Inc. determined that a 0.50 percent annual rate would be appropriate.

Site Specific Development

Conley Associates, Inc. called the Town of Acton to determine if there were any development projects that might affect future traffic volumes in the study area. Two projects were identified including the Woodlands at Laurel Hill and another residential project off of Brabrook Road.

The Woodlands at Laurel Hill is a large residential project located north of the study area and includes 308 apartment units (to be located in both Acton and Westford) as well as 64 town homes for residents over 55. The other project is already under construction and will consist of 33 townhouses for residents over 55. The trip generation for these projects was estimated based on information contained in the ITE Trip Generation manual, specifically, LUC 220—Apartment and LUC 251—Senior Adult Housing-Detached were used. The trip generation worksheets for each of these projects are included in the Appendix.

No Build Condition Traffic Volumes

The existing traffic volumes were increased by 0.5 percent per year for five years and added to the traffic volumes associated with the site specific developments to determine the 2012 No Build traffic volumes. The 2012 No Build traffic volumes can be found in the Appendix.

Build Condition

As mentioned previously, the building program outlined in the FEIR has been constructed and the Quail Ridge Country Club is open and operational. However as part of the Notice of Project Chang (NPC), the site will be reconfigured again to include 175 units of age-restricted housing and the 18-hole golf course will be converted to only a 9-hole golf course. The traffic volumes

associated with the NPC building program were calculated and added to the 2012 No Build traffic volumes to determine the 2012 Build condition.

Site Access

Quail Ridge Country Club is currently accessible via Skyline Drive and will remain so in the future. The proposed 175age-restricted residential units will be accessible via Skyline Drive, Hazelnut Street, and Palmer Lane. Both Hazelnut Street and Palmer Lane connect to Great Road via Acorn Park Drive.

Trip Generation

The trip generation of the proposed age-restricted residential units was based on the ITE Trip Generation manual, using a combination of LUC 230—Residential Condominium/Townhouse and LUC 251—Senior Adult Housing-Detached. To be conservative in our estimate of trip generation, the average trip generation between both land use codes was calculated. This methodology was employed because the trip rates for standard housing (non age-restricted) were determined to be too high for age-restricted type housing and the trip rates for senior housing land use code were very low. Therefore, the proposed 175 units of age-restricted housing are expected to generate 838 vehicle trips over the course of a weekday, 56 vehicle trips during the weekday AM peak hour, 69 vehicle trips during the weekday PM peak hour, 738 vehicle trips over the course of a Saturday, and 58 vehicle trips during the Saturday midday peak hour.

In addition to the proposed age-restricted housing units, the 18-hole golf course will be converted to a 9-hole course as part of the Notice of Project Change building program. A credit for the reduction in the number of holes was taken, based on trip generation rates from ITE LUC 430—Golf Course. It was determined that the reduction in the number of holes would generate 322 fewer vehicle trips over the course of a weekday, 20 fewer vehicle trips during the weekday AM peak hour, 25 fewer vehicle trips during the weekday PM peak hour, 366 fewer vehicle trips during the course of a Saturday, and 41 fewer vehicle trips during the Saturday midday peak hour.

The net increase in trip generation was then calculated. The NPC building program is expected to generate 516 vehicle trips over the course of a weekday, 36 vehicle trips during the weekday AM peak hour, 44 vehicle trips during the weekday PM peak hour, 372 vehicle trips over the course of a Saturday, and 17 vehicle trips during the Saturday midday peak hour. A detailed trip generation summary is shown in Table 4.

Table 4: Trip Generation Summary

Peak Hour/Scenario	Direction	175 Age-Restricted Residential Units	Conversion of 18-hole course to 9-hole course	Net Trip Generation
Weekday Daily	In	419	-161	258
	Out	419	-161	258
	Total	838	-322	516
Weekday AM Peak Hour	In	10	-16	-6
	Out	46	-4	42
	Total	56	-20	36
Weekday PM Peak Hour	In	46	-11	35
	Out	23	-14	9
	Total	69	-25	44
Saturday Daily	In	369	-183	186
	Out	369	-183	186
	Total	738	-366	372
Saturday Midday Peak Hour	In	31	-20	11
	Out	27	-21	6
	Total	58	-41	17

Trip Distribution

Traffic volumes associated with the NPC building program were distributed throughout the study area roadways based on existing traffic patterns. Approximately 30 percent of the site trips will be oriented to and from points north of Acorn Park Drive/Harris Street along Great Road and 30 percent of the site trips will be oriented to and from points south of Main Street (Route 27) along Great Road. Along Main Street, 20 percent of the site trips will be oriented to and from points west of Great Road and 15 percent will be oriented to and from points east of Great Road. The remaining 5 percent will be oriented to and from points east of the site along Harris Street. The trip distribution is shown in Table 5.

Table 5: Trip Distribution Summary

Location	Percent (%)
Great Road, north of Acorn Park Drive/Harris Street	30
Great Road, south of Main Street	30
Main Street, west of Great Road	20
Main Street, east of Great Road	15
Harris Street, east of Great Road	5
Total	100

2012 Build Condition Traffic Volumes

Conley Associates, Inc. added the trips associated with the NPC building program to the 2012 No Build traffic volumes to determine the 2012 Build condition traffic volumes. The weekday

AM, weekday PM, and Saturday midday peak hour traffic volumes associated with this condition are included in the Appendix.

