MEMORANDUM

To: Dan Bradley, Burlington Transportation Plan Staff
From: Lucinda E. Gibson, P.E. and Norman Marshall
Date: 19 April 2007
Re: Complete Streets Engineering Plan

Included in our tasks for the Burlington Transportation Plan is the development of street design guidelines that will promote a multimodal transportation system that is supported by the public and the Steering Committee. The "Multimodal Scenario" embraced by the Steering Committee emphasizes walking, biking, and transit, including:

- Priority high frequency direct bus routes with longer service hours;
- Improved pedestrian crossings and network;
- Complete on-road bicycle network; and
- Lowered traffic speeds to promote walking and bicycle safety and level of service, especially downtown.

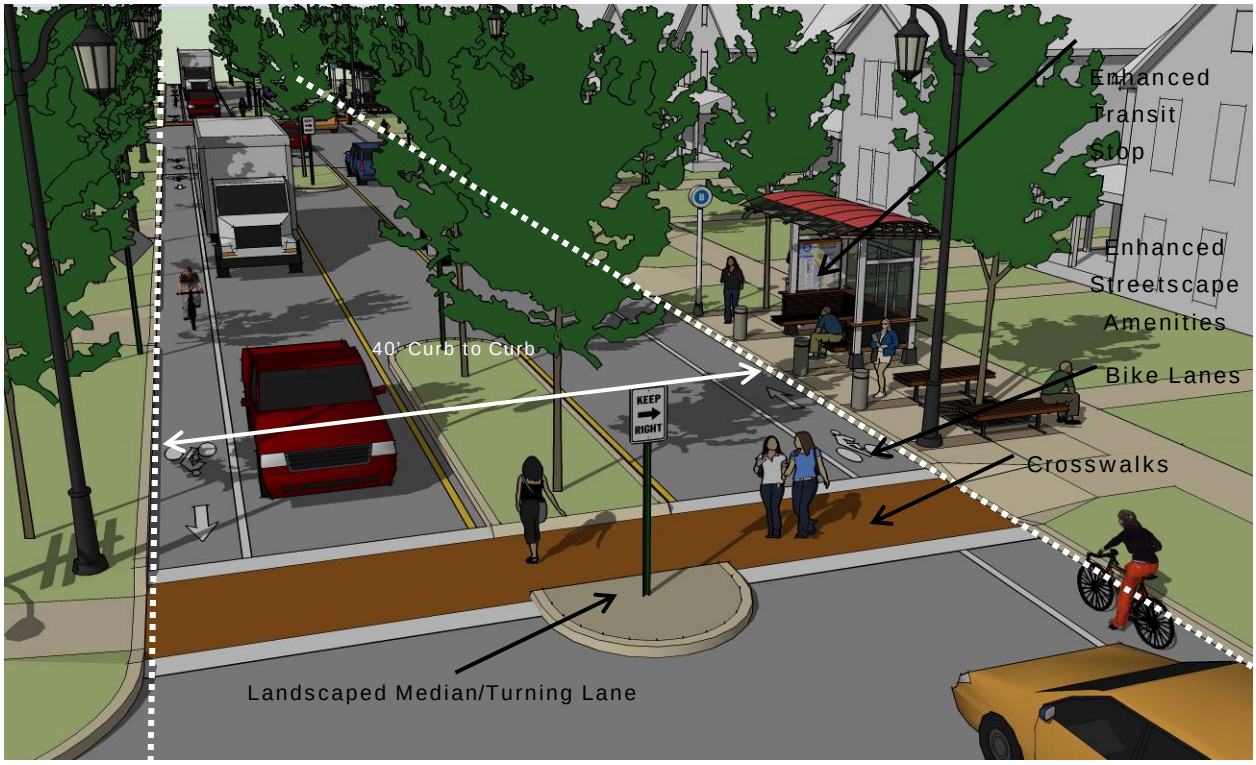
Towards this end, we have proposed street classification scheme that includes "complete streets" designation for some of the major corridors entering the core area of Burlington. The goal will be to establish reasonable service and conditions for all modes of transportation on these corridors. The challenge will be to accomplish this goal in a manner that is affordable and feasible.

