CHITTENDEN COUNTY RPC
Communities Planning Together

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MEMORANDUM

TO: Sarah Hadd, Bryan Osborne, Kathi O'Reilly; Town of Colchester
FROM: Jason Charest, Sai Sarepalli, Melanie Needle; CCRPC Staff
DATE: August 7, 2015
RE: Bayside Build-Out Analysis (Memo 1 of 2: Traffic)

Overview

The Town of Colchester requested CCRPC staff expertise in evaluating congestion and examining alternatives for improvement at the Bayside Park signalized intersection. A kick-off meeting was held on Tuesday, September 9, 2014 to review the scope of work for these services. Several meetings with Town staff followed to review results and provide feedback throughout the analysis. Alternatives focused on congestion reduction while also attempting to increase land-use connectivity between Bayside Park and Bayside Beach (see primary study in Figure 1). The town was also interested in how many additional development trips could be added to the intersection while maintaining acceptable performance levels. Sensitivity analyses were conducted for each alternative in order to evaluate this.

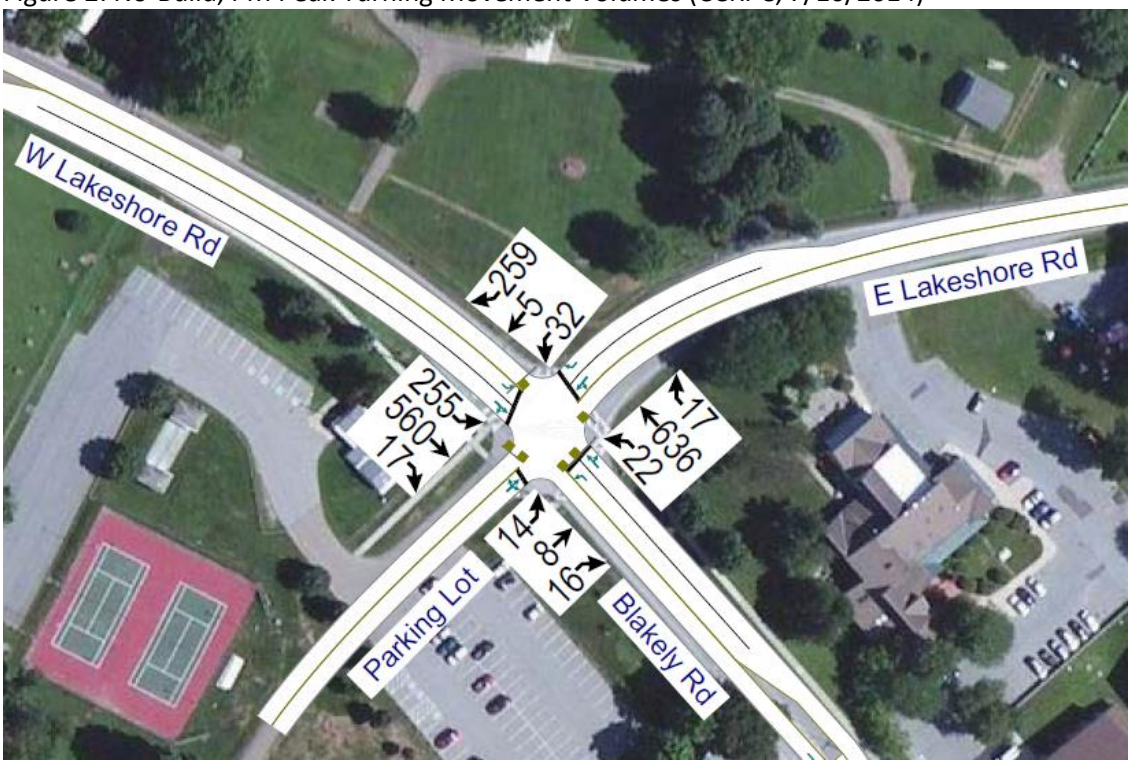
This memo serves to culminate CCRPC staff efforts related to traffic. A companion memo (Memo 2 of 2: Land Use) is a land-use build-out analysis that examines what and how much development could be added to the nearby area for Alternatives 3B and 4B. This is based on the number of additional vehicles the intersection could reasonably accommodate without triggering the need for additional through lanes.

Figure 1: Primary Study Area

Existing Conditions Analysis

Existing traffic conditions for 2014 were evaluated to establish a baseline and provide a No-Build alternative for comparison purposes. CCRPC utilized intersection counts collected by CCRPC interns during the summer of 2014. Due to the summer recreational activity in nearby Mallets Bay, raw count volumes were utilized to provide an accurate depiction of summer congestion levels. The No-Build intersection volumes can be seen in Figure 2 below.

Figure 2: No-Build, PM Peak Turning Movement Volumes (CCRPC, 7/16/2014)



To understand how the intersection is performing under existing conditions, the following performance metrics were analyzed:

- Level of Service (LOS) – A qualitative measure describing the operating conditions as perceived by motorists driving through the intersection. LOS is a measure of average vehicular delay in seconds represented by letter grades ranging from A to F (see Table 1). This is similar to a report card except that designing transportation infrastructure to perform at LOS A during peak hours is undesirable due to its associated land use, economic and other resource impacts. In densely settled areas such as this, LOS E or better during peak hours is typically acceptable for previously discussed reasons and often desired in order to support other modes of transportation (i.e. walking and biking). This is especially applicable in this area given the nearby public facilities (Bayside Park and Bayside Beach) and desire for pedestrians to cross the street. For this analysis the lowest acceptable LOS for an approach lane was E.

- Volume-to-Capacity (v/c) ratio – A measure that quantifies the amount of available roadway capacity that is being utilized by traffic. For example a v/c ratio of 0.84 for a given facility means that 84% of capacity is spoken for and 16% remains. Congested conditions can and will occur before the v/c ratio reaches 1.0. Therefore, a target maximum threshold for this analysis is 0.90 for each approach lane. This same threshold is identified in Vermont's Highway System Policy Plan for state highways in urban area downtowns.[1]

Table 1: Intersection Level of Service (LOS) Thresholds

	Average Delay per Vehicle (seconds)	
Level of Service (LOS)	Signalized Intersections	Unsignalized Intersections
A	≤ 10	≤ 10
B	10.1 – 20	10.1 – 15
C	20.1 – 35	15.1 – 25
D	35.1 – 55	25.1 – 35
E	55.1 – 80	35.1 – 50
F	> 80	> 50

Table 2 shows existing conditions capacity results for each approach lane. Results indicate that two lanes currently exceed the desired v/c capacity threshold of 0.90 and could not handle additional traffic. These are highlighted in Table 2 and they are: West Lakeshore Drive left and Blakely Road thru/right.

