transportation master plan element
burlington, massachusetts

recommended plan
draft final report

Prepared for

Master Plan Committee
Burlington Planning Board
Town of Burlington, Massachusetts

August 1994

mcdonough & scully, inc.
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part 1 introduction
**Introduction**

Developing the transportation and circulation element of the Burlington Master Plan included an extensive study leading to the short and long range plans for meeting the transportation needs of the community. The intent of the Master Plan Committee was to conduct a comprehensive assessment of all modes of transportation culminating in a complete program to guide transportation activity in the Town during both the short and long time periods. This goal was accomplished through this effort. Two public forums were conducted during the course of the study prior to developing the transportation plan. Figure 1 illustrates the overall study process that included three major technical tasks prior to developing the recommended plan.

- **Tasks 1:**
  - **Inventories**
    - roadway
    - transit
    - ped/bike
    - capacity
    - safety
  - **Assessing needs**
    - current
    - future
  - **Public participation and input**

- **Tasks 2/3:**
  - **Evaluate alternatives**
    - roadway capacity
    - safety
    - transit
    - demand management
    - system management
    - neighborhood safety

- **Tasks 4/5:**
  - **Prepare plan**
    - strategies/actions
    - costs
    - timeframe
    - funding potential

Objectives of the transportation study included:

- identifying present and future traffic and circulation problems and needs;
- determining suitable and feasible measures to ameliorate existing inadequacies and to minimize future transportation deficiencies, with a logical sequencing and timing of improvements and actions, including an identification of costs and funding sources;
- enhancing opportunities for alternative modes of travel including ride sharing, public transit, walking and bicycling; and,
- developing realistic traffic and transportation actions which are fully compatible with the Town's Master Plan.

**Study Process**

The initial task consisted of an inventory and analysis of the transportation facilities and services including roadway, transit, pedestrian and bicyclist. Task 1 included a compilation of various traffic data such as volumes, accidents and physical conditions. All the major roadway corridors were
 incorporated into the study. The existing public transportation service was also evaluated in the initial task. The final key item in the first study task was to forecast potential traffic volumes based on a buildout of land under current zoning. The detailed results of Task 1 are documented in Technical Report No. 1, inventory and analysis.

A series of problems and needs identified in Task 1 became the basis of study in Task 2 which focused on developing alternative improvements to the roadway system. These included individual intersections as well as entire corridors facing capacity, safety and management deficiencies. Also considered were the general physical conditions of roadways and adjacent sidewalks. The alternatives ranged from simple, low cost measures (i.e. pavement markings, signing, and circulation changes) that can be implemented in the short term to more capital intensive projects which require longer periods of time to implement. Travel demand management (TDM) actions including transit, ridesharing, and bicycling were included Task 3, however, as major roadway alternatives were developed, the applicability of TDM in terms of design and/or operations were taken into consideration. Technical Report No. 2, roadway alternatives, described the evaluation in detail.

Task 3 specifically addressed travel demand management (TDM). TDM is defined as strategies and actions intended to reduce or spread out the demand of private, single occupant vehicles. It is made up of a number of different types of strategies including but, not limited to ridesharing, public transit, bicycling, land use management, and parking. The TDM task included conducting research on various types of TDM actions and determining their potential for application in Burlington. The task also included conducting an employee travel survey at several key employers located in Burlington. Technical Report No. 3, travel demand management, summarizes the findings of the research and surveys as well as the potential actions for the Town to consider.

Tasks 4 and 5 represented finalizing the results from previous tasks to formulate the draft and final plans, respectively. The plan outlines strategies, specific actions, schedules for implementation, estimated costs and potential funding sources. The draft plan was prepared with input and suggestions from the residents and business community solicited during the process through the public forums. Following additional review by the Committee, the draft plan will be finalized and presented to the public.