Several of the corridors that have been identified in the draft street design guidelines as "complete streets" are currently configured as a four lane, 40 foot wide arterial, including sections of Shelburne Road, North Avenue, Battery Street, South Winooski, and Colchester Avenue. For these corridors, one possible treatment would be conversion to a three lane cross section with bike lanes, as an affordable way to convert these to "complete streets". In each case, a full scoping study would be conducted, including more detailed traffic analysis to weigh the various alternatives. In this memo, I am presenting a very preliminary analysis for Colchester Avenue as a candidate for this conversion.

The figures on the following page show a typical existing condition on a four lane, 40 foot wide urban street. This basic condition is found on sections of North Avenue, Battery Street, Colchester Avenue, Shelburne Road, and South Winooski Street. Following that is a proposed conversion to a multimodal street, within the existing curb-to-curb width. The proposed cross section includes bike lanes, two travel lanes, and a central median or left turn lane, depending on the needs and accesses.

Typical Existing Condition: 4 lane urban arterial within a 40 foot curb-to-curb width.

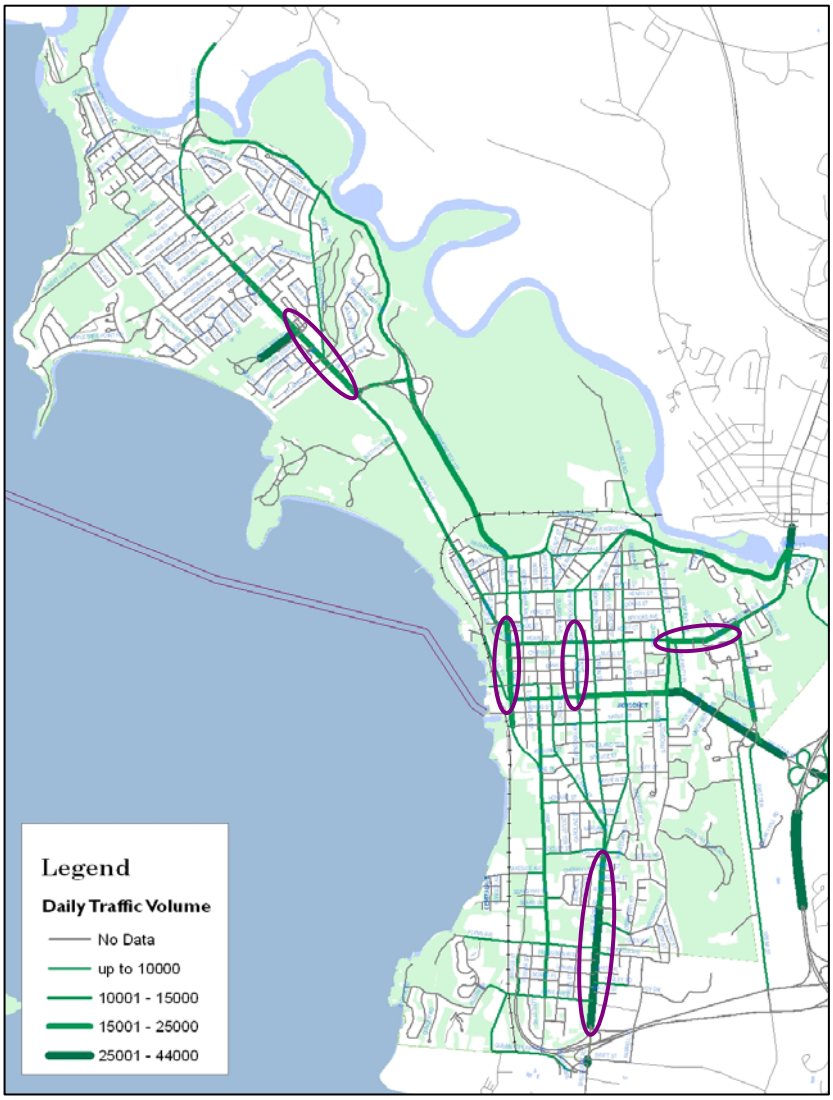
Proposed Conversion to a Complete Street:



This treatment is increasingly common for four lane arterials nationally, and is sometimes referred to as a "road diet". Four lane cross sections are an obsolete design, and are fraught with flaws in how they operate:

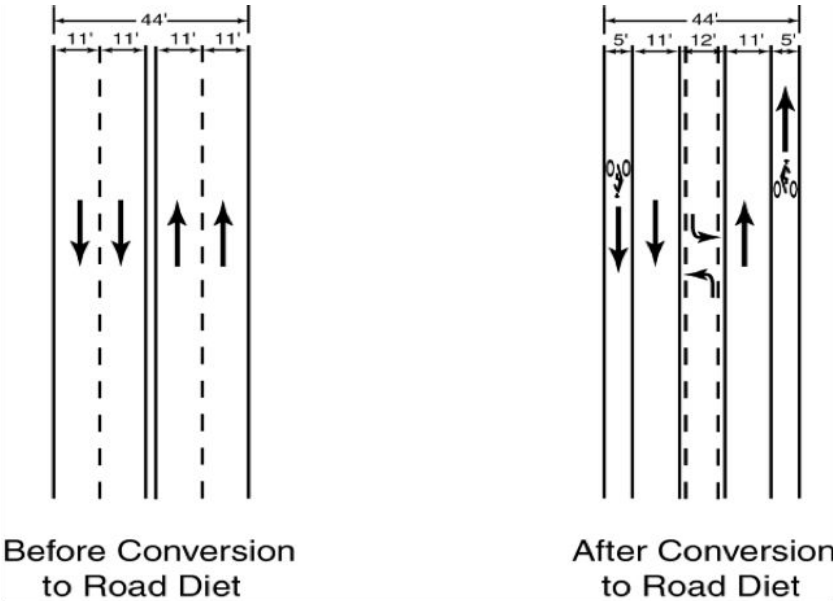
- Mid-block left turns block the left lane, effectively reducing the capacity.
- Through traffic sometimes makes excessive lane changing maneuvers to avoid following slower moving vehicles, which results in high crash rates and inefficient use of the travel lanes.
- Bicycle lanes are not provided, and bicycle conditions are dangerous due to high vehicle speeds.
- Pedestrians are more at risk crossing these wider streets because they cannot easily see traffic in the outside lane, and vehicles cannot see pedestrians.

Design solutions to address these problems include adding a left turn lane and bike lanes to the street cross section. To maintain two travel lanes in each direction, plus a left turn lane and bike lanes, the street right-of-way would need to be substantially expanded. The resulting conditions would be even worse for pedestrians, who would continue to be exposed to relatively high speed traffic, and have to negotiate even wider street widths. On the other hand, a conversion to a three lane cross section with bike lanes can be easily accomplished within the existing common 40 feet width, and will greatly improve conditions for bicycles and pedestrians. The following sections of Burlington arterials are potential candidates for conversion to a three lane. We recommend that a detailed traffic analysis be conducted for candidate locations for a four to three conversion.

