June 23, 2022

NEX-2021356.00

Ms. Kristin Carlson
Harborlight Community Partners
283 Elliot Street
Beverly, Massachusetts 01915

SUBJECT: Trip Generation and Site Access Letter
Residential Development
130 Essex Street
Hamilton, Massachusetts

Dear Ms. Carlson:

Greenman-Pedersen Inc. (GPI) has prepared this letter to evaluate the potential traffic impacts associated with the proposed residential redevelopment to be located at 130 Essex Street in Hamilton, Massachusetts. The site is currently part of the Gordon-Conwell Theological Seminary. The project consists of the conversion of 210 dormitory units associated with the existing Seminary, to 210-units of affordable housing. The existing dormitory units are contained within six (6) separate buildings, with on-site parking provided. As proposed, there are no changes to the building footprints or the total number of units (210). Further, no changers are proposed to access and egress to and from the site as part of the residential conversion. The Gordon-Conwell Theological Seminary may be accessed via a full-access/egress driveway on Essex Street known as Graham Way, via an egress-only driveway on Bridge Street known as Ockenga Lane, and via an entrance-only driveway on Woodbury Street known as Pew Lane. The residential buildings can be accessed via a series of existing driveways along Pew Lane and Gordon Court. This letter provides an estimate of the additional vehicle trips anticipated to be generated by the proposed redevelopment, as well as an evaluation of the safety of the proposed driveways, including a review of the collision history and available sight lines at each of the site driveway intersections.

Collisions

Collision data for the study intersections and the intersections with the site driveways were obtained from the Massachusetts Department of Transportation (MassDOT) for the most recent complete five-year period (2015 to 2019). A summary of the collision data is provided in Table 1.

Based on the collision data, the intersection of Pew Lane at Woodbury Street experienced only one collision over the five-year study period. This collision involved a single vehicle colliding with an unknown fixed object on a dark, lighted roadway, and occurred while the roadway surface was wet due to rain. This resulted in a non-fatal injury.

In addition, the intersection of Graham Way and Essex Street experienced three collisions over the five-year study period, averaging less than one collision per year. All three collisions involved a single vehicle colliding with a fixed object: an embankment, a utility pole, and a tree. No injuries or fatalities were reported. Two of the three collisions occurred under darkness on a snow-covered roadway. Based on the low occurrence of collisions at this location, a safety risk does not appear to exist.

There were no collisions reported at the existing site driveways within the most recent complete five-year period.

Table 1
COLLISION SUMMARY

Location	Number of Crashes		Severity [a]				Crash Type [b]						Percent During	
	Total	Average per Year	PD	PI	F	U	SS	CM	RE	HO	FO	Ped	Commuter Peak [d]	Wet/Snowy Conditions
Bridge Street at Ockenga Lane	0	--	--	--	--	--	--	--	--	--	--	--	--	--
Ockenga Lane at Driveway	0	--	--	--	--	--	--	--	--	--	--	--	--	--
Graham Way at Pew Lane	0	--	--	--	--	--	--	--	--	--	--	--	--	--
Pew Lane at Driveway	0	--	--	--	--	--	--	--	--	--	--	--	--	--
Pew Lane at School Driveway	0	--	--	--	--	--	--	--	--	--	--	--	--	--
Pew Lane at Gordon Court	0	--	--	--	--	--	--	--	--	--	--	--	--	--
Gordon Court at Driveway	0	--	--	--	--	--	--	--	--	--	--	--	--	--
Pew Lane at Woodbury Street	1	0.2	--	1	--	--	--	--	--	--	1	--	0%	100%
Graham Way at Essex Street	3	0.6	2	--	--	1	--	--	--	--	3	--	--	67%

Source: Crash data provided by MassDOT for the years 2015-2019.
[a] PD = property damage only; PI = personal injury; F = fatality; U = Unknown.
[b] SS = sideswipe; CM = cross movement; RE = rear-end; HO = head on; FO = fixed object; Ped = Pedestrian/Bicyclist.
[c] Measured in collisions per million vehicle miles traveled.
[d] Percent of vehicle collisions that occurred during the weekday AM (7:00 AM-9:00 AM) and weekday PM (4:00 PM -6:00 PM) commuter peak periods.

Sight Distance

Access and egress to and from the proposed affordable units will remain unchanged as part of the redevelopment. To identify potential safety concerns associated with site access and egress, sight distances have been evaluated at the various access points to determine if the available sight distances for vehicles exiting the site meet or exceed the minimum distances required for approaching vehicles to safely stop. The available sight distances were compared with minimum requirements, as established by the American Association of State Highway and Transportation Officials (AASHTO).[1] AASHTO is the national standard by which vehicle sight distance is calculated, measured, and reported.