**organization of this report**
This report represents the culmination of months of work focused solely on the transportation system in Burlington. Part 2 of the report includes a brief summary of the existing and future conditions followed by a description of the recommended transportation plan. Part 3 presents conceptual plans and mapping of preferred actions. The basis for developing the plan is addressed in the various technical reports completed under each study task. These are included in Parts 4 through 6. Relevant data and other information are included in the technical appendices.
part 2  executive summary &  recommended plan
the recommended transportation plan

The Burlington Transportation Study was initiated by the community as part of the overall master plan development process. Transportation infrastructure and service are generally recognized as key components of a community's character and consequently, become key components in the master plan. The transportation plan was developed by the Master Plan Committee with assistance from the consultant and Town staff. The process included: examining existing and future traffic conditions assuming no improvements; evaluating various roadway and demand management/transit options; and, based on the analysis results, preparing a plan that will be used as a guideline for the next 10 years or more. The study also integrated public participation through several public forums. In the next several pages, key highlights from the analyses are presented prior to the description of the recommended plan.

existing conditions

Part of the analysis focused on the major roadways in the community and the key intersections and segments along the roadway. The inventory and analysis of current conditions revealed that many congestion and safety problems exist on the major roadways while TDM and transit related activities have had a limited impact on peak period travel at the present time.

The major corridors of Middlesex Turnpike, Cambridge Street and Winn Street all carry volumes in excess of 20,000 vehicles per day creating serious congestion and delay. This is more pronounced on the northern section of Middlesex Turnpike and several sections of Cambridge Street, where each roadway operates as a two lane facility. The high volumes on each of these north-south roadways also result in substantial delay to side street traffic attempting to enter the major roadway and contribute to the diversion of some traffic onto the more minor roadways in an effort to avoid the congested locations.

Roadways such as Bedford Street, Center Street and Lexington Street, with generally east-west orientations, function with a greater emphasis to locally generated (i.e. Burlington) traffic. While important roadways, they do not experience the volume levels of the north-south corridors and consequently, the levels of congestion along the routes are lower.

In addition to the congested locations, twelve (12) intersections in the community were identified on the Massachusetts Highway Department's high accident listing. An additional five locations appeared problematic based on recent accident experience reported by the Burlington Police Department. Figure 2 summarizes the current roadway deficiencies.

In addition to roadway conditions, transit networks and facilities to accommodate pedestrians and bicycles were also reviewed. While the Town is well covered in terms of geography by either the MBTA or the town's own B-Line Bus service, use of transit to commute to and from the work place located in Burlington is low. The B-line service is not presently geared to meeting the needs
summary of roadway deficiencies

transportation master plan
burlington, massachusetts

not to scale
figure 2
of the work commuter. The routes are circuitous resulting in long trip times making its use unattractive in relation to the work trip. At the time of this inventory, there was no public commuter service to Burlington from outlying areas. Within the past six (6) months, a transit connection to the Mishawum Station in Woburn is being provided under the auspices of the North Suburban Transportation Management Association. In addition, limited service provided by the Lowell Regional Transit Authority has recently been authorized. However, coordination among all providers is lacking.

The analysis of sidewalks or bike routes/storage facilities in relation to the communities residential areas and key land uses (i.e. schools, parks) showed many discontinuities in the sidewalk system. Although a local bike committee is working towards developing an initial bike path in Town located off Mountain Road and other areas, there is a lack of bicycle facilities within the Town at the present time.

**future conditions**

Evaluation of future build out conditions in terms of traffic flow indicated a substantial potential growth in traffic volumes could occur along Middlesex Turnpike, Cambridge Street, Bedford Street, Blanchard Road and others. The analysis indicated that on two lane sections of Middlesex Turnpike, Cambridge Street and Winn Street, the demand would exceed capacity, assuming a daily capacity of a two lane being in the 20,000 to 25,000 vehicles per day range. Figure 3 illustrates estimated changes in traffic volumes on various roadways considering both the buildout and the full occupancy of currently planned or standing buildings. The analysis of projected volumes shows that without major changes in the roadway network, buildout conditions will result in a demand on sections of Middlesex Turnpike and Cambridge Street in excess of 40,000 vehicles per day. Other sections of these roadways as well as Burlington Mall Road and Winn Street are projected to carry between 28,000 and 41,000 vehicles per day. The two lane roadways are generally inadequate to efficiently accommodate these high levels of demand. At these levels, severe congestion will occur along the roadways, substantial delays will be incurred by motorists attempting to exit side streets or driveways, and additional diversion onto more locally oriented streets is highly probable.