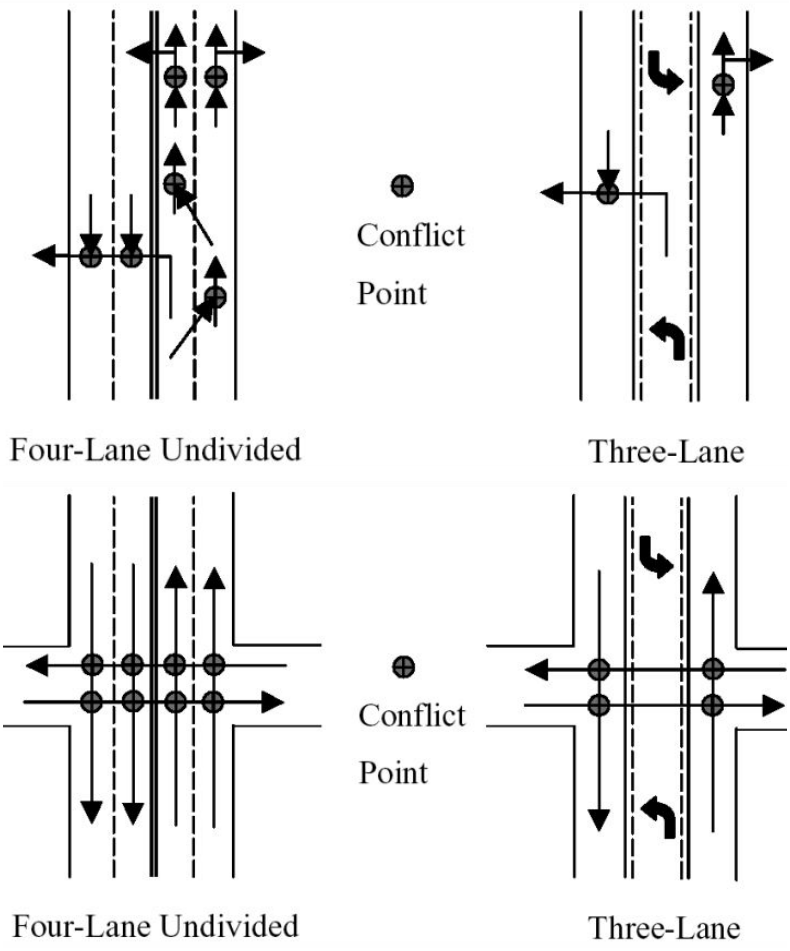


Arterial	From	To	Daily Traffic Volume
Colchester Ave.	East Ave.	North Prospect St.	20,000
Battery St	Pearl St.	Main St.	15,230
South Winooski St.	Pearl St.	Main St.	12,900
Shelburne Rd.	So. Willard/Locust/Ledge	I-189	22,700
North Avenue	Ethan Allen Shopping Center	127 Connector	19,120

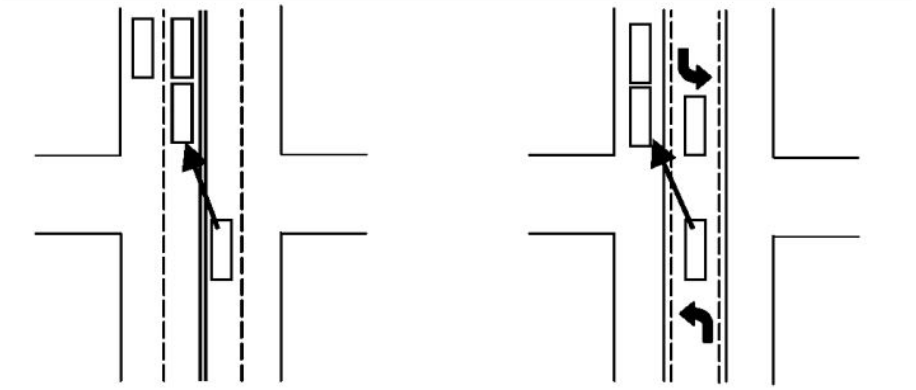
The following graphics show schematic examples of a four to three lane conversion



The benefits of the road diet conversions include increasing safety by reducing conflict points at intersections. Actual experience with these conversions has shown substantial reductions in vehicle crashes.



The road diet also results in much better visibility of on-coming traffic. This improves vehicular safety, as well as pedestrian safety.



Four-Lane Undivided
(Outside Lane Traffic Hidden)

Three-Lane
(No Outside Lane Traffic to Hide

The following photographs illustrate examples of four to three lane conversions. These conversions allow additional landscaping opportunities, far safer crossings for pedestrians, and traffic flow at more moderate speed, as passing is eliminated, yet turning blockage is eliminated with the left turn lanes.