Table 2: Existing Conditions Performance

Approach Lane	v/c	LOS
W. Lakeshore Dr Left	0.95	E
W. Lakeshore Dr Thru/Right	0.53	A
Blakely Rd Thru/Right	0.94	D
Blakely Rd Left	0.09	B
E. Lakeshore Dr Thru/Left	0.35	D
E. Lakeshore Dr Right	0.21	C
Parking Lot Left/Thru/Right	0.21	D
Overall Intersection Performance	0.82	C

Highlighting denotes v/c ≥ 0.90 or LOS F

[1] VTrans. (2004, June). *Vermont's Highway System Policy Plan*. p 3-10. Retrieved from http://vtransplanning.vermont.gov/sites/aot_policy/files/documents/highwayresearch/VermontHighwaySystemPolicyPlan.pdf

Alternatives Description

The existing conditions analysis highlighted an immediate need to examine an alternative that could be implemented relatively quickly and is summarized below.

- ***No-Build Optimized with Advanced Walk:*** Short-term, low-cost alternative which evaluates the effects of optimizing the intersection signal timing and changing the nature of the pedestrian crossing to advanced walk. The concept of the advanced walk is explained in the ***Alternatives and Sensitivity Analysis Results*** section.

Following the No-Build Optimized with Advanced Walk alternative were four build alternatives that examine the effects of new roadway alignments. Traffic signal timings were optimized for each of the build alternatives. Alternatives 1-3 were evaluated with and without the advanced walk enhancement. This is denoted by a letter "B" on the pages that follow and represents the only change to each respective alternative. Alternative 4B was only evaluated with an advanced walk. The build alternatives are bulleted and displayed below.

- ***Alternatives 1/1B and 2/2B:*** Under these alternatives, the existing Bayside Park intersection is removed and a new intersection is formed at Laker Lane and Blakely Road. This is accomplished by rerouting East and West Lakeshore Drives. Alternative 2/2B expands upon Alternative 1/1B and adds an additional new roadway that loops behind Colchester High School and intersects with the 95TripleX (WXXX) access road. Alternatives 1/1B and 2/2B are shown in Figures 3 and 4, respectively.

Figure 3: Alternative 1/1B

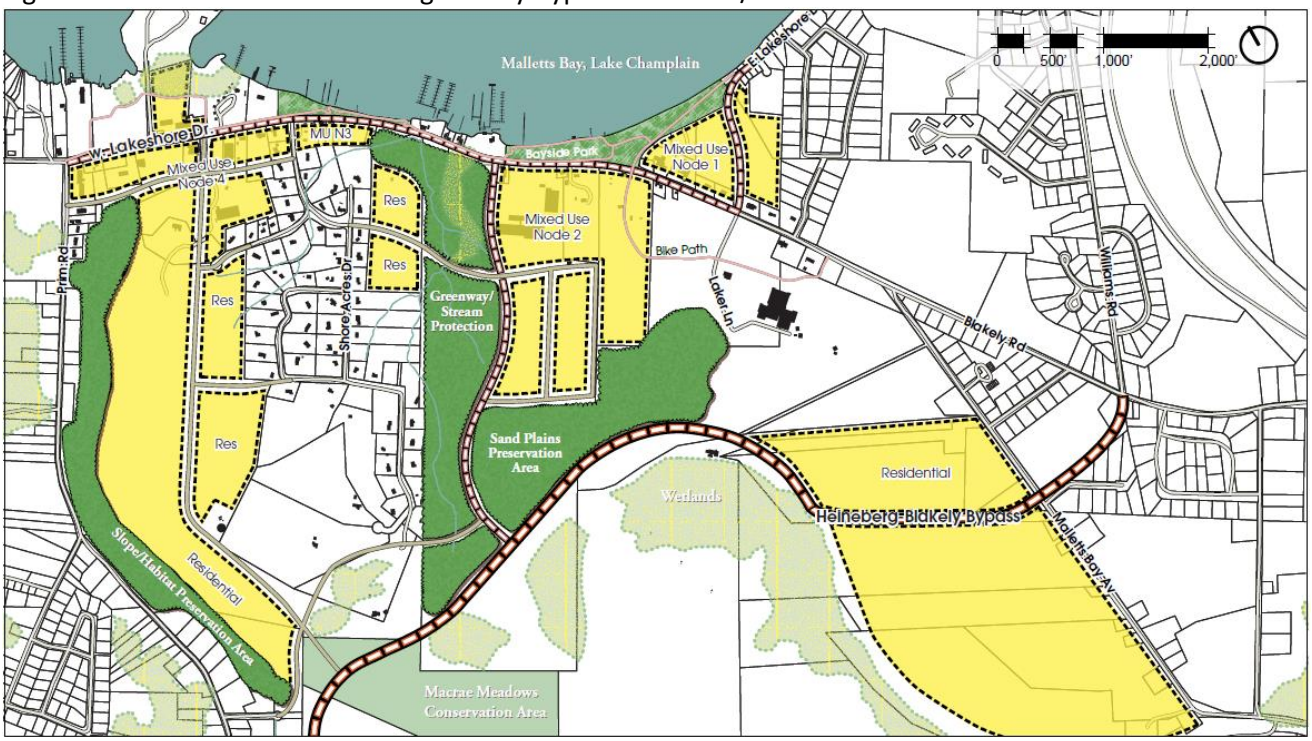
Figure 4: Alternative 2/2B

- ***Alternative 3/3B:*** This alternative makes no changes to the Bayside Park intersection and adds a connector street between East Lakeshore Drive and Blakely Road. The connector street creates a four-way intersection with Laker Lane and a new T-intersection with East Lakeshore Drive. Alternative 3/3B is shown in Figure 5 below.

Figure 5: Alternative 3/3B

- ***Alternative 4B:*** This alternative creates a bypass road that connects Heineberg Drive to Blakely Road (Heineberg-Blakely Bypass). The impetus for examining this alternative was sparked after reviewing preliminary traffic results with town staff. Initial results of Build Alternatives 1-3 did not allow for a significant amount of additional capacity to be allocated to future development trips. The Heineberg-Blakely Bypass was previously envisioned in the West Lakeshore Drive Conceptual Development Plan[1] but its impacts to traffic were not examined. The bypass largely follows the former CIRC Highway alignment aside from where it veers to cross Malletts Bay Avenue and intersect with Blakely Rd. A companion north/south road from West Lakeshore Drive to the Heineberg-Blakely Bypass was also incorporated as part of this alternative. Alternative 4B can be seen in Figure 6 below.