In summary, the analysis of existing and future transportation conditions revealed that while the Burlington transportation system including roadways and alternative travel services is fairly extensive, there is a need for improvements to the roadway and transit systems. Other demand management actions are also appropriate. Several roadway locations currently experience severe congestion or are considered high accident locations. Without improvements, the future growth will tend to exacerbate these locations and create additional problems. While TDM and transit will not necessarily resolve all the problems created by the high demands, they must also become an integral part of the transportation improvement plan as there will also be ultimate limits on roadway construction. The recommended plan must consider the effect actions have not only on traffic flow but it must also consider costs, environmental constraints, property, existing residential areas, and other goals of the community.
During Tasks 2 and 3, various roadway, TDM and transit options were identified and evaluated. The alternative actions were extensively reviewed by the master plan committee as well. Public forums were held at key points in the process to gather citizen input and suggestions. As outlined in the next section, the recommended plan attempts to balance the transportation needs and impacts of meeting those needs.

The recommended transportation plan
The recommended plan included the development of specific actions for isolated intersections, typical treatments for corridors as a whole and strategies related to TDM and transit. The selection of alternatives has been based on the potential positive impact of the action, and the ability of the action to help satisfy the transportation goals and objectives developed as part of the study process. The goals are listed below while specific objectives that related to the goals can be found in the Task 2 report (see Part 5 of this document).
transportation goals

goal #1 promote a transportation plan and system that is intermodal and encourages safe, effective alternatives for travel, reduces the need to drive alone, and maximizes the integration of all modes.

goal #2 implement a transportation plan which is consistent with the community's economic and land use plan and which is sensitive to the needs of abutting communities in the region.

goal #3 create a transportation system that provides safe and efficient arterials to accommodate through movement and movement to major commercial and business centers while minimizing unnecessary traffic through neighborhoods.

goal #4 develop a transportation system that is cost-effective and affordable, that maximizes the use of federal and state transportation funds, that equitably incorporates private financing, and minimizes town expenditures.

goal #5 implement actions that minimize the negative impact on the community, the environment, and Town resources.

plan elements

With an understanding of the various transportation problems and the goals, a number of alternatives were developed, studied and discussed at the Committee level as well as during the public forums. The types of alternatives can be categorized into four basic areas:

- key intersection roadway safety and capacity
- major corridor improvements
- transportation system management (TSM), and
- travel demand management (TDM)

The key intersections addressed included high accident locations, locations where long delays occurred, or locations where awkward geometry existed and possibly contributed to the above problems. The major corridor actions considered the entire length or a long section of a particular roadway such as Cambridge Street. Transportation system management actions tend to focus on traffic engineering techniques that are relatively low cost and can be implemented in a short time frame such as signal timing, signing, and turn restrictions. Included in the TDM category are public transit, bicycling, ridesharing and regulatory actions. Table 1 summarizes the 1994 transportation recommended plan for the town of Burlington. Listed in the table are the actions, likely implementation times, estimated costs, priority schedule, and anticipated next steps.
<table>
<thead>
<tr>
<th>Location/Category</th>
<th>Recommended Action</th>
<th>Order of Magnitude Cost Estimate</th>
<th>Priority Schedule for Implementation</th>
<th>Anticipated Next Step</th>
<th>Potential Funding Program</th>
</tr>
</thead>
<tbody>
<tr>
<td>Middlesex Turnpike/Bedford Street</td>
<td>Upgrade signal, phasing and visibility, markings, sidewalks</td>
<td>$300,000</td>
<td>I</td>
<td>Design</td>
<td>CMAQ, STP</td>
</tr>
<tr>
<td>Middlesex Turnpike/Terrace Hall Ave</td>
<td>Upgrade signal, improve geometry, sidewalks</td>
<td>$250,000</td>
<td>II</td>
<td>Design</td>
<td>CMAQ, STP, MHD</td>
</tr>
<tr>
<td>Bedford Street/Terrace Hall Avenue</td>
<td>Improve alignment and geometry, install flashing beacon</td>
<td>$75,000</td>
<td>I</td>
<td>Design</td>
<td>CH90</td>
</tr>
<tr>
<td>Bedford Street/Francis Wyman Road</td>
<td>Provide left turn lane on Bedford Street, left and right turn lanes on Francis Wyman, sidewalks, flashing beacon</td>
<td>$75,000</td>
<td>II</td>
<td>Design</td>
<td>STP, CH90, MHD</td>
</tr>
<tr>
<td>Cambridge Street at Bedford Street</td>
<td>Upgrade signal equipment and visibility</td>
<td>$150,000</td>
<td>I</td>
<td>Design</td>
<td>STP, CMAQ</td>
</tr>
<tr>
<td>Winn Street at Center Street</td>
<td>Add signage, potential left turn lane on Winn Street, flashing beacon</td>
<td>$50,000</td>
<td>II</td>
<td>Design</td>
<td>STP, CH90</td>
</tr>
<tr>
<td>Winn Street at Mill Street</td>
<td>Improve visibility with signage, monitor for future signal control potentially install traffic signal</td>
<td>$20,000</td>
<td>I/II</td>
<td>Signage, Monitor</td>
<td>CH90, STP</td>
</tr>
<tr>
<td>Mill Street at Locust Street</td>
<td>Modify geometry to define Mill Street as through street</td>
<td>$20,000</td>
<td>I</td>
<td>Design</td>
<td>CH90, TWM</td>
</tr>
<tr>
<td>Peach Orchard at Winter Street</td>
<td>Modify geometry to define Peach Orchard as through street</td>
<td>$20,000</td>
<td>II</td>
<td>Design</td>
<td>CH90, TWM</td>
</tr>
<tr>
<td>Winn Street at Mountain Street</td>
<td>Improve geometry, sidewalks, visibility</td>
<td>$30,000</td>
<td>II</td>
<td>Study/Dev Concept</td>
<td>CH90, TWM</td>
</tr>
</tbody>
</table>