Sight distance is the length of roadway ahead that is visible to the driver. Stopping Sight Distance (SSD) is the minimum distance required for a vehicle traveling at a certain speed to safely stop before reaching a stationary object in its path. The values are based on a driver perception and reaction time of 2.5 seconds and a braking distance calculated for wet, level pavements. When the roadway is either on an upgrade or downgrade, grade correction factors are applied. SSD is measured from an eye height of 3.5 feet to an object height of 2 feet above street level, equivalent to the taillight height of a passenger car. The SSD is measured along the centerline of the traveled way of the major road.

Intersection sight distance (ISD) is provided on minor street approaches to allow the drivers of stopped vehicles a sufficient view of the major roadway to decide when to enter the major roadway. By definition, ISD is the minimum distance required for a motorist exiting a minor street to turn onto the major street, without being overtaken by an approaching vehicle reducing its speed from the design speed to 70 percent of the design speed. The ISD is measured from an eye height of 3.5 feet to an object height of 3.5 feet above street level. The use of an object height equal to the driver eye height makes ISDs reciprocal (i.e., if one driver can see another vehicle, then the driver of that vehicle can also see the first vehicle). When the minor street is on an upgrade that exceeds 3 percent, grade correction factors are applied. The ISD design values for right turns from a minor street are less than the design values for left turns because, in making right turns, drivers generally accept gaps that are slightly shorter than those accepted in making left turns.

The SSD is generally more important as it represents the minimum distance required for safe stopping while ISD is based only upon acceptable speed reductions to the approaching traffic stream. The ISD, however, must be equal to or greater than the minimum required SSD in order to provide safe operations at the intersection. In accordance with the AASHTO manual, *"If the available sight distance for an entering or crossing vehicle is at least equal to the appropriate stopping sight distance for the major road, then drivers have sufficient sight distance to anticipate and avoid collisions. However, in some cases, this may require a major-road vehicle to stop or slow to accommodate the maneuver by a minor-road vehicle. To enhance traffic operations, intersection sight distances that exceed stopping sight distances are desirable along the major road."* Accordingly, ISD should be at least equal to the distance required to allow a driver approaching the minor road to safely stop.

The available SSD and ISD were measured in the field and compared to minimum requirements as established by AASHTO. Since the distance required to stop a vehicle is dependent on the speed of that vehicle, the 85th percentile speed on each roadway was assumed to be the posted speed limit plus 5 miles per hour (MPH). The posted speed limit on Essex Street near the site driveway is 35 MPH, the posted speed limit on Woodbury Street is 30 MPH, and the posted speed on Bridge Street is 40 MPH. The posted speed on Pew Lane is 20 MPH. Based on the posted speed limit, the SSD and ISD requirements at the site driveway intersections were calculated. The required minimum sight distances for each direction are compared to the available distances, as shown in Table 2.

[1] *A Policy on Geometric Design of Highways and Streets*; American Association of State Highway and Transportation Officials (AASHTO); 2018.

Table 2
SIGHT DISTANCE SUMMARY

Location/Direction	Stopping Sight Distance (feet)		Intersection Sight Distance (feet)		
	Measured	Minimum Required [a]	Measured	Minimum Required [b]	Desirable [c]
1. Ockenga Lane at Buildings E/F Parking Lot Driveway:					
South of Intersection (NB)	276	155	332	155	195
North of Intersection (SB)	171	155	171	155	225
2. Graham Way at Pew Lane:					
South of Intersection (NB)	400+	155	400+	155	195
North of Intersection (SB)	306	155	270	155	225
3. Pew Lane at Buildings C/D Parking Lot Driveway:					
West of Intersection (EB)	236[d]	155	236[d]	155	195
East of Intersection (WB)	400+	155	400+	155	225
4. Pew Lane at Buildings E/F Parking Lot Exit-Only Driveway:					
East of Intersection (WB)	400+	155	400+	155	195
West of Intersection (EB)	400+	155	400+	155	225
5a. Pew Lane at Buildings E/F Parking Lot Driveway:					
East of Intersection (WB)	321	155	310	155	195
West of Intersection (EB)	210	155	226	155	225
5b. Pew Lane at Gordon Court:					
West of Intersection (EB)	233	155	214	155	195
East of Intersection (WB)	364[d]	155	364[d]	155	225
6. Gordon Court at Buildings C/D Parking Lot Driveway:					
North of Intersection (SB)	266	155	341	155	195
South of Intersection (NB)	330	155	321	155	225
7. Essex Street at Graham Way:					
East of Intersection (WB)	540	305	480	305	335
West of Intersection (EB)	570	305	590	305	390
8. Woodbury Street at Pew Lane:					
North of Intersection (SB)	540	250	N/A	N/A	N/A
South of Intersection (NB)	340	250	N/A	N/A	N/A
9. Bridge Street at Ockenga Lane:					
East of Intersection (WB)	470	360	+600	360	445
West of Intersection (EB)	610	360	490	360	385