Figure 6: Alternative 4B – Heineberg-Blakely Bypass and north/south connection



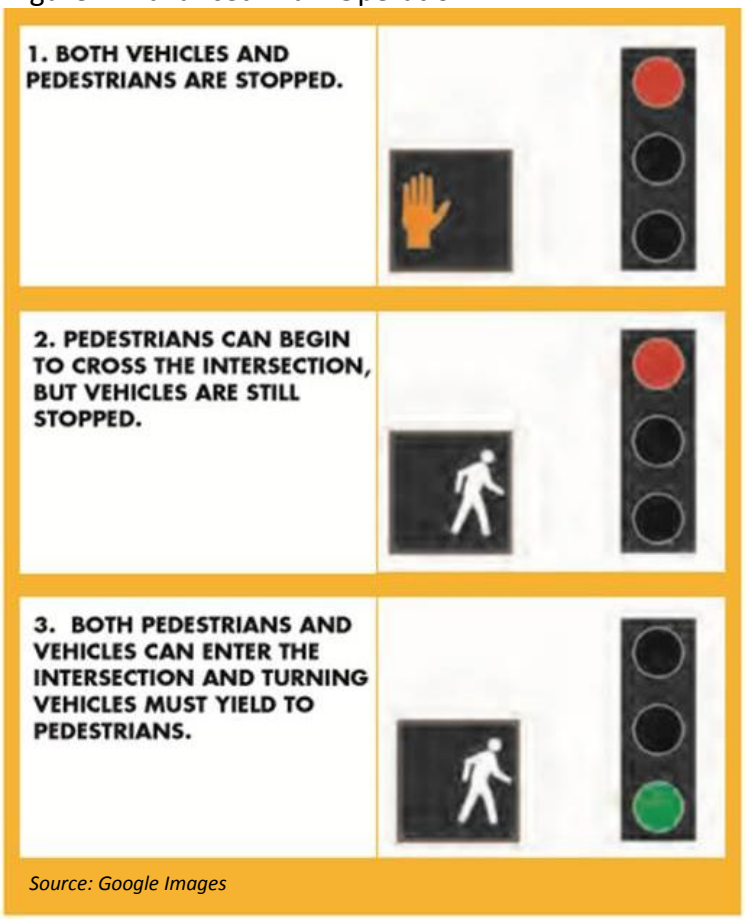
Source: West Lakeshore Drive Conceptual Development Plan (April, 2008)

[1] West Lakeshore Drive Conceptual Development Plan, Town of Colchester, Vermont; April 2008

Alternatives & Sensitivity Analysis Results

The performance of each build alternative was first evaluated utilizing existing conditions traffic volumes. To understand how increases in traffic would affect each alternative, a sensitivity analysis was conducted. This was accomplished by increasing the intersection volumes in 5-percent increments until a 20% increase threshold was reached. A 30% increase in traffic was evaluated as well for all alternatives except for the No-Build due to capacity being reached prior to 20%.

Figure 7: Advanced Walk Operation



Source: Google Images

In addition to the sensitivity analysis, an advanced walk pedestrian crossing was evaluated. The existing pedestrian crossing at the Bayside Park Signal is what is known as an exclusive crossing. This means that during the walk and flashing don't walk intervals, all traffic signals are red. While this provides pedestrians ample time to cross the street without any vehicles present, it can also contribute to congestion in times of frequent pedestrian use. In places where a balanced approach is needed, a compromise known as the advanced walk has been implemented (also known as a leading pedestrian interval). This keeps all traffic signals red during the walk interval (5-7 seconds) and then grants concurrent approaches a green light at the same time the flashing don't walk interval begins. Conflicting right and left turning vehicles will yield to any pedestrians that have started crossing during the walk interval. See Figure 7 (above right) for a graphical representation of how an advanced walk works.

Table 4 shows overall intersection performance metrics for each alternative. Most alternatives exceeded or reached the v/c threshold of 0.90 when intersection volumes were increased by 30 percent.

Table 4: Overall Intersection Performance

Alternative	LOS						v/c					
	Percent Traffic Increase						Percent Traffic Increase					
	Base	5	10	15	20	30	Base	5	10	15	20	30
No-Build	C	D	D	D	D	---	0.82	0.78	0.81	0.85	0.89	---
No-Build Opt. w/Adv. Walk	C	C	D	D	D	D	0.77	0.80	0.84	0.85	0.87	0.94
1	C	C	C	C	D	D	0.78	0.81	0.82	0.84	0.88	0.93
1B	C	C	C	C	C	D	0.77	0.80	0.82	0.85	0.88	0.93
2	C	C	C	D	D	D	0.78	0.81	0.83	0.83	0.85	0.91
2B	C	C	C	C	C	D	0.78	0.80	0.80	0.82	0.84	0.88
3	C	C	D	D	D	D	0.79	0.75	0.80	0.82	0.86	0.92
3B	C	C	C	C	C	C	0.77	0.79	0.82	0.83	0.86	0.90
4B	B	B	B	B	B	B	0.57	0.60	0.63	0.64	0.64	0.68

The advanced walk build alternatives are denoted by a letter "B". Alternative 4 was not evaluated without an advanced walk.

Highlighting denotes v/c ≥ 0.90 or LOS F

Figure 8 below displays the LOS results of Table 4 in a chart format to better understand how percentage increases in traffic affect each alternative.