1. Construction costs only and does not include land acquisition, surveying or engineering.
2. Schedule: I - 1 to 5 years, II - 6 to 10 years, III - 11 to 15 years.
3. See Table 2 for description of funding sources.
<table>
<thead>
<tr>
<th>Location/Category</th>
<th>Recommended Action</th>
<th>Order of Magnitude Cost Estimate 1</th>
<th>Priority Schedule for Implementation 2</th>
<th>Anticipated Next Step</th>
<th>Potential Funding Program 3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Major Corridors</strong></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Cambridge Street</td>
<td>Redesign roadway with better definition, emphasis in streetscaping, sidewalks, bus turnouts, consolidate curb cuts upgrade and coordinate all traffic signals</td>
<td>$3M to $5M (total)</td>
<td>I</td>
<td>Design</td>
<td>SP</td>
</tr>
<tr>
<td></td>
<td>Route 128 to Bedford Street - 4 lanes, 52' cross-section</td>
<td></td>
<td>I/III</td>
<td>Design</td>
<td>SP</td>
</tr>
<tr>
<td></td>
<td>Bedford Street to Skilton Lane or Wilmington Rd - 4 lanes with median</td>
<td></td>
<td>III</td>
<td>Design</td>
<td>SP</td>
</tr>
<tr>
<td></td>
<td>or Turn Lane, North of Wilmington - 2 lanes with median or Turn Lane</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Middlesex Turnpike/Route 3</td>
<td>North of Lexington Street - provide turn lanes as appropriate, sidewalks, curbing, streetscaping, bus turnouts</td>
<td>$500,000</td>
<td>II</td>
<td>Design</td>
<td>SP</td>
</tr>
<tr>
<td></td>
<td>Pursue direct access to Route 3 - at 2nd Avenue</td>
<td>$15M to 30M</td>
<td>II</td>
<td>Justification/Approval</td>
<td>NHS, MHD</td>
</tr>
<tr>
<td></td>
<td>Feasibility Study of Extending North Avenue to Route 42</td>
<td>$40,000</td>
<td>II</td>
<td>Study</td>
<td>CH90, HWH, PS</td>
</tr>
<tr>
<td>Bedford Street</td>
<td>Maintain 2 lanes, consistent cross-section, improve sidewalks, curbing, visibility of isolated locations</td>
<td>$100,000</td>
<td>I</td>
<td>Design</td>
<td>CH90</td>
</tr>
<tr>
<td>Wheeler Road/Blanchard Road</td>
<td>Redesign Wheeler Road to connect with van de Graf</td>
<td>$2M to 3M</td>
<td>II</td>
<td>Design</td>
<td>PWED, CH90, PS</td>
</tr>
<tr>
<td></td>
<td>Provide 2 lanes approximately 40 feet wide cross-section separate Wheeler/Van de Graf from from Blanchard/Muller</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Incorporate streetscaping, sidewalks, bikeway plan</td>
<td></td>
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</tr>
<tr>
<td>Winn Street</td>
<td>Monitor corridor volume/recent improvements</td>
<td>Minimal</td>
<td>I</td>
<td>Study</td>
<td>HWH</td>
</tr>
<tr>
<td>Center Street</td>
<td>Improve visibility of isolated locations</td>
<td>$100,000</td>
<td>II</td>
<td>Design</td>
<td>CH90</td>
</tr>
<tr>
<td></td>
<td>Improve definition, curbing and visibility</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