[a] Values based on the speed limit plus 5 mph; 35 MPH on Woodbury Street, 40 MPH on Essex Street, 45 MPH on Bridge Street, and 25 MPH on Pew Lane and Gordon Court.
[b] Values based on AASHTO requirements for SSD.
[c] Values based on AASHTO requirements for a posted speed limit of 20 mph on Pew Lane and Gordon Court, 30 MPH on Woodbury Street, 35 MPH on Essex Street, and 40 MPH on Bridge Street.
[d] Measurement to the adjacent intersection.

As indicated in Table 2, available sight distances at all site driveway intersections exceed the minimum requirements as recommended by AASHTO for safe operation. To ensure the safe and efficient flow of traffic

to and from the site, it is recommended that any proposed plantings, vegetation, landscaping, and signing along the site frontage be kept low to the ground (no more than 3.0 feet above street level) or set back sufficiently from the edge of the roadway so as not to inhibit the available sight lines.

Trip Generation

To estimate the volume of traffic to be generated by the proposed redevelopment, trip-generation rates published by the Institute of Transportation Engineers (ITE) *Trip Generation Manual* [2] were researched. Land Use Code (LUC) 225 (Off-Campus Student Apartment [Low-Rise]) was used to estimate the existing trip generation of the current site. Although the existing housing is located on campus, not off-campus, the description for LUC 225 states "the property is typically located near or within walking distance of a college campus." Additionally, the data points were based on apartments located adjacent to campus, as opposed to the other subcategory, over ½ mile from campus. Based on the description and subcategory, LUC 225 is expected to provide a reasonable trip generation estimate for the existing housing.

LUC 221 (Multifamily Housing [Mid-Rise])[3] was used to estimate the trip generation of the proposed site. The trip generation summary is presented in Table 3 and the detailed trip generation worksheets are attached to this letter.

Table 3
TRIP-GENERATION SUMMARY

Time Period/Direction	Existing Trips [a]	Proposed Trips [b]	Additional Trips [c]
Weekday Daily	972	956	-16
Weekday AM Peak Hour:			
In	14	19	5
Out	24	62	38
Total	39	81	42
Weekday PM Peak Hour:			
In	33	50	17
Out	33	32	-1
Total	66	82	16
Saturday Daily	754	960	206
Saturday Midday Peak Hour:			
In	23	43	20
Out	19	41	22
Total	42	84	42

[a] ITE LUC 225 (Off-Campus Student Apartment [Low-Rise]) for 210 bedrooms.
[b] ITE LUC 221 (Multifamily [Mid-Rise]) for 210 dwelling units.
[c] Proposed Trips minus Existing Trips.

[2] *Trip Generation, 11th Edition*. Institute of Transportation Engineers; Washington, DC; 2021.
[3] Although the proposed buildings will have three floors, the availability of elevators and common amenities/lounge space within the buildings are more consistent with a mid-rise apartment complex. Therefore, LUC 221 (Multifamily Housing [Mid-Rise]) was utilized to estimate site-generated trips over LUC 220 (Multifamily Housing [Low-Rise]).

As shown in Table 3, the proposed residential development is expected to generate 42 *new* vehicle trips (5 entering and 38 exiting) during the weekday AM peak hour, 16 *new* vehicle trips (17 entering and -1 exiting) during the weekday PM peak hour, and 42 *new* vehicle trips (20 entering and 22 exiting) during the Saturday midday peak hour to the surrounding area.