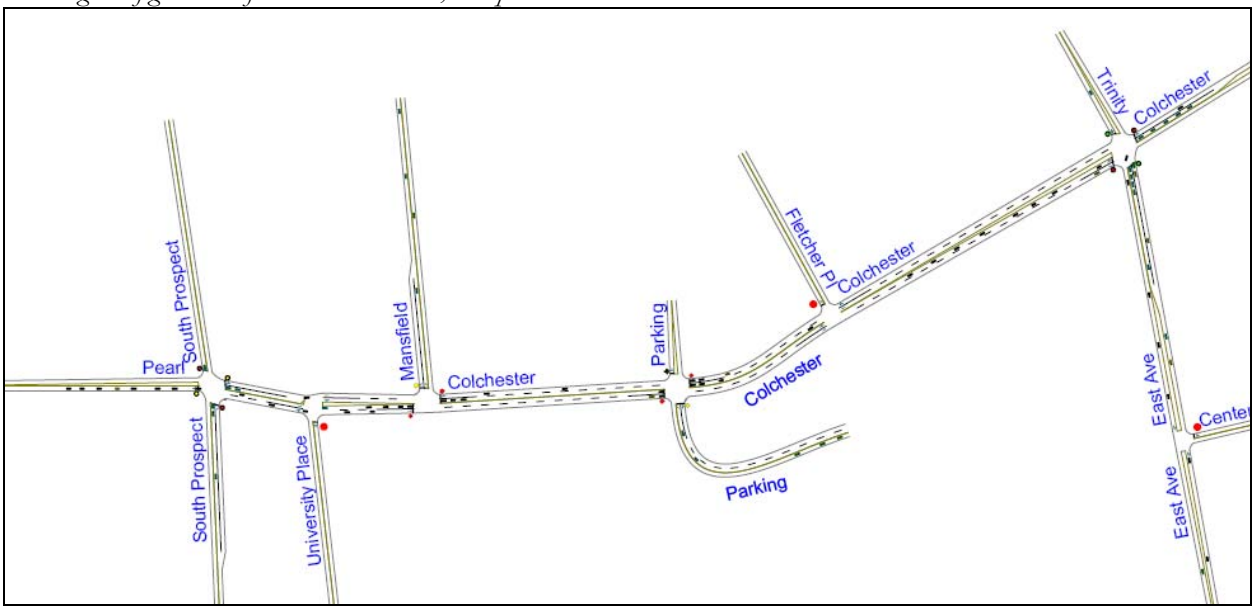
Olympia, Washington – former 4 lane arterial

Lake Washington Boulveard, Kirkland, Washington: ADT 21,000

Road Diet Candidate Analysis

This section presents an analysis of Colchester Avenue to determine the feasibility of a road diet for the four lane portion of this road. This analysis could be conducted for all potential road diet candidates in the transportation plan, if desired. Using recent traffic counts from CCMPO, morning and afternoon peak hour traffic volumes are available to conduct this analysis.

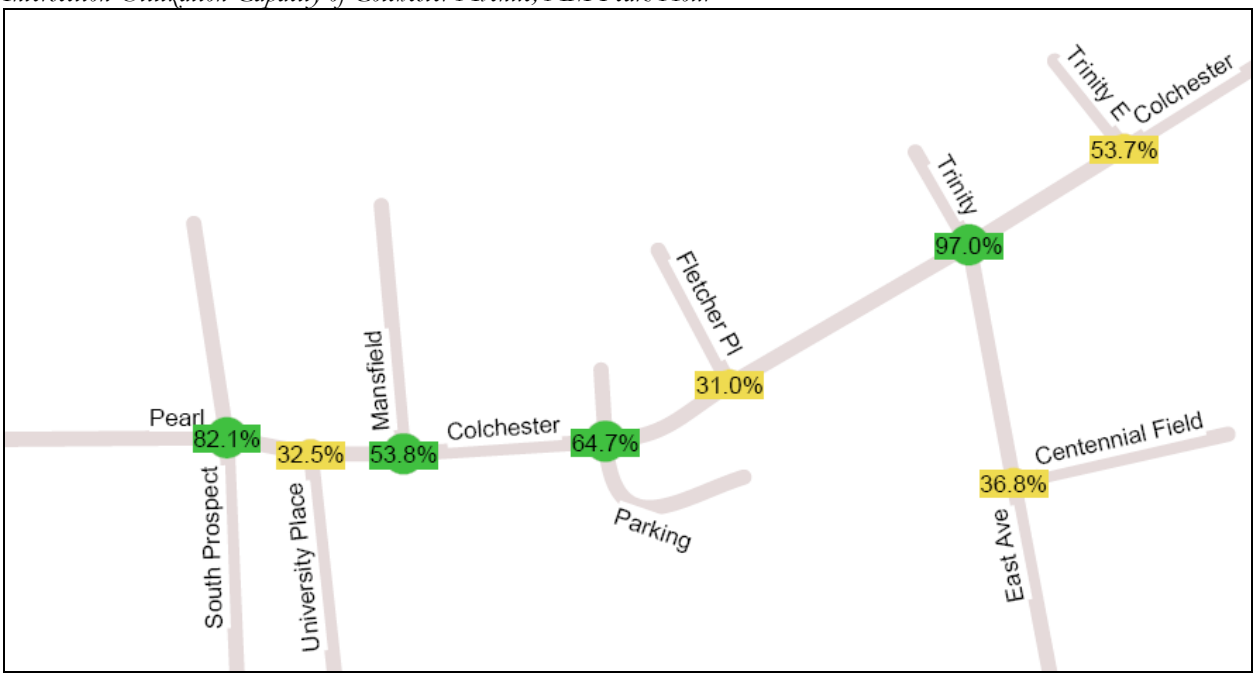
Existing Configuration of Colchester Avenue, Prospect to East Avenue



