



Date: 13 December 2021
To: Eric Farrell, Farrell Properties
From: Corey Mack, PE
Subject: Cambrian Rise Trip Generation Review
Updated Land Use Program: Burlington Planning and Zoning

WCG has reviewed the proposed change to the land use development program at Cambrian Rise in Burlington, VT. We have compared the latest development program and trip generation estimate to the originally permitted condition (December 2016) and most recent development program (April 2019) trip generation estimates. This memo documents the trip generation estimate, adjustments, and summarizes the changes.

In summary:

- The proposed land use development program at Cambrian Rise includes several changes, including a reduction in office space, removal of the convenience store, addition of a neighborhood grocery store, and other minor modifications.
- The current proposed land use development program results in an overall estimated external primary vehicle trip generation of 362 trip ends in the AM peak hour and 348 trip ends in the PM peak hour.
- The originally permitted development program from December 2016 estimated a total external trip generation of 381 trips and 425 trips in the AM and PM peak hours, respectively.
- The proposed land use development program results in an estimated 19 fewer external primary vehicle trips in the AM peak hour and 77 fewer external primary vehicle trips in the PM peak hour compared to the originally permitted land use development program from December 2016.
- This reduction in new external primary vehicle trip generation is expected to improve traffic operations and reduce transportation impacts compared to the originally evaluated and permitted land use development program from December 2016.

BACKGROUND

Cambrian Rise is a mixed-use development located near 351 North Avenue in Burlington VT. The project is permitted under Act 250 land use permit 4C1301 with four amendments. The City of Burlington Planning and Zoning department has most recently reviewed a traffic supplement dated April 18, 2019. That most recent traffic supplement from April 18, 2019 included an increase in the number of housing units to 950 (including the 65 units at Liberty House), a reduction in the office and retail space, an increase in restaurant space, and other minor changes to the land use development program. In all permitting applications, Building A “Liberty

House” consisting of 65 units of mid-rise residential housing, is considered an existing property under separate permitting.

The evolution of the land use development program and the resulting estimated primary external vehicle trip generation is documented in Table 1.

TABLE 1: SUMMARY OF LAND USE DEVELOPMENT PROGRAMS AND ESTIMATED PRIMARY EXTERNAL VEHICLE TRIP GENERATION FROM FORMER AND CURRENT CAMBRIAN RISE LAND USE DEVELOPMENT PROGRAMS

ITE LUC Description	Units	December 2016 4C1301	October 2018 4C1301-3	April 2019	December 2021 Current
221 Mid-Rise Apartment	DUs	673	705	815	815
252 Senior Adult Housing (Attached)	DUs	*	*	70	70
311 All-Suites Hotel	Rooms	42	50	79	64
311 Hotel (VIC)	Rooms	-	40	-	-
540 Junior/Community College	SF	16,500	-	-	-
565 Daycare Center	SF	4,025	3,000	3,000	-
710 General Office Building	SF	22,541	60,250	64,900	13,400
760 R&D Office (VIC)	SF	-	40,000	-	-
820 Retail (e.g. Shopping Center)	SF	-	4,350	900	1,300
826 Specialty Retail	SF	2,675	-	-	-
850 Grocery Store	SF	-	-	-	5,000
851 Convenience Market	SF	-	2,000	2,000	-
932 High-Turnover (Sit-Down) Restaurant	SF	2,650	3,000	8,000	5,000
Total External Primary Vehicle Trip Generation:					
	AM Peak Hour	381	394	380**	362
	PM Peak Hour	425	443	399**	348
	Daily (including pass-by trips)	4620	5057	5635	4742

*Previous land use development programs included senior housing, however the land use was included within LUC 221 and not specifically broken out as a distinct generator of traffic prior to the current traffic supplement

** Not explicitly calculated in the April 2019 Memo; estimated as Table 6 subtract Table 3

VEHICLE TRIP GENERATION ESTIMATE

To estimate the total primary external vehicle trips of the proposed site, the following methodology was applied:

- A. Estimate the base trip generation by evaluating the single-use trip generation for each land use code per ITE Trip Generation Manual, 11th Edition trip generation rates¹
- B. Estimate internally captured trips using NCHRP Report 684 Methodology
- C. Estimate pass-by and primary trips by applying appropriate Trip Generation Handbook, 3rd Edition pass-by rates to external trips (the base trips subtracted by the internal trips, A minus B)
- D. Estimate the effect of transportation demand management (TDM) by applying a TDM factor to primary trips per VTrans guidance
- E. Estimate primary external vehicle trips as primary external trips minus TDM trips (C minus D)

A. Base Trip Generation

Base vehicle trips are the total estimated vehicle trips prior to any reductions associated with internal capture, pass-by, or transportation demand management (TDM) features. Base trip generation from the current development program has been estimated using the Institute of Transportation Engineers (ITE) Trip Generation Manual, 11th Edition.

The 5,000 SF neighborhood grocery store is expected to offer food, beverage, produce, food preparation materials, prepared foods, and household goods, similar to the Grocery Store land use description defined by ITE land use code (LUC) 850. The data supporting the trip generation rates for this land use code are based on sites ranging in size from 9,000 to 144,000 square feet, with the average data based on a 55,000 square foot site. Given the proposed site is not within the range of data, the base trip generation has been estimated using the smallest square footage in the sample set. The resulting base trip generation estimates are summarized by land use code (ITE LUC) in Table 2.

B. Internally Captured Trips

Because of the complementary nature of the proposed land uses on the Cambrian Rise site, some trips are made between the on-site uses. This capture of trips internal to the site has the net effect of reducing vehicle trip generation between the overall development site and the external street system (compared to the total number of trips generated by comparable land uses developed individually on stand-alone sites). For these internally captured trips, the origin, destination, and travel path are all within the site.

¹ 11th Edition was released in September 2021. Previous trip generation estimation utilized data from the ITE Trip Generation Manual, 10th edition, or earlier.

TABLE 2: BASE TRIP GENERATION OF THE PROPOSED CAMBRIAN RISE DEVELOPMENT PROGRAM

ITE LUC	Description	Units/size		AM Peak		PM Peak	
				enter	exit	enter	exit
221	Multifamily Housing (Mid-Rise)	815	units	80	267	194	124
252	Senior Adult Housing - Attached	70	units	5	9	10	8
311	Hotel	64	rooms	12	10	11	12
710	General Office Building	13,400	s.f.	26	4	5	26
822	Strip Retail Plaza (<40k)	1,300	s.f.	4	3	9	9
850	Grocery Store	5,000	s.f.	18	13	53	54
932	High-Turnover (Sit-Down) Restaurant	5,000	s.f.	26	22	27	18
		sub-total		171	328	309	251
		total		499		560	

Internally captured trips have been estimated using the recommended methodology in the ITE Trip Generation Handbook² and are shown in Table 3. Internal capture trips are estimated prior to splitting site generated trips into pass-by and non-pass-by trips or estimating the effect of TDM strategies.

TABLE 3: ESTIMATED INTERNALLY CAPTURED TRIPS

ITE LUC	Description	Units/size		AM Peak		PM Peak	
				enter	exit	enter	exit
221	Multifamily Housing (Mid-Rise)	815	units	3	9	20	13
252	Senior Adult Housing - Attached	70	units	0	0	0	0
311	Hotel	64	rooms	0	3	4	2
710	General Office Building	13,400	s.f.	7	3	3	7
822	Strip Retail Plaza (<40k)	1,300	s.f.	0	0	0	0
850	Grocery Store	5,000	s.f.	7	5	19	27
932	High-Turnover (Sit-Down) Restaurant	5,000	s.f.	10	7	14	11
		sub-total		27	27	60	60
		total		54		120	

Total external trips are estimated by subtracting the internally generated trips shown in Table 3 from the base vehicle trips estimated in Table 2. The resulting total external trips are shown in Table 4.