1. Construction costs only and does not including land acquisition, surveying or engineering
2. Schedule I - 1 to 5 years, II - 6 to 10 years, III - 11 to 15 years

Burlington Transportation Master Plan
<table>
<thead>
<tr>
<th>location/category</th>
<th>recommended action</th>
<th>order of magnitude cost estimate ¹</th>
<th>priority schedule for implementation ²</th>
<th>anticipated next step</th>
<th>potential funding program ³</th>
</tr>
</thead>
<tbody>
<tr>
<td>system management</td>
<td> </td>
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</tr>
<tr>
<td>traffic signal management study</td>
<td>inventory/evaluate all town owned signal equipment</td>
<td>$10,000 - $15,000</td>
<td>I</td>
<td>field evaluation</td>
<td>cmaq, ch90, twn</td>
</tr>
<tr>
<td>existing signal installations</td>
<td>update signal equipment</td>
<td>$75,000 - $200,000 each</td>
<td>I/II</td>
<td>design</td>
<td>ch90, twn, cmaq, hhs</td>
</tr>
<tr>
<td>Middlesex Tpke/Mall Road</td>
<td>develop closed loop, coordinated, computerized signal systems</td>
<td>$100,000</td>
<td>II</td>
<td>design</td>
<td></td>
</tr>
<tr>
<td>Cambridge Street</td>
<td>guide signing, bike routes, pedestrian crossings</td>
<td>$10,000</td>
<td>I</td>
<td>designate/install</td>
<td>ch90</td>
</tr>
<tr>
<td>pavement management system</td>
<td>update system</td>
<td>$50,000</td>
<td>I</td>
<td>update/programming</td>
<td>ch90</td>
</tr>
<tr>
<td>access management</td>
<td>encourage driveway consolidation and appropriate design</td>
<td>minimal</td>
<td>I</td>
<td>update regulations</td>
<td>twn</td>
</tr>
<tr>
<td></td>
<td>refine traffic study requirements for private developments</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>demand management</td>
<td> </td>
<td></td>
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</tr>
<tr>
<td>employer sponsored programs</td>
<td>continue dialogue with private businesses initiated through surveys</td>
<td>minimal</td>
<td>I</td>
<td>continued dialogue</td>
<td>ps</td>
</tr>
<tr>
<td></td>
<td>require major developers, employers to join the existing TMA</td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>require employers to encourage ridesharing or</td>
<td></td>
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<tr>
<td></td>
<td>participate in other TDM programs like guaranteed ride home</td>
<td></td>
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</tr>
<tr>
<td>public transportation</td>
<td>evaluate modifying B-line service to provide Intown commuter</td>
<td>$10,000</td>
<td>I</td>
<td>cost/service analysis</td>
<td>twn</td>
</tr>
<tr>
<td></td>
<td>routes and frequencies - seek employer participation</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>identify location in town center or on major corridor for</td>
<td></td>
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<tr>
<td></td>
<td>neighborhood travel center where coordination of all bus</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>service occurs</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>seek funding and conceptual development for neighborhood</td>
<td>$15,000</td>
<td>II</td>
<td>mpo communication</td>
<td>cmaq</td>
</tr>
<tr>
<td></td>
<td>travel center</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>investigate potential park and ride service from north through</td>
<td>$20,000</td>
<td>II</td>
<td>location decision</td>
<td>cmaq</td>
</tr>
<tr>
<td></td>
<td>existing private operators service Boston route</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>work with the MBTA on improving coordination of existing routes</td>
<td>minimal</td>
<td>I</td>
<td>MBTA discussions</td>
<td>n/a</td>
</tr>
<tr>
<td></td>
<td>develop B-line objectives annually and monitor progress</td>
<td>minimal</td>
<td>I</td>
<td>dev new objectives</td>
<td>n/a</td>
</tr>
<tr>
<td></td>
<td>provide midday shuttle on Burlington Mall Road corridor</td>
<td>$25,000/yr</td>
<td>I</td>
<td>and monitoring process</td>
<td>n/a</td>
</tr>
<tr>
<td></td>
<td>Install bus turnouts and shelters for bus stops along major arterials</td>
<td>n/a</td>
<td>II</td>
<td>MBTA request</td>
<td>cmaq, twn, sfp</td>
</tr>
</tbody>
</table>