Traffic Operations Analysis

The operating conditions at each of the study area intersections were determined. Intersection analysis was completed utilizing Highway Capacity Manual methodologies for signalized and unsignalized intersections.

Level of Service

Level of service (LOS) is a calculation of control delay for an intersection. LOS is an indication of driver discomfort, frustration, fuel consumption, and lost time. LOS is defined by an index from A (free flow) to F (long delays).

Signalized intersection analysis is based upon the capacity of each lane group and the correlating control delay associated with the intersection. Capacity is a measurement of the ability of an intersection design to accommodate all movements within the intersection. Delay is the measure of the user quality of service. Capacity is a function of physical geometry and signalization conditions.

For unsignalized intersections, delay values apply only to the controlled movements, since the main street movements are not restricted. Control delay is the elapsed time for deceleration, queue time, stopped delay and final acceleration. Average control delay for unsignalized intersections is a function of the capacity of the approach and the degree of saturation. The LOS categories (A through F) and the corresponding control delay for each value is given in Table 6.

Table 6: Level of Service Criteria

	Average Delay (seconds)	
Level of Service	**Signalized Intersections**	**Unsignalized Intersections**
A	≤ 10	≤ 10
B	>10 and ≤ 20	>10 and ≤15
C	>20 and ≤ 35	>15 and ≤ 25
D	>35 and ≤ 55	>25 and ≤ 35
E	>55 and ≤ 80	>35 and ≤ 50
F	>80	>50

Source: 2000 Highway Capacity Manual

Synchro 6 was used as the analysis tool for determining both the signalized and unsignalized level of service for the intersections. Synchro 6 implements the methods of the 2000 Highway Capacity Manual to analyze intersection capacity and level of service.

Intersection Operating Conditions

The level of service procedures described above were used to determine Existing, Future Condition with FEIR Build program, and Future Condition with NPC Build program peak hour operating levels of service at the study area intersections.

Signalized Intersection Operations

Conley Associates, Inc. conducted operational analysis for the signalized intersection of Great Road at Main Street. The LOS and delay results for this intersection are summarized in Table 7.

Table 7: Signalized Intersection Level of Service Summary

Location/Peak Hour	Existing		No Build		Build	
Great Rd at Main St	LOS[1]	Delay[2]	LOS	Delay	LOS	Delay
Weekday AM	B	17.2	B	19.1	B	19.8
Weekday PM	C	27.0	D	40.4	D	42.7
Saturday Midday	C	33.8	D	50.3	D	51.1

1. LOS = Level of Service.
2. Delay is measured in seconds per vehicle.

As shown in Table 7, the intersection of Great Road at Main Street is currently operating at LOS B during the weekday AM peak hour. This intersection is expected to continue to operate at LOS B in the future condition with or without the NPC building program in place. During the weekday PM and Saturday midday peak hour, this intersection is currently operating at LOS C and is expected to operate at LOS D in the 2012 No Build and 2012 Build condition.

Although the NPC building program consists of 175 residential units, these units are for age-restricted housing, which means that not all of the residents will be traveling during peak hours. In addition, the reduction in the number of holes will reduce the overall number of golfers able to use the course at one time. Therefore, the NPC building program is not expected to significantly impact operations at the signalized intersection of Great Road at Main Street during the peak hours analyzed.

Unsignalized Intersection Operations Analysis

Conley Associates, Inc. then analyzed operations at the unsignalized intersections of Great Road at Harris Street and Acorn Park Drive and Great Road at Skyline Drive. Table 8 summarizes the LOS and average delay per vehicle at the unsignalized study area intersections.