It is important to realize that the four lane section of Colchester Avenue serves traffic that is essentially "metered" at various points outside this area, in particular at the intersection of Colchester and Riverside Avenues. Therefore, peak hour traffic volumes along this corridor are unlikely to grow significantly unless there are capacity increases at these metering points.

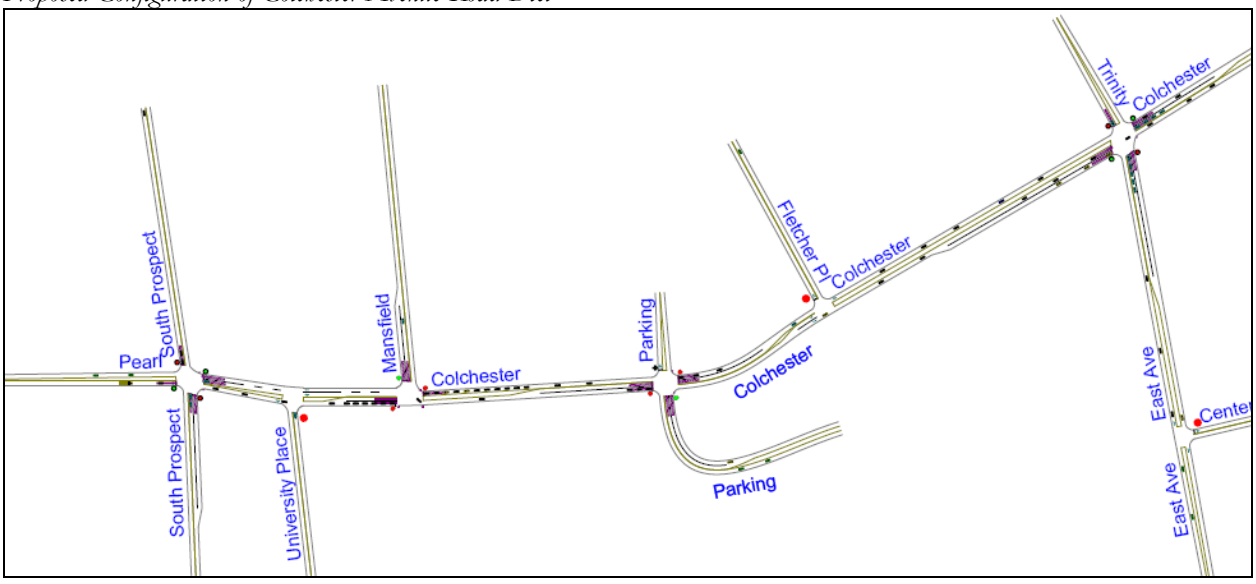
The following figure shows the "Intersection Capacity Utilization" for the AM peak hour for the corridor intersections for the existing street conditions. (100% indicates that intersection if at capacity)