¹ construction costs only and does not including land acquisition, surveying or engineering
² schedule: I - 1 to 5 years, II - 6 to 10 years, III - 11 to 15 years
### Table 1 (continued)

#### Summary of Burlington 1994 Transportation Plan Recommended Program

<table>
<thead>
<tr>
<th>Location/Category</th>
<th>Recommended Action</th>
<th>Order of Magnitude Cost Estimate</th>
<th>Priority Schedule for Implementation</th>
<th>Anticipated Next Step</th>
<th>Potential Funding Program</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public Transit (continued)</td>
<td>support transit service connection between Town and Mishawum Station and Logan Express, continue to improve marketing of b-line and other transit services to residents and employees of town</td>
<td>$50,000/yr</td>
<td>I</td>
<td></td>
<td>cmaq, ps, twm</td>
</tr>
<tr>
<td>Town TDM Actions</td>
<td>work with existing TMA in support of demand management actions on local and regional levels, eliminate sidewalk discontinuities giving priority to areas leading to schools, public parks, and high volume roadways</td>
<td>n/a</td>
<td>I</td>
<td>participate at Board mtgs</td>
<td>n/a</td>
</tr>
<tr>
<td></td>
<td>highlight pedestrian crossing locations on major arterials through signing, improved markings, lighting and different texture surface set priorities and begin implementation of bike plan through signing, markings, information maps, and construction</td>
<td>$15-20/foot</td>
<td>II</td>
<td>prioritize /program</td>
<td>cmaq, ch90, twm</td>
</tr>
<tr>
<td></td>
<td>provide bike storage racks at all public facilities and require new developments to provide bike racks, storage lockers and building showers, investigate feasibility of areawide advance traveler information system including pre-trip info and electronic message boards</td>
<td>n/a</td>
<td>VII</td>
<td>prioritize /program</td>
<td>cmaq</td>
</tr>
<tr>
<td></td>
<td>continue to evaluate parking issues in order to determine the: level of parking needs for town residents who commute, location of parking for resident commuters, possible development of fringe parking policy for business centers, local requirements/needs II regional parking facility is located off route 128</td>
<td>$20,000</td>
<td>II</td>
<td>study / MHD discussions</td>
<td>cmaq, lvhs</td>
</tr>
<tr>
<td>Regulatory</td>
<td>modify site plan approval regulations to ensure TDM</td>
<td>minimal</td>
<td>I</td>
<td>modify regulations</td>
<td>n/a</td>
</tr>
<tr>
<td></td>
<td>modify regulations to allow ancillary retail and commercial use in existing office center, encourage building layout in office and business parks to allow for convenient pedestrian movement among various buildings</td>
<td>minimal</td>
<td>I</td>
<td></td>
<td>n/a</td>
</tr>
</tbody>
</table>

1. Construction costs only and does not include land acquisition, surveying, or engineering.
2. Schedule: I· 1 to 5 years, II· 6 to 10 years, III· 11 to 15 years.
Figure 4 summarizes the roadway plan. As indicated in the table, there are ten (10) locations within the community recommended for intersection level improvements including new signalization, modification of geometry and the enhancement of visibility and overall safety at the location. The total estimated construction costs for these 10 locations is approximately $1,100,000. They address four of the locations considered high accident or potentially hazardous. Most of these locations can be addressed in the short to medium timeframe (i.e. 2 to 6 years). Most are eligible for state or federal construction funding. Typically, the costs for design and land takings are borne by the community. Preferred conceptual plans that provide guidelines for design for seven of these locations were prepared and are included in Part 3 of this report.