Figure 8: Intersection Delay vs. Traffic Increase

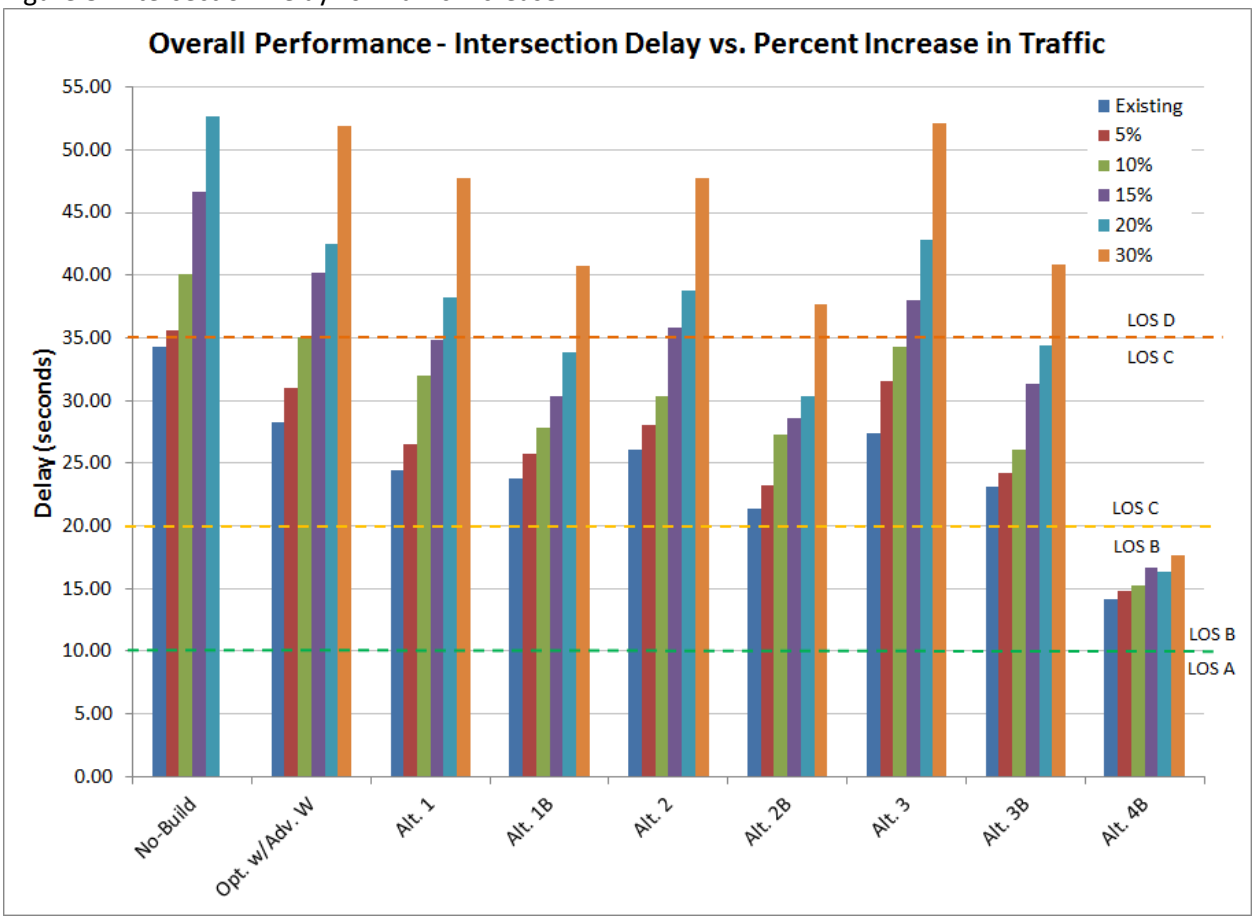
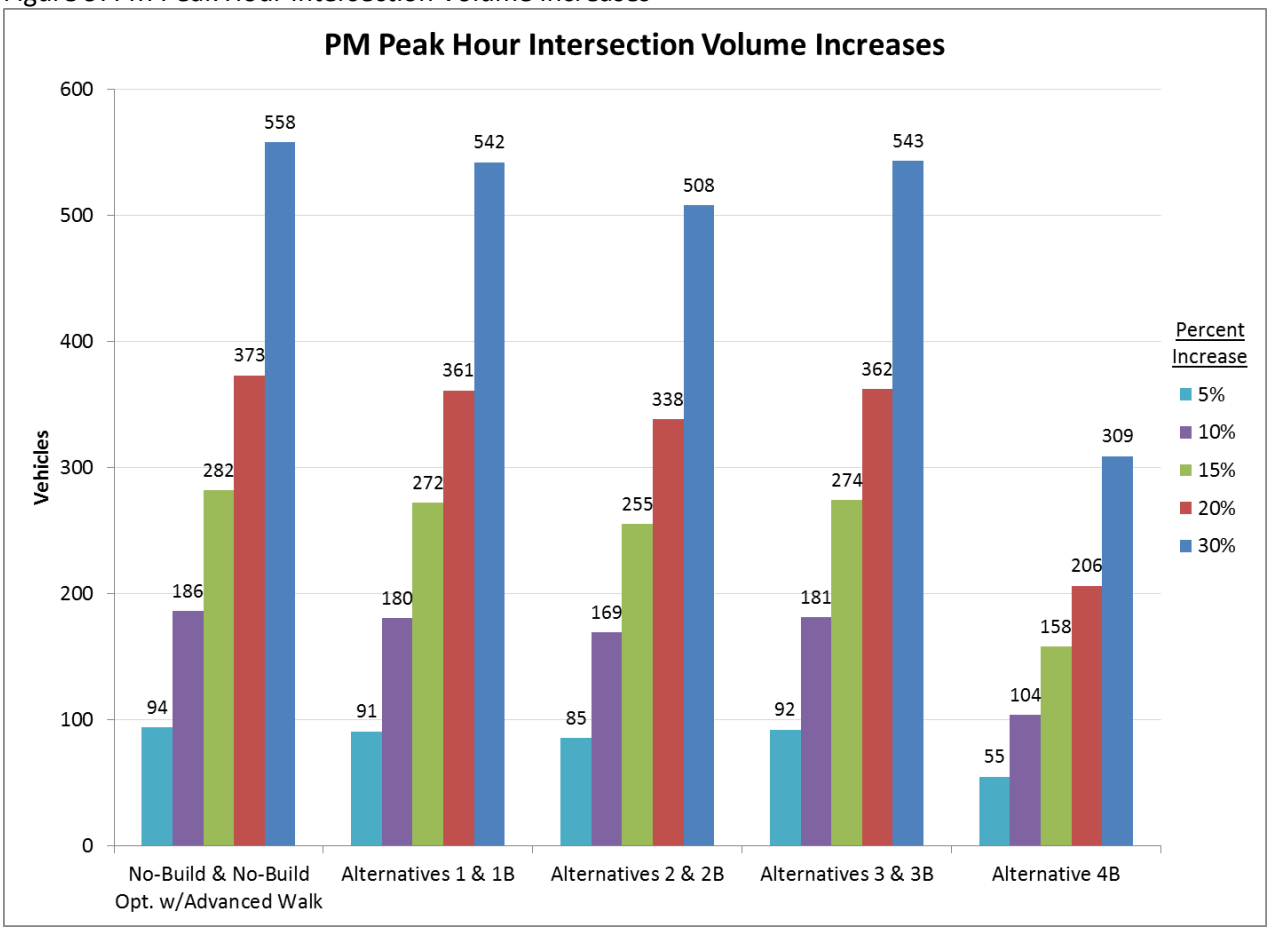


Figure 9 on the following page shows the PM peak hour intersection volume increases for each alternative by their respective percentage increase. Differences between each alternative are due to the redistribution of traffic onto new streets.

It was previously shown in Table 4 that, from an overall intersection perspective, the alternatives did not exhibit problems until a 30% increase in traffic was reached. Tables 5 and 6 on the following pages look more closely at each approach lane to reveal issues not seen at an overall level.

Figure 9: PM Peak Hour Intersection Volume Increases



Note: "B" alternatives have the same volumes as their numbered counterparts as the only change is the advanced walk pedestrian phasing.

Table 5: No-Build Alternatives Performance by Approach Lane

Alt.	Approach Lane	LOS						v/c					
		Percent Traffic Increase						Percent Traffic Increase					
		Base	5	10	15	20	30	Base	5	10	15	20	30
No Build	W. Lakeshore Dr Left	E	E	E	E	E	N/A for No Build	0.95	0.84	0.88	0.89	0.92	N/A for No Build
	W. Lakeshore Dr Thru/Right	A	A	A	A	A		0.53	0.52	0.53	0.56	0.58	
	Blakely Rd Thru/Right	D	D	E	E	F		0.94	0.92	0.96	1.03	1.07	
	Blakely Rd Left	B	B	B	C	C		0.09	0.09	0.1	0.11	0.13	
	E. Lakeshore Dr Thru/Left	D	E	E	E	E		0.35	0.42	0.42	0.43	0.44	
	E. Lakeshore Dr Right	C	C	C	C	C		0.21	0.22	0.23	0.24	0.25	
	Parking Lot Left/Thru/Right	D	E	E	E	E		0.21	0.28	0.28	0.3	0.32	
No Build Opt. w/ Adv. Walk	W. Lakeshore Dr Left	E	E	E	E	E	F	0.82	0.87	0.90	0.89	0.90	0.96
	W. Lakeshore Dr Thru/Right	A	A	A	A	A	A	0.49	0.52	0.54	0.56	0.57	0.60
	Blakely Rd Thru/Right	D	D	D	E	E	F	0.88	0.91	0.96	0.99	1.00	1.05
	Blakely Rd Left	B	B	B	B	B	B	0.08	0.09	0.10	0.11	0.11	0.13
	E. Lakeshore Dr Thru/Left	D	D	D	D	E	E	0.31	0.33	0.34	0.37	0.39	0.46
	E. Lakeshore Dr Right	C	C	C	C	D	D	0.21	0.24	0.29	0.35	0.41	0.50
	Parking Lot Left/Thru/Right	D	D	D	D	E	E	0.18	0.19	0.20	0.24	0.27	0.31