Trip Distribution

Having estimated project-generated vehicle trips, the next step is to determine the distribution of project traffic and assign these trips to the local roadway network. The distribution of proposed residential site traffic on the area roadways is based on United States Census Bureau 2011-2015 Journey-to-Work information. Accordingly, approximately 40 percent of the site-generated traffic is expected to and from the west on Essex Street, 30 percent to and from the west along Bridge Street, 20 percent to and from the south along Woodbury Street, 5 percent to and from the east along Essex Street, and 5 percent to and from the east along Bridge Street. The Journey-to-Work data is attached to this letter. A graphical depiction of the trip distribution and the site-generated trips is shown on Figure 1 attached.

Traffic volume increases leading beyond the study area are anticipated to be between 1 to 17 vehicle trips. These increases represent, on average, one additional vehicle trip approximately every 3.5 to 60 minutes on roadways leading beyond the study area during the peak hours and are not anticipated to have a significant impact on the operations of the surrounding area roadway network.

Summary

- The site is currently part of the Gordon-Conwell Theological Seminary. The project consists of the conversion of 210 dormitory units associated with the existing Seminary, to 210-units of affordable housing. The existing dormitory units are contained within six (6) separate buildings, with on-site parking provided. As proposed, there are no changes to the building footprints or the total number of units (210).

- Access and egress to and from the proposed affordable units will remain the same, as when utilized by the Seminary. Namely, vehicles may gain access to the surrounding public roadway system via existing driveways on Essex Street, Woodbury Street, and Bridge Street.

- Collision data for the study intersections and the intersections with the site driveways were obtained from the MassDOT for the most recent complete five-year period (2015 to 2019). Based on the average number of collisions per year, a safety risk does not appear to exist at the intersections.

- Available sight distances exceed the minimum requirements as recommended by AASHTO for safe operation. To ensure the safe and efficient flow of traffic to and from the site, it is recommended that any proposed plantings, vegetation, landscaping, and signing along the site frontage be kept low to the ground (no more than 3.0 feet above street level) or set back sufficiently from the edge of the roadway so as not to inhibit the available sight lines.

- The proposed residential development is expected to add 42 *new* vehicle trips (5 entering and 38 exiting) during the weekday AM peak hour, 16 *new* vehicle trips (17 entering and -1 exiting) during the weekday PM peak hour, and 42 *new* vehicle trips (20 entering and 22 exiting) during the Saturday midday peak hour to the surrounding area.

- Traffic volume increases leading beyond the study area are anticipated to be between 1 to 17 vehicle trips. These increases represent, on average, one additional vehicle trip approximately every 3.5 to

60 minutes on roadways leading beyond the study area during the peak hours and are not anticipated to have a significant impact on the operations of the surrounding area roadway network.

Based on the findings above and the number of additional trips expected to be generated as a result of the redevelopment, minimal impacts are expected on the adjacent roadways and intersections beyond the study area. Additionally, based on existing collision history, there are no safety concerns at the driveway intersections.

Should you have any questions, or require additional information, please contact me at (603) 766-5223.

Sincerely,

GREENMAN-PEDERSEN, INC.

Rebecca L. Brown, P.E.
Senior Project Manager

Enclosures:

Trip Generation Data
Journey to Work Data
Figure 1 – Trip Distribution Network

FIGURE 1 – TRIP DISTRIBUTION

Institute of Transportation Engineers (ITE)

Land Use Code (LUC) 221 - Multifamily Housing (Mid-Rise)

General Urban/Suburban

Average Vehicle Trips Ends vs: Bedrooms
Independent Variable (X): 210

AVERAGE WEEKDAY DAILY

Ln(T) = 0.75 Ln (X) + 2.87
Ln(T) = 0.75 Ln (210) + 2.87
Ln(T) = 6.88
T = 972.95
T = 972 vehicle trips
with 50% (486 vpd) entering and 50% (486 vpd) exiting.

WEEKDAY MORNING PEAK HOUR OF ADJACENT STREET TRAFFIC

Ln(T) = 0.62 Ln (X) + 0.34
Ln(T) = 0.62 Ln (210) + 0.34
Ln(T) = 3.66
T = 38.68
T = 38 vehicle trips
with 38% (14 vpd) entering and 62% (24 vpd) exiting.

WEEKDAY EVENING PEAK HOUR OF ADJACENT STREET TRAFFIC

Ln(T) = 0.76 Ln (X) + 0.13
Ln(T) = 0.76 Ln (210) + 0.13
Ln(T) = 4.19
T = 66.27
T = 66 vehicle trips
with 50% (33 vpd) entering and 50% (33 vpd) exiting.