Six (6) corridors are also listed in Table 1. The corridor recommended for the most extensive level of improvement is the Cambridge Street corridor followed by the Middlesex Turnpike/Route 3 corridor. Cambridge Street was divided into 3 sections and recommendations have been made for each section. Improvements for the section from Route 128 to Bedford Street include providing a consistent four lane cross-section to accommodate two lanes per direction. Between Bedford Street and Skilton Lane or possibly Wilmington Road, a four lane section with a raised median or left turn lane where needed is recommended. North of Skilton Lane, two through lanes are generally sufficient for the present time and a center median with left turn lanes provided as needed has been suggested. Upgraded traffic signals or new signals would be provided at Burlington High School, Bedford Street, Winn Street, and Skilton Lane (or Murray Avenue Extension) and Francis Wyman Road. Traffic signal coordination is recommended for the entire corridor. Each section would include streetscaping, sidewalks, sufficient shoulder room to accommodate bicyclists, and bus turnouts/shelters as appropriate. The cost for the entire corridor is estimated in the range of $3 Million to $5 Million. The improvements can be staged and scheduled over time. Several alternative concepts for the section between Winn Street and just north of Skilton Lane have been developed and are included in Part 3. Final design plan would need to be refined from these concepts and require working with the abutters.

The focus of Middlesex Turnpike recommendations are to provide relief through new connections to both Route 3 or Route 62. Traffic engineering improvements to the section north of Lexington Street are also recommended. The analysis completed during the development of the Transportation Plan indicated that it would be highly desirable and effective to improve a direct connection between Route 3 and Middlesex Turnpike. One option recommended for continued study is a modified interchange system between the existing Route 128/Route 3/Middlesex Turnpike interchange and a new connection at Second Avenue. The Route 3 access/egress ramp would also be extended to Middlesex Turnpike opposite Wheeler Road. In addition, it is recommended that the potential for extending of North Avenue or a new service road to Bedford Street be studied in detail in terms of location, property impacts, design criteria and costs. Together, these major improvements to the corridor help to relieve the current roadway congestion, reduce the need for adding capacity to the Turnpike and better accommodate the long range economic development objectives of the community in the lower Middlesex Turnpike corridor area. If these major improvements can be realized, then the improvements to Middlesex Turnpike between Lexington Street and Bedford Street would generally consist of providing an
summary of recommended roadway improvements

transportation master plan
burlington, massachusetts
alternating left turn lane or a center two way left turn lane, upgrading existing signalized intersections, installing right turn lanes at key locations, and providing for sidewalks and bus turnouts along the corridor. The feasibility study for extending North Avenue is estimated to be $40,000. The new connection/interchange with Route 3, Route 128, Middlesex Turnpike, and Second Avenue is estimated to range between $20 Million and $30 Million. If approved in concept by the Massachusetts Highway Department (MHD), it would be eligible for federal aid. This action requires federal concurrence and approval for a "break in access" as well. Work on the section of the corridor north of Lexington Street is estimated to be $500,000 assuming the improvement consists of turn lanes and amenities such as those just described. The cost does not include the key intersection upgrades or improving the signal coordination.

The final major corridor improvement program concerned the Wheeler Road/Blanchard Road corridor. This corridor currently services an area that has limited development with a hotel, and several office buildings. However, this area has a very high potential for major growth in the future. Besides serving this office and commercial zone, Wheeler Road presently connects with the adjacent residential area via the Muller Road intersection. As part of past development proposals, the idea has been formed to revise Wheeler Road to connect with a new street (Van de Graf Drive) and be physically disconnected from Blanchard Road as well as Muller Road. As part of this 1994 Transportation Plan, it is recommended that this concept continue to be pursued through public implementation and private participation where possible. The new Wheeler Road/Van de Graf Drive roadway is recommended to be a two lane roadway (40 feet in width) with sidewalks, streetscape and a bicycle path within the right of way. The small bridge in the vicinity of Middlesex Turnpike will have to be reconstructed as part of the future improvement. The estimated cost for this corridor project is $2 Million to $3 Million not including the bridge related work. It is scheduled to be implemented in the medium term (i.e. 6 to 10 years).

The other corridors included in the Table: Bedford Street; Center Street; and, Winn Street; are recommended for general maintenance and minor improvements to curbing, visibility, sidewalks, etc. The two lane cross-sections that presently exist are to remain under the Plan. Minor increases in width to allow a wider shoulder for bicycle travel should be considered on any rehabilitation project. Winn Street is to be monitored, however, recognizing that a recent improvement project was implemented between Route 128 and Center Street. While the need may exist in the future for more than two lanes of through travel, it is hoped that, by upgrading the other north-south corridors, the need for added capacity on Winn Street would be diminished. There may, however, be isolated locations, such as at Center Street or at Mill Street, where improvements such as turn lanes, signalization and minor geometry are necessary in the short to medium time frame.