Table 6: Build Alternatives Performance by Approach Lane

Alt	Approach Lane	LOS						v/c					
		Percent Traffic Increase						Percent Traffic Increase					
		Base	5	10	15	20	30	Base	5	10	15	20	30
1	W. Lakeshore Dr/Laker Ln Left	D	E	E	E	F	F	0.78	0.86	0.87	0.91	0.95	1.03
	W. Lakeshore/Laker Ln Thru	A	A	A	A	A	A	0.46	0.48	0.50	0.52	0.54	0.58
	Blakely Rd Thru	C	C	D	D	D	E	0.83	0.85	0.90	0.92	0.95	1.00
	Blakely Rd Right	B	B	B	B	B	B	0.02	0.02	0.02	0.02	0.02	0.02
	E. Lakeshore Dr Left	F	F	F	E	F	F	0.72	0.74	0.82	0.62	0.77	0.76
	E. Lakeshore Dr Right	C	C	C	D	D	D	0.19	0.20	0.21	0.22	0.23	0.29
1B	W. Lakeshore Dr/Laker Ln Left	D	D	D	E	E	F	0.73	0.77	0.81	0.86	0.93	0.96
	W. Lakeshore/Laker Ln Thru	A	A	A	A	A	A	0.46	0.48	0.49	0.51	0.53	0.56
	Blakely Rd Thru	C	D	D	D	D	D	0.87	0.89	0.91	0.92	0.94	0.99
	Blakely Rd Right	B	B	B	B	B	B	0.02	0.02	0.02	0.02	0.02	0.02
	E. Lakeshore Dr Left	D	D	D	E	E	F	0.47	0.49	0.52	0.55	0.56	0.70
	E. Lakeshore Dr Right	C	C	C	C	C	D	0.19	0.20	0.26	0.33	0.39	0.49
2	W. Lakeshore Dr/Laker Ln Left	D	D	E	E	E	F	0.76	0.84	0.87	0.88	0.92	0.97
	W. Lakeshore/Laker Ln Thru	A	A	A	A	A	A	0.42	0.44	0.45	0.47	0.48	0.52
	Blakely Rd Thru	C	C	C	D	D	E	0.85	0.85	0.87	0.91	0.92	0.98
	Blakely Rd Right	B	B	B	B	B	B	0.02	0.02	0.02	0.02	0.02	0.02
	E. Lakeshore Dr Left	E	F	F	F	F	F	0.62	0.74	0.77	0.76	0.82	0.92
	E. Lakeshore Dr Right	C	C	D	D	D	D	0.16	0.16	0.17	0.19	0.20	0.26
2B	W. Lakeshore Dr/Laker Ln Left	C	D	D	D	E	E	0.72	0.76	0.79	0.80	0.84	0.93
	W. Lakeshore/Laker Ln Thru	A	A	A	A	A	A	0.41	0.43	0.44	0.45	0.46	0.50
	Blakely Rd Thru	C	C	C	D	D	D	0.86	0.88	0.89	0.91	0.91	0.94
	Blakely Rd Right	B	B	B	B	B	B	0.01	0.02	0.02	0.02	0.02	0.02
	E. Lakeshore Dr Left	D	D	D	D	E	E	0.54	0.56	0.51	0.51	0.61	0.53
	E. Lakeshore Dr Right	C	C	C	C	C	D	0.19	0.20	0.23	0.29	0.34	0.45
3	W. Lakeshore Dr Left	D	E	E	E	F	F	0.78	0.82	0.85	0.89	0.93	0.98
	W. Lakeshore Dr Thru/Right	A	A	A	A	A	A	0.50	0.51	0.53	0.56	0.58	0.62
	Blakely Rd Thru/Right	D	D	D	E	E	E	0.91	0.86	0.91	0.95	0.99	1.05
	Blakely Rd Left	B	B	B	B	B	B	0.09	0.08	0.09	0.11	0.12	0.14
	E. Lakeshore Dr Thru/Left	D	E	E	E	E	E	0.12	0.13	0.14	0.13	0.13	0.16
	E. Lakeshore Dr Right	C	D	D	D	D	D	0.16	0.17	0.18	0.19	0.20	0.22
	Parking Lot Left/Thru/Right	D	E	E	E	E	E	0.40	0.40	0.41	0.43	0.45	0.57
3B	W. Lakeshore Dr Left	D	D	D	E	E	F	0.71	0.77	0.82	0.87	0.91	0.94
	W. Lakeshore Dr Thru/Right	A	A	A	A	A	A	0.47	0.49	0.51	0.54	0.56	0.58
	Blakely Rd Thru/Right	C	C	C	D	D	D	0.85	0.86	0.88	0.91	0.94	0.97
	Blakely Rd Left	B	B	B	B	B	B	0.07	0.08	0.08	0.09	0.10	0.11
	E. Lakeshore Dr Thru/Left	D	D	D	D	D	E	0.13	0.14	0.16	0.13	0.13	0.14
	E. Lakeshore Dr Right	C	C	C	C	D	D	0.19	0.22	0.28	0.34	0.39	0.50
	Parking Lot Left/Thru/Right	D	D	D	E	E	E	0.43	0.44	0.46	0.40	0.42	0.51
4B	W. Lakeshore Dr Left	C	C	C	D	C	C	0.61	0.65	0.68	0.75	0.62	0.68
	W. Lakeshore Dr Thru/Right	A	A	A	A	A	A	0.31	0.33	0.34	0.37	0.36	0.39
	Blakely Rd Thru/Right	B	B	B	B	C	C	0.62	0.64	0.67	0.70	0.73	0.77
	Blakely Rd Left	B	B	B	B	B	B	0.04	0.04	0.04	0.04	0.05	0.05
	E. Lakeshore Dr Thru/Left	C	C	C	C	C	C	0.40	0.44	0.46	0.29	0.33	0.36
	E. Lakeshore Dr Right	B	B	B	B	B	B	0.11	0.11	0.12	0.13	0.13	0.14
	Parking Lot Left/Thru/Right	C	C	C	C	C	C	0.28	0.33	0.33	0.23	0.26	0.30

Discussion of Results

The benefits of implementing an advanced walk can be seen when comparing the build alternatives and their respective "B" counterparts. Benefits include decreased vehicle delay (LOS improvements) and increases in available capacity (v/c ratio decreases). The benefits become more pronounced as traffic volumes increase as shown in Figure 8.

Alternatives 1/1B and 2/2B move traffic away from Malletts Bay and better connect Bayside Park to Bayside Beach by removing the intersection and offer modest congestion reduction. Congestion is essentially moved to the new signalized intersection at Laker Lane and Blakely Road.