SATURDAY DAILY

$$\frac{\text{ITE LUC 221 Saturday Daily Trip Rate}}{\text{ITE LUC 221 Weekday Daily Trip Rate}} = \frac{\text{ITE LUC 225 Saturday Daily Trip Rate}}{\text{ITE LUC 225 Weekday Daily Trip Rate}}$$

$$\frac{4.57}{4.54} = \frac{(Y)}{3.57} \qquad Y = 3.59$$

T = Y * 210
T = 753.90
T = 754 vehicle trips
with 50% (377 vpd) entering and 50% (377 vpd) exiting.

(same distribution split as ITE LUC 220 during the Saturday Daily)

SATURDAY PEAK HOUR OF GENERATOR

T = 0.20 * (X)
T = 0.20 * 210
T = 42.00
T = 42 vehicle trips
with 54% (23 vph) entering and 46% (19 vph) exiting.

Institute of Transportation Engineers (ITE)

Land Use Code (LUC) 221 - Multifamily Housing (Mid-Rise)

General Urban/Suburban

Average Vehicle Trips Ends vs: Dwelling Units
Independent Variable (X): 210

AVERAGE WEEKDAY DAILY

T = 4.77 * (X) - 46.46
T = 4.77 * 210 - 46.46
T = 955.24
T = 956 vehicle trips
with 50% (478 vpd) entering and 50% (478 vpd) exiting.

WEEKDAY MORNING PEAK HOUR OF ADJACENT STREET TRAFFIC

T = 0.44 * (X) - 11.61
T = 0.44 * 210 - 11.61
T = 80.79
T = 81 vehicle trips
with 23% (19 vph) entering and 77% (62 vph) exiting.

WEEKDAY EVENING PEAK HOUR OF ADJACENT STREET TRAFFIC

T = 0.39 * (X) + 0.34
T = 0.39 * 210 + 0.34
T = 82.24
T = 82 vehicle trips
with 61% (50 vph) entering and 37% (32 vph) exiting.

SATURDAY DAILY

T = 4.57 * (X)
T = 4.57 * 210
T = 959.70
T = 960 vehicle trips
with 50% (480 vpd) entering and 50% (480 vpd) exiting.

SATURDAY PEAK HOUR OF GENERATOR

Ln(T) = 1.00 Ln (X) - 0.91
Ln(T) = 1.00 Ln (210) - 0.91
Ln(T) = 4.44
T = 84.53
T = 84 vehicle trips
with 51% (43 vpd) entering and 49% (41 vpd) exiting.

Residence		Place of Work		Commuting Flow	West		East		South	West		East		South	
State Name	Minor Civil Division Name	State Name	Minor Civil Division Name	Workers in Commuting Flow	Essex St	Bridge St	Essex St	Bridge St	Woodbury St	Essex St	Bridge St	Essex St	Bridge St	Woodbury St	
Massachusetts	Hamilton town	Massachusetts	Hamilton town	623		100%				0	623	0	0	0	
Massachusetts	Hamilton town	Massachusetts	Beverly city	523	100%					523	0	0	0	0	
Massachusetts	Hamilton town	Massachusetts	Boston city	511	50%				50%	256	0	0	0	256	
Massachusetts	Hamilton town	Massachusetts	Danvers town	247	70%	30%				173	74	0	0	0	
Massachusetts	Hamilton town	Massachusetts	Gloucester city	184			10%	30%	60%	0	0	18	55	110	
Massachusetts	Hamilton town	Massachusetts	Peabody city	161	50%				50%	81	0	0	0	81	
Massachusetts	Hamilton town	Massachusetts	Ipswich town	129		100%				0	129	0	0	0	
Massachusetts	Hamilton town	Massachusetts	Salem city	117	30%				70%	35	0	0	0	82	
Massachusetts	Hamilton town	Massachusetts	Wenham town	95	50%	50%				48	48	0	0	0	
Massachusetts	Hamilton town	Massachusetts	Topsfield town	76	50%	50%				38	38	0	0	0	
Massachusetts	Hamilton town	Massachusetts	Essex town	63			50%	50%		0	0	32	32	0	
Massachusetts	Hamilton town	Massachusetts	Waltham city	63	50%				50%	32	0	0	0	32	
Massachusetts	Hamilton town	Massachusetts	Wakefield town	60	50%				50%	30	0	0	0	30	
Massachusetts	Hamilton town	Massachusetts	Cambridge city	58	50%				50%	29	0	0	0	29	
				2,910						1243	912	50	87	619	2910
										43%	31%	2%	3%	21%	
									USE:	40%	30%	5%	5%	20%	100%