Table 10: Unsignalized Intersections Level of Service Summary

	Existing		No Build		Build	
Location/Peak Hour	LOS[3]	Delay[4]	LOS	Delay	LOS	Delay
Great Road at Harris Street and Acorn Park Drive						
Weekday AM						
Harris St Westbound Left-Thru	F	85.8	F	>100	F	>100
Harris St Westbound Right	C	22.1	D	26.1	D	28.8
Acorn Pk Dr Eastbound Left	F	82.9	F	>100	F	>100
Acorn Pk Dr Eastbound Thru-Right	B	11.7	B	12.1	B	12.1
Great Rd Northbound	A	0.5	A	0.6	A	0.6
Great Rd Southbound	A	2.7	A	3.1	A	3.1
Weekday PM						
Harris St Westbound Left-Thru	F	>100	F	>100	F	>100
Harris St Westbound Right	C	24.6	D	30.1	D	29.3
Acorn Pk Dr Eastbound Left	F	>100	F	>100	F	>100
Acorn Pk Dr Eastbound Thru-Right	C	24.2	D	29.8	D	29.7
Great Rd Northbound	A	1.1	A	1.3	A	1.6
Great Rd Southbound	A	3.3	A	4.0	A	4.0
Saturday Midday Hour						
Harris St Westbound Left-Thru	F	>100	F	>100	F	>100
Harris St Westbound Right	C	19.6	C	22.2	D	29.2
Acorn Pk Dr Eastbound Left	F	>100	F	>100	F	>100
Acorn Pk Dr Eastbound Thru-Right	C	16.5	C	18.1	C	18.0
Great Rd Northbound	A	1.4	A	1.7	A	1.9
Great Rd Southbound	A	1.7	A	2.0	A	2.0
Great Road at Skyline Drive						
Weekday AM						
Skyline Dr Eastbound left	E	45.0	F	61.1	F	61.1
Skyline Drive Eastbound Right	C	16.9	C	19.0	C	20.4
Great Rd Northbound	A	1.4	A	1.5	A	1.2
Great Rd Southbound	A	0.0	A	0.0	A	0.0
Weekday PM						
Skyline Dr Eastbound Left	F	>100	F	>100	F	>100
Skyline Drive Eastbound Right	B	13.6	B	14.5	B	14.6
Great Rd Northbound	A	0.8	A	1.1	A	2.0
Great Rd Southbound	A	0.0	A	0.0	A	0.0
Saturday Midday Hour						
Skyline Dr Eastbound Left	F	>100	F	>100	F	>100
Skyline Drive Eastbound Right	C	17.3	C	19.0	C	18.9
Great Rd Northbound	A	1.5	A	1.8	A	1.8
Great Rd Southbound	A	0.0	A	0.0	A	0.0

3. LOS = Level of Service.
4. Delay is measured in seconds per vehicle.

As shown on Table 10, the unsignalized intersection of Great Road at Harris Street and Acorn Park Drive and Great Road at Skyline Drive are currently operating at LOS F and will continue to operate at LOS F with or without the proposed NPC building program in place. However,

only the side street movements are experiencing these delays, the movements along Great Road are experiencing LOS A conditions.

Signal Warrant Analysis

Project traffic will travel through two unsignalized intersections, Great Road at Harris Street and Acorn Park Drive as well as Great Road at Skyline Drive. These intersections are currently operating at poor levels of service. In order to determine if a signal is justified at either of these locations, Conley Associates, Inc. reviewed the warrants for signalization outlined in the Manual on Uniform Traffic Control Devices (MUTCD). Specifically, the warrants that rely on approach volumes, including Warrant 2-Four Hour Vehicular Volume and Warrant 3-Peak Hour Volume, were reviewed.

The intersection of Great Road at Harris Street and Acorn Park Drive did not meet the criteria for the four hour warrant in the Existing or Build condition. This intersection did meet the criteria for the peak hour warrant in the Existing and Build condition.

The intersection of Great Road at Skyline Drive did not meet the criteria for the four hour warrant in the Existing or Build condition. This intersection did not meet the criteria for the peak hour warrant in the Existing or Build condition.

Although the intersection of Great Road at Harris Street and Acorn Park Drive me the criteria for the peak hour warrant, this intersection did not meet the criteria for the four hour warrant. Therefore, Conley Associates, Inc. would not recommend signalization of this intersection.

The intersection of Great Road at Skyline Drive did not meet the criteria for either the peak hour warrant or the four hour warrant, therefore, Conley Associates, Inc. would not recommend the installation of a signal at this intersection.

EIR Building Program

As mentioned in the introduction, the building program from the EIR (which included the 18-hole golf course) has been constructed and occupied. Therefore, the 2007 Existing and 2012 No Build condition from this study already include the traffic associated with the EIR building program. The 2012 Build condition in this study analyzes the traffic impact of the NPC program, which includes the age-restricted housing and the reduction of the 18-hole golf course to a 9-hole golf course. And so, the 2012 No Build condition and the 2012 Build condition actually compare the EIR building program to the NPC building program.

Conclusion

Conley Associates, Inc. previously completed the transportation component of the Draft and Final Environmental Impact Report submitted for the Quail Ridge Country Club on Skyline Drive in Acton, Massachusetts. The country club with 18-hole golf course and onsite amenities was constructed and the site is now operational. However, the project proponent, as part of a Notice of Project Change, is now proposing to add 175 units of age-restricted housing and reduce the number of holes on the golf course from 18 to only 9.

Conley Associates, Inc. calculated the trip generation for the proposed age-restricted housing and took credit for the reduction in the number of holes on the golf course. The NPC building program is expected to generate 516 vehicle trips over the course of a weekday, 36 vehicle trips during the weekday AM peak hour, 44 vehicle trips during the weekday PM peak hour, 372 vehicle trips over the course of a Saturday, and 17 vehicle trips during the Saturday midday peak hour.

The intersection of Great Road at Main Street is expected to operate at LOS D or better under all conditions. The side street approaches at the unsignalized intersections of Great Road at Harris Street and Acorn Park Drive and Great Road at Acorn Park Drive are currently operating with lengthy delays and will continue to operate with lengthy delays in the future with or without the proposed redevelopment. However, only the side street movements are experiencing delays, the Great Road movements are operating with little or no delay.