Alternative 3/3B achieves similar benefits as Alternatives 1/1B and 2/2B without building as many new roadways. Therefore it will likely have fewer land and environmental impacts along with the lowest construction costs of all the build alternatives. Following discussions with Town staff, a cost of $350 per linear foot (based on the Campus Connector construction) was used to estimate the cost of Alternative 3/3B. The length of new roadway was roughly measured to be 1,200 feet which yields an approximate construction cost of $420,000. It is important to note that this estimate does not include costs for engineering, property acquisition and permitting.

Alternative 4B provides the greatest reductions in traffic at the Bayside Park intersection. It will also be the most expensive of all build alternatives given the scale of the bypass. While detailed cost estimates were not calculated as part of this analysis, recent VTrans construction costs for new roadways of similar characteristics have ranged from 10 to 15 million dollars per mile[1]. These figures should not be applied to Alternative 3/3B due to the differences in roadway function, purpose, and design standards.

Recommendations & Preferred Alternative

CCRPC staff is recommending that prior to pursuing any build alternative the existing signal should be optimized and an advanced pedestrian walk implemented. The existing signal controller may need to be updated in order to facilitate the advanced walk feature. Given the age of the signal infrastructure, it is likely to require full replacement in the near future. This is estimated to be around $250,000 and would include upgrading to mast arms.

Alternatives 3B and 4B are recommended for land-use build out analysis to determine what scale of development could be implemented as a result of respective improvements. While 4B is likely unachievable in the foreseeable future for various reasons (e.g. cost, environmental impacts, permitting, etc.) it will provide some perspective for long term planning purposes.

Town staff has identified Alternative 3B as their preferred alternative. This alternative will establish a new grid street and provide access to an existing parcel owned by the Town. It offers beneficial traffic improvements without having to construct multiple new roadways.

[1] 2/13/2015 email correspondence with Ken Robie, VTrans. The ballpark estimate includes engineering, permitting, property acquisition, and construction.

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MEMORANDUM

TO: Sarah Hadd, Bryan Osborne, Kathi O'Reilly; Town of Colchester
FROM: Melanie Needle, Jason Charest, Sai Sarepalli; CCRPC Staff
DATE: August 17, 2015
RE: Bayside Build-Out Analysis (Memo 2 of 2: Land Use)

Overview

CCRPC staff worked with Town staff to evaluate multiple transportation alternatives in order to improve capacity at the Bayside Park intersection. Descriptions of all transportation alternatives can be found in Memo 1 of 2: Traffic. Alternatives 3B and 4B were the alternatives recommended for land use analysis. The purpose of the land use analysis was to determine the amount of development (in terms of new dwelling units and commercial floor area) that could occur given the increased capacity and additional trips that could be accommodated through the Bayside Park intersection as a result of the transportation improvements. This memo also estimates tax revenue associated with the additional development for Alternative 3B. The tax revenue estimates were not conducted for Alternative 4B because it was determined to not be feasible in the near term.

Description of Transportation Alternatives

Alternative 3B includes the addition of a connector street between East Lakeshore Drive and Blakely Road as well as an advanced walk signal at the Bayside Park intersection. The connector street creates a four-way intersection with Laker Lane and a new T-intersection with East Lakeshore Drive. There is no change made to the Bayside Park intersection.

Alternative 4B creates a bypass road that connects Heineberg Drive to Blakely Road (Heineberg-Blakely Bypass). The impetus for examining this alternative was sparked after reviewing preliminary traffic results with Town staff. Initial results of Build Alternatives 1-3 did not allow for a significant amount of additional capacity to be allocated to future development trips. The Heineberg-Blakely Bypass was previously envisioned in the West Lakeshore Drive Conceptual Development Plan[1] but its impacts to traffic were not examined. The bypass largely follows the former CIRC Highway alignment aside from where it veers to cross Malletts Bay Avenue and intersect with Blakely Rd. A companion north/south road from West Lakeshore Drive to the Heineberg-Blakely Bypass was also incorporated as part of this alternative.

Traffic models of Alternatives 3B and 4B indicate that they accommodate increased number of trips while achieving acceptable levels of service for motorists traveling through the Bayside Park intersection during the PM peak hour. The potential increase in the number of trips through the Bayside intersection opens up an opportunity for the Town to realize their goal of improving transportation functionality and creating an opportunity for residents, business, and visitors to

[1] West Lakeshore Drive Conceptual Development Plan, Town of Colchester, Vermont; April 2008

experience the Mallets Bay Area in a variety of ways. As stated in the 2008 Conceptual Development Plan for Mallets Bay opportunities for this area include:

- The creation of a community where residents, visitors and businesses can make the most of the waterfront;
- The redevelopment of a congested commuter thoroughfare into a welcoming, multi-modal, street; and
- The creation of a sense of place and identity for the area.

In addition, it is important to note that the land use scenarios presented in this memo are not intended to be a projection, proposal, or prediction of development that will actually utilize the Bayside Park intersection. The data and analysis in this study is for planning purposes only.

Land Use Scenarios

The intent of the land use component of this project is to translate the additional trip capacity achieved through transportation Alternatives 3B and 4B into dwelling units and commercial floor area. Town staff has identified Alternative 3B as their preferred alternative. This alternative will establish a new grid street and provide access to an existing parcel owned by the Town. It offers beneficial traffic improvements without having to construct multiple new roadways. Alternatively, 4B provides the greatest reduction in traffic, however, it will be the most expensive of the build alternatives given the scale of the bypass. Both alternatives were examined to estimate the type and amount of development that would generate additional trips within the study area using the methodology discussed below.

The West Lakeshore Drive Conceptual Development Plan, Town staff input, and the additional trip capacity achieved through the transportation alternatives provided the primary guidance for identifying land uses consistent with the Town's vision for this area. The additional trip capacity was the limiting factor for estimating new development. New development could not exceed the estimated 540 additional PM peak hour trips for Alternative 3B and 1,000 additional trips for Alternative 4B. Please note that the estimated trip numbers are assuming an even distribution throughout the project area during the PM peak hour and future development may impact the network differently than what was modeled. This does not negate the need for a more detailed transportation impact study.

With this as the framework, the number of trips and therefore the amount of new development, was split between 70% residential and 30% commercial uses. Within those broad land use categories further disaggregation was needed to get to the actual type of residential or commercial development. The trips allocated for residential uses were split evenly between single-family, multi-story, and Townhouse development. The trips allocated for commercial uses were split evenly between light industrial, retail, restaurant, and hospitality.

To convert from trips to development, the 8th Edition of the Trip Generation Manual from the Institute for Transportation Engineers was used. The Trip Generation Manual is a well-established publication that transportation planners and engineers use to estimate the number of vehicle trips

generated by a new commercial or residential project based on its floor area or number of dwelling units. In this project, the approach was reversed by converting vehicle trips to floor area and dwelling units. The floor area estimation was also used to determine increases in employment associated with more commercial development. This methodology gave an overall picture of the types of development that could emerge given the additional trip capacity estimated for 3B and 4B.