² NCHRP Report 684 - Enhancing Internal Trip Capture Estimation for Mixed-Use Developments

TABLE 4: ESTIMATED TOTAL EXTERNAL TRIPS

ITE LUC	Description	Units/size		AM Peak		PM Peak	
				enter	exit	enter	exit
221	Multifamily Housing (Mid-Rise)	815	units	77	258	174	111
252	Senior Adult Housing - Attached	70	units	5	9	10	8
311	Hotel	64	rooms	12	7	7	10
710	General Office Building	13,400	s.f.	19	1	2	19
822	Strip Retail Plaza (<40k)	1,300	s.f.	4	3	9	9
850	Grocery Store	5,000	s.f.	11	8	34	27
932	High-Turnover (Sit-Down) Restaurant	5,000	s.f.	16	15	13	7
		sub-total		144	301	249	191
		total		445		440	

C. Pass-By and Primary Trips

The estimated external trips may be separated into primary trips and pass-by trips. Pass-by trips result in a change in turning traffic at project intersections, but do not add traffic to the adjacent street network. As defined by the ITE Trip Generation Handbook:

“A pass-by trip is made as an intermediate stop on the way from an origin to a primary trip destination without a route diversion. Pass-by trips are attracted from traffic passing the site on an adjacent street...”

Pass-by trips are estimated using the average pass-by rates surveyed by ITE for that land use. These trips are anticipated in addition to the primary trips. In this case, only the retail store, grocery store and restaurant are expected to attract pass-by trips, estimated in Table 5.

TABLE 5: ESTIMATED PASS-BY TRIPS

ITE LUC	Description	Units/size		AM Peak		PM Peak	
				enter	exit	enter	exit
221	Multifamily Housing (Mid-Rise)	815	units				
252	Senior Adult Housing - Attached	70	units				
311	Hotel	64	rooms				
710	General Office Building	13,400	s.f.				
822	Strip Retail Plaza (<40k)	1,300	s.f.	1	1	3	3
850	Grocery Store	5,000	s.f.	3	2	8	6
932	High-Turnover (Sit-Down) Restaurant	5,000	s.f.	7	6	6	3
		sub-total		11	9	17	12
		total		20		29	

All non-pass-by trips are estimated to be primary external trips. Primary external trips are made for the specific purpose of visiting the generating site. The estimated primary external trips are shown in Table 6.

TABLE 6: ESTIMATED EXTERNAL PRIMARY TRIPS

ITE LUC	Description	Units/size		AM Peak		PM Peak	
				enter	exit	enter	exit
221	Multifamily Housing (Mid-Rise)	815	units	77	258	174	111
252	Senior Adult Housing - Attached	70	units	5	9	10	8
311	Hotel	64	rooms	12	7	7	10
710	General Office Building	13,400	s.f.	19	1	2	19
822	Strip Retail Plaza (<40k)	1,300	s.f.	3	2	6	6
850	Grocery Store	5,000	s.f.	8	6	26	21
932	High-Turnover (Sit-Down) Restaurant	5,000	s.f.	9	9	7	4
		sub-total		133	292	232	179
		total		425		411	

D. Effect of Transportation Demand Management

While the Trip Generation Handbook recommends calculating walk, bike, and transit trips prior to splitting trips into pass-by and non-pass-by trips³, the VTrans TDM Guidance states “TDM reductions should be applied... after the pass-by factors have been applied”. Accounting for the anticipated effects of Transportation Demand Management, as suggested in the VTrans TDM Guidance, results a 15% reduction in primary (non-pass-by) external trips shown in Table 7.

TABLE 7: ESTIMATED MULTIMODAL / TDM MITIGATED TRIPS

ITE LUC	Description	Units/size		AM Peak		PM Peak	
				enter	exit	enter	exit
221	Multifamily Housing (Mid-Rise)	815	units	12	39	26	17
252	Senior Adult Housing - Attached	70	units	1	1	2	1
311	Hotel	64	rooms	2	1	1	2
710	General Office Building	13,400	s.f.	3	0	0	3
822	Strip Retail Plaza (<40k)	1,300	s.f.	0	0	1	1
850	Grocery Store	5,000	s.f.	1	1	4	3
932	High-Turnover (Sit-Down) Restaurant	5,000	s.f.	1	1	1	1
		sub-total		20	43	35	28
		total		63		63	

E. Net External Primary Vehicle Trips

The external primary vehicle trip total, or the expected number of new vehicle trips entering and exiting the development, is estimated as the total primary external trips shown in Table 6 subtracting the multimodal trips estimated in Table 7. The resulting estimated external primary vehicle trips are shown in Table 8.