Intersection Utilization Capacity of Colchester Avenue, AM Peak Hour

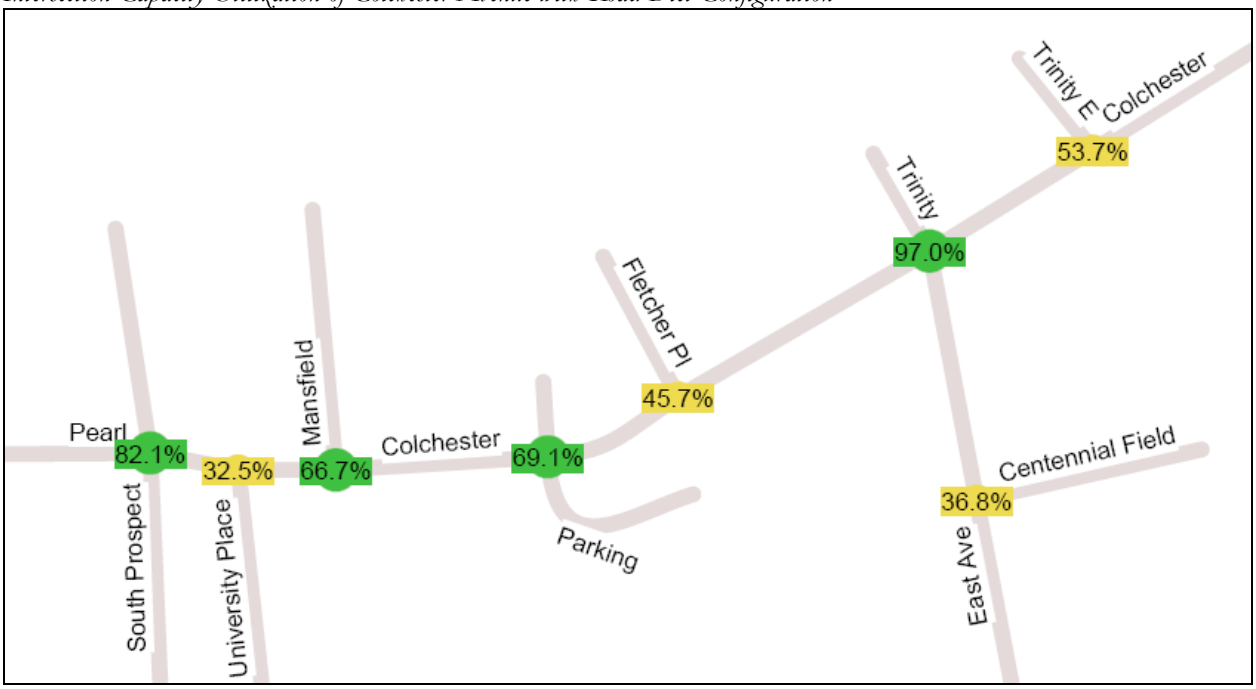


The above figure shows that the primary bottleneck in the corridor is the Colchester/East Avenue intersection, which is at 97% of its capacity. The remaining intersections all have some available capacity. The figure below shows the proposed "road diet" configuration, and intersection capacity utilization. The intersection capacity of the two end points, East Ave/Colchester and Prospect/Pearl/Colchester, do not change, as the geometry remains as it is currently.

Proposed Configuration of Colchester Avenue Road Diet



Intersection Capacity Utilization of Colchester Avenue with Road Diet Configuration



The traffic operations for the existing configuration were compared to the three lane configuration using Synchro and SimTraffic software. This is a very preliminary analysis, conducted merely for comparison purposes, as these models have not been calibrated to match existing conditions. The following table shows the results for the morning peak hour. Additional runs for the afternoon peak hour can also be conducted.

Measure	Existing Four Lane	Three Lane Conversion	Change
Travel Time (hr)	91.4	103.2	13%
Average Speed (mph)	18.1	15.8	-12%
Total Stops	4,692	4,252	-9%
Stops/Vehicle	1.5	1.36	-9%
Fuel Used (gal)	140.8	139.8	-1%
HC Emissions (g)	390	365	-6%
CO Emissions (g)	14910	12051	-19%
NOx Emissions (g)	1228	1085	-12%

The results show a small increase in travel time through the corridor, and corresponding small decrease in average travel speed. The number of vehicle stops actually decreases with the four to three lane conversion, due to the left turn lanes that are provided. Fuel consumption and air pollutant emissions decrease with the three lane conversion, due to the lower number of stops and slower speeds. These changes in traffic operations should be weighed against the greater safety for bicyclists and pedestrians along this corridor that would be provided by a three lane cross section, as well as other goals of the City regarding energy consumption and greenhouse gas emissions.