Tables 1 and 2 provide the results of the land use analysis for Alternatives 3B and 4B, respectively. Table 3 reports the trip generation rates for each land use type. Multi-story and Townhouse residential development has a greater potential because the trip generations from these land use types are lower than that of single-family homes. For commercial land use types, light industrial land use has the lowest trip rate compared to retail, restaurant, and hospitality thus creating more potential for light industrial floor area.

Considering that Alternative 4B includes a bypass road, Alternative 4B can accommodate almost double the amount of trips in the PM peak hour compared to Alternative 3B. When comparing Alternative 4B to existing conditions, 4B can accommodate an increase of 365% or 1,056 additional dwelling units and 65% or 136,255 square feet of commercial floor area. However, Alternative 3B could accommodate a 197% (570 dwelling units) increase in dwelling units and a 35% increase (73,578 square feet) in commercial floor area from existing development without the infrastructure costs and resource impacts associated with 4B.

The land use estimated for Alternative 3B seems reasonable and aligns with design standards and density conceptualized in the West Lakeshore Conceptual Development Plan. For example, the conceptual development plan suggests that there is significant opportunity on the Town-owned Bayside parcel, the 77-acre proposed mixed-use area, the Hazelett parcel, and the 30-acre waterfront area. The conceptual development plan also states that if the vision is implemented the Town's zoning regulations would need to be revised using a form-based approach to achieve the desired character and village-scale that is most appropriate for the area.

Table 1: Alternative 3B Additional Development

Total Residential Trips-70%	**Trips**	**Dwelling Units**	
Single Family	126	125	
Multi-Story	126	203	
Townhouse	126	242	
Total	378	570	
Total Commercial Trips-30%	**Trips**	**Floor Area (sq. ft.)**	**Employees**
Light Industrial	41	41,753	96
Retail	41	3,607	8
Restaurant	41	5,473	18
Hospitality	41	22,745	55
Total	162	73,578	178
Grand Total	**540**		

Table 2: Alternative 4B Additional Development

Total Residential Trips-70%	**Trips**	**Dwelling Units**	
Single Family	233	231	
Multi-Story	233	376	
Townhouse	233	449	
Total	700	1056	
Total Commercial Trips-30%		**Floor Area (sq. ft.)**	**Employees**
Light Industrial	75	77,320	179
Retail	75	6,680	15
Restaurant	75	10,135	33
Hospitality	75	42,121	103
Total	300	136,255	329
Grand Total	**1,000**		

Table 3: Average Trip end Rates for PM Peak Hour -"ITE Trip Generation, 8th Edition"

Trips per Res. Land Use Type	
Single Family	1.01
Multi-Story	0.62
Townhouse	0.52
Trips per 1,000 Sq. Ft of Non-Res	
Industry	0.97
Hospitality**	1.78
Restaurant	7.4
Retail Trips per 1,000 Sq. Ft.	
Specialty	3
Garden Center	4
Convenience Store	35
Apparel	4
Average	11.23
Trips per Employee	
Light Industry	0.42
Hospitality	0.73
Sq. Ft. per employee Non-Res	
Retail *	440
Restaurant*	310

**Assumptions derived from CCRPC Employment/CI Database*

***ITE Trip Generation assumes .58 trips per occupied room in the p.m. peak hour, Google search results say an average hotel room is 325 square feet*

Table 4: Annual Rate of Change- 20 Year Horizon

Use Type	Compound Avg Annual Rate of Change
Light Industrial	1.23%
Retail	0.34%
Restaurant	3.35%
Hospitality	19.20%
Single Family	2.34%
Multi Family	10.04%

Tax Revenue Analysis Alternative 3B

The tax revenue analysis estimates the potential revenue generated from the additional land use development for Alternative 3B. A comprehensive Return on Investment (ROI) analysis is not feasible at this time since information on increased spending for municipal services and additional students in the school system is unavailable. However, a cost estimate of constructing the new Alternative 3B roadway and upgrading the signal infrastructure was conducted and is shown in table 9 on page 8. Furthermore, the local tax rate used in this analysis is fixed despite that this analysis projects tax revenue over the next 20 years. A ROI analysis is necessary to help the Town make decisions about specific development plans.

The inputs to this tax revenue analysis are derived from the land use scenario described in the previous section for Alternative 3B, assessor data, and the CCRPC housing database. The inputs include the net development capacity for residential and commercial uses, average annual rate of change based on the future year development estimates, the FY2014/2015 tax rate, and average assessed values. It is important to note that the commercial tax estimates are likely low, as this analysis only considers the tax revenue on building floor area and not the total building and land value.

Tax revenues are estimated for both residential and commercial land uses in five-year increments until 2035. 2035 was chosen as the end year because planning projects typically look at a 20-year time horizon. Given this time horizon and a set amount of additional growth, the average growth rate for residential development is considerably higher than 2014 Town Plan's housing projections of 40 units per year Town wide. The Town plan is silent on projections related to commercial development. It is important to note that the growth rates can vary depending on the subsequent steps undertaken by the Town to realize the goals of the West Lakeshore Drive Conceptual Development Plan

Table 5 shows tax revenue estimates for both single-family development and for multi-family development. The tax revenue is broken out by different types of residential development because

multi-family units are typically a lower value as the ownership of the land is not included in the assessment. Whereas, the assessed value for single family homes includes both the building and land values. The average assessed parcel value (building value + land value) for single-family homes in the West Lakeshore Drive and Town Services neighborhoods is $275,861. The average assessed value for multi-family units is $155,223. Although the average assessed value for multi-family is lower, this land use type yields a higher overall tax revenue because there is a higher potential for multi-family units in the West Lakeshore Drive and Town Services neighborhoods. Given these differences in value and amount of development estimated for each type, the Town will likely see additional residential tax revenue of $21,437,680 over a 20-year period.

Table 5: Alternative 3B Residential Uses Tax Revenues

	Existing[1]	2015-2020	2020-2025	2025-2030	2030-2035	Total
Single Family						
Total Dwelling Units	212	238	267	300	337	337
Additional Dwelling Units		26	29	33	37	125
Assessed Value on Additional Dwelling Units		$ 7,170,264.66	$ 8,049,376.65	$ 9,036,272.37	$ 10,144,166.67	$ 34,400,080.35
Cumulative Tax Revenue on Additional Dwelling Units		$ 715,090.49	$ 1,517,854.83	$ 2,419,042.27	$ 3,430,720.01	$ 8,082,707.61
Multi-Story/Townhomes						
Total Dwelling Units	77	124	201	324	522	522
Additional Dwelling Units		47	76	123	199	445
Assessed Value on Additional Dwelling Units		$ 7,336,350.31	$ 11,839,452.90	$ 19,106,591.04	$ 30,834,348.86	$ 69,116,743.11
Cumulative Tax Revenue on Additional Dwelling Units		$ 731,654.22	$ 1,912,402.85	$ 3,817,903.18	$ 6,893,012.79	$ 13,354,973.04
Single Family and Multi Family Units and Associated Tax Revenue (municipal + school)						
Total Dwelling Units	289	362	468	624	859	859
Additional Dwelling Units		73	105	156	235	570
Assessed Value on Additional Dwelling Units		$ 14,506,614.97	$ 19,888,829.55	$ 28,142,863.41	$ 40,978,515.53	$ 103,516,823.46
Cumulative Tax Revenue on Additional Dwelling Units		$ 1,446,744.71	$ 3,430,257.68	$ 6,236,945.45	$ 10,323,732.80	$ 21,437,680.65