³ ITE Trip Generation Handbook, 3rd Edition, page 95

TABLE 8: ESTIMATED NET EXTERNAL PRIMARY VEHICLE TRIPS FOR THE PROPOSED CAMBRIAN RISE DEVELOPMENT PROGRAM

ITE LUC	Description	Units/size	AM Peak		PM Peak	
			enter	exit	enter	exit
221	Multifamily Housing (Mid-Rise)	815 units	65	219	148	94
252	Senior Adult Housing - Attached	70 units	4	8	8	7
311	Hotel	64 rooms	10	6	6	8
710	General Office Building	13,400 s.f.	16	1	2	16
822	Strip Retail Plaza (<40k)	1,300 s.f.	3	2	5	5
850	Grocery Store	5,000 s.f.	7	5	22	18
932	High-Turnover (Sit-Down) Restaurant	5,000 s.f.	8	8	6	3
		sub-total	113	249	197	151
		total	362		348	

The net effect of the proposed development program is 19 fewer primary external vehicle trips generated in the AM peak hour and 77 fewer primary external vehicle trips generated in the PM peak hour compared to the originally permitted development program from December 2016. The total daily external trip generation is estimated to be 4,742 trips per day (including pass-by trips), an increase of 122 trips per day compared to the originally permitted development program from December 2016.

TABLE 9: SUMMARY OF ESTIMATED PEAK HOUR TRIP GENERATION

Step	AM Peak Hour	PM Peak Hour
A. Base Trip Generation	499	560
B. Internally Captured Trips	54	120
C. Pass-By Trips	20	29
C.2 Primary Trips (A-B-C)	425	411
D. Multimodal / TDM Trips (C.2 x 15%)	63	63
E. External Primary Vehicle Trips (C.2-D)	362	348
Previously Approved Trips from April 2019 Traffic Supplement	380	399
Previously Permitted Trips in 4C1301-3 (Amended traffic report dated 10/16/18)	394	443
Originally Permitted Trips in 4C1301 (From traffic report dated 12/28/16)	381	425
Net Change in External Primary Vehicle Trips (current trips compared to originally permitted trips)	-19	-77

The revised land use proposal includes a significant number of pass-by trips due to the grocery store and increased restaurant space (Table 5). As noted earlier, pass-by trips are not new traffic generation, but trips resulting from the existing traffic already driving by the site. The net effect of pass-by trips at the development entrances is minor, as existing through trips on North Avenue are simply converted to turning movements. Outside the entrance intersections, pass-by trips are already on the road network and do not contribute to increased traffic volumes along North Avenue or beyond. The original Transportation Impact Assessment (TIA) from December 2016 did not include any land uses capitalizing on pass-by trips; all originally permitted trips were new, external primary vehicle trips.

The proposed development program also removes higher trip generating land uses, such as the office space and convenience market, and replaces this floor area with lower trip generating land uses such neighborhood grocery store. The net result is a reduction in overall new external primary vehicle trip generation in the peak hours compared to previously permitted and approved conditions.

The current proposed land use program is expected to generate fewer new, primary external vehicle trips than in the original TIA from December 2016 and the amended trip generation assessment from October 2018 and April 2019. Fewer new primary external vehicle trips are likely to improve the evaluated traffic operations and reduce transportation impacts compared to the originally permitted land use development program in December 2016.

CONCLUSIONS

The methodology to calculate internally captured trips, primary and pass-by trips, and TDM trips has been updated to be consistent with the latest guidance by VTrans, the ITE Trip Generation Manual, 11th Edition, and the ITE Trip Generation Handbook, 3rd Edition.

Under the updated methodology, the current development program results in a net change in external vehicle trips of -19 trips / -77 trips in the AM / PM peak hours compared to the originally approved December 2016 land use development program. This reduction in new external primary vehicle trip generation is expected to improve traffic operations and reduce transportation impacts compared to the originally evaluated and permitted land use development program from December 2016.