1-CCRPC Housing Points, 2013

Note: Tax Revenue is based on 2014/2015 total tax rate (municipal + education)

Table 6 shows tax revenues for additional commercial floor area. As stated earlier, the tax revenue shown only considers that revenue gained from additional floor area and does not include land value. As such, the estimated tax revenue on additional floor area is extremely low. Even though the overall revenue projections are low, the hospitality land use yields the highest revenue. This is due in part to high average assessed value per square feet of floor area and the minimal impact hospitality uses have on the transportation network. For example, the Trip Generation Manual estimates that the number of trips per 1,000 sq. ft. of hotel is 1.78 whereas retail uses generate 11.23 trips per 1,000 sq. ft. The average trip end rates for the other uses are seen in Table 3. Given these differences in value and amount of development estimated for each type, the Town will likely see additional commercial tax revenue of $125,382 over a 20-year period (understanding that this figure is likely very low without the land value included).

Table 6: Alternative 3B Commercial Uses Tax Revenue

	Existing	2015-2020	2020-2025	2025-2030	2030-2035	Total
Light Industrial						
Total Floor Area (sq. ft.)	150,198	159,697	169,796	180,534	191,952	191,952
Additional Floor Area (sq. ft.)	-	9,499	10,099	10,738	11,417	41,754
Assessed Value on Additional Floor Area	-	$ 135,900.01	$ 144,494.55	$ 153,632.63	$ 163,348.61	$ 597,375.80
Cumulative Tax Revenue on Additional Floor Area	-	$ 2,860.42	$ 5,901.74	$ 9,135.40	$ 12,573.57	$ 30,471.14
Retail						
Total Floor Area (sq. ft.)	51,766	52,645	53,539	54,449	55,373	55,373
Additional Floor Area (sq. ft.)	-	879	894	909	925	3,607
Assessed Value on Additional Floor Area	-	$ 44,210.31	$ 44,961.18	$ 45,724.82	$ 46,501.42	$ 181,397.72
Cumulative Tax Revenue on Additional Floor Area	-	$ 930.54	$ 1,876.88	$ 2,839.30	$ 3,818.06	$ 9,464.78
Restaurant						
Total Floor Area (sq. ft.)	5,872	6,923	8,162	9,622	11,345	11,345
Additional Floor Area (sq. ft.)	-	1,051	1,239	1,461	1,722	5,473
Assessed Value on Additional Floor Area	-	$ 69,404.56	$ 81,825.35	$ 96,469.00	$ 113,733.30	361,432.22
Cumulative Tax Revenue on Additional Floor Area	-	$ 1,460.83	$ 3,183.09	$ 5,213.57	$ 7,607.43	$ 17,464.91
Hospitality						
Total Floor Area (sq. ft.)	699	1,682	4,048	9,741	23,442	23,442
Additional Floor Area (sq. ft.)	-	983	2,366	5,693	13,701	22,743
Assessed Value on Additional Floor Area	-	$ 87,915.64	$ 211,566.75	$ 509,130.01	$ 1,225,208.42	$ 2,033,820.82
Cumulative Tax Revenue on Additional Floor Area	-	$ 1,850.45	$ 6,303.51	$ 17,019.67	$ 42,807.86	$ 67,981.49
Grand Total						
Total Floor Area (sq. ft.)		220,947	235,545	254,347	282,112	282,112
Additional Floor Area (sq. ft.)		12,412	14,598	18,802	27,765	73,577
Assessed Value on Additional Floor Area		$ 337,430.52	$ 482,847.84	$ 804,956.45	$ 1,548,791.75	$ 3,174,026.56
Cumulative Tax Revenue on Additional Floor Area		$ 7,102.24	$ 17,265.22	$ 34,207.94	$ 66,806.91	$ 125,382.31

Note: The tax revenue shown here does not consider the full-assessed value of a commercially developed parcel due to analysis limitations. The tax revenue shown only considers that revenue gained from additional floor area and does not include land value. Additional floor area may not exactly line up with floor area amounts reported in the land use scenario section due to rounding. Tax Revenue is based on 2014/2015 total tax rate (municipal + education)

Table 7: Average Assessed Value

Use Type	Average Assessed Value
Light Industrial	$ 14.31
Retail	$ 50.28
Restaurant	$ 66.05
Hospitality	$ 89.42
Single Family	$ 275,861.00
Multi Family	$ 155,223.53
*Note:commercial uses are per sq. ft.	

Cost Estimate for Alternative 3B

Table 9 on the following page shows the cost estimate for constructing the roadway between Blakely Rd. and East Lakeshore Drive and for replacing the signal infrastructure at the Bayside intersection. It is important to note that these estimates do not include costs for engineering, property acquisition and permitting. The total cost for these transportation improvements is about 6% of the total revenue the Town will likely see with increased development.

Table 9: Total Transportation Improvement Cost

Cost		Percent of Revenue
Alternative 3B Construction	$ 420,000.00	1.95%
Signal Infrastructure	$ 250,000.00	1.16%
Total	$ 670,000.00	3.11%

Conclusion

In summary, Alternative 4B can accommodate an increase of 365% more dwelling units (1,056 dwelling units) and 65% (136,255 square feet) more commercial floor area. Alternative 3B could accommodate a 197% (570 dwelling units) increase in dwelling units and a 35% increase (73,578 square feet) in commercial floor area from existing development, without the infrastructure costs and resource impacts associated with 4B. Assuming the full development is realized, residential and commercial development for Alternative 3B will likely generate a minimum of $21,563,062.
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As stated previously, Town staff has identified Alternative 3B as their preferred alternative. Alternative 3B meets many of the recommendations stated in the West Lakeshore Drive Conceptual Plan. In particular, the plan states that the vision set for the West Lakeshore Drive Corridor cannot become a reality unless traffic levels are addressed. Alternative 3B will establish a new grid street and provide access to an existing parcel owned by the Town. It offers beneficial traffic improvements without having to construct multiple new roadways. The additional trip capacity created enables additional development to happen without further reducing transportation functionality.

The land use estimated for Alternative 3B seems reasonable and aligns with design standards and density conceptualized in the West Lakeshore Conceptual Development Plan. The conceptual development plan also states that if the vision is implemented the Town's zoning regulations would need to be revised using a form-based approach to achieve the desired character and village-scale that is most appropriate for the area. Thus, this study provides the Town with a solid framework for considering the implementation steps needed to transform the West Lakeshore Corridor from a "congested commuter thoroughfare" to one that includes a mix of uses that attract both residents and visitors to stay, live, work, and play.