While the listing under the transportation system management (TSM) category is relatively short in contrast to the other categories, it is by no means less important. The key action under TSM is to upgrade all existing signal equipment into a modern, flexible and efficient system. The major corridors require signal coordination improvements. It is recommended that a closed loop, computerized signal system be envisioned for the Town. New installations would conform to the
system level equipment and be added to the system. Early action should be taken on the key corridors such as Cambridge Street, Burlington Mall Road and Middlesex Turnpike. Other TSM actions will include signing for various items including motorist guidance, and information and warning signs as appropriate. TSM principals such as improved driveway definition and control of the number of driveways are also evident in the various improvements at intersections or along the corridors as described in the above paragraphs such as modifying driveway openings and improving overall access management along the corridors.

The final major category of the recommended transportation plan concerns travel demand management of TDM. TDM is generally thought of as a set of actions designed to reduce the amount of vehicular traffic during either the peak period of travel or on a daily basis. It encompasses public transit, ridesharing, parking, encouraging other modes such as walking and bicycling, reducing peak demand by altering travel times, and modifying the land uses to further encourage these actions. While the study has recognized that TDM alone will not fully resolve the significant safety and congestion problems on the major roadways, there are a number of opportunities where TDM can be implemented and have a positive effect on travel. As outlined in Table 1, some of these actions will require the cooperation of employers while the Town must take the initiative on others. Employer sponsored actions recommended at this time relates to requiring membership in the existing North Suburban Transportation Management Association (TMA). Requirements would be made at the time the company or developer is advancing through the local planning (or site plan review) approval process. One benefit of TMA membership tends to be an assessment of the employee travel characteristics and the initiation of a company ridesharing program or other alternative modes programs to address its transportation needs. For alternative modes to work effectively, the employers must provide a guaranteed ride home (GRH) for emergency conditions. The Lahey Clinic is an example of TMA membership which is attempting to increase ridesharing, manage its parking and does participate in a guaranteed ride home program. It is recommended that the Town build and maintain good working relationships with the business community located in Burlington in order to cooperatively better manage transportation services.

There were several public transit recommendations as a result of the study. Actions include potential methods for making the B-line service more attractive for resident commuters and reducing midday vehicular travel in the high density employment areas. In addressing the former, a change in starting and ending times with related modifications to routes to meet the commuters workday schedules and to reduce the overall travel time on the bus to the work zones. The latter involves providing a midday shuttle on the Burlington Mall Road corridor. One deficiency identified in the evaluation of public transit was the lack of coordination among the different transit services. Consequently, it is recommended that routes be coordinated and a central location be selected for all transit services to make connections. These services include the B-line, the Railink, the MBTA bus routes and the service run by the Lowell Transit Authority. It is preferred that the location be in the Town Center area which may require some adjustments to the routes and schedules. It is also recommended that a neighborhood travel center be established, possibly at the location where all transit services will coordinate their respective routes. As envisioned, the center would be relatively small and service local needs only. It would be
desirable that the facility be accessible by foot, have bike storage facilities and possibly have a small number of parking spaces which would be restricted to residents only. Funding and the conceptual development for this center should be advanced.

Other transit related actions being recommended include continued monitoring and marketing the b-line service, working with the MBTA to improve local coordination and service, and installing bus turnouts and shelters on the major arterials. In addition, with a substantial portion of employees working in Burlington and living to the north along the Route 3 corridor, it is recommended that the potential park and ride service from the north including southern New Hampshire to the community's major activity centers be conducted and implemented if shown to be cost-effective.

The Town's TDM related actions relate to regulatory actions, physical changes and areas of future study. The Town should work closely with the North Suburban TMA in support of demand management actions on both the local and regional level. By actively participating, the Town's relationship with key employers will remain strong as well. The regulatory changes pertain to TMA membership requirements by companies and developers, requiring developers and companies to develop individual TDM plans to reduce traffic and parking needs, and allowing certain land uses or development patterns to occur that are more conducive to transit service and may reduce the reliance on the private automobile.

The Town should also continue to construct or reconstruct the sidewalks, eliminating discontinuities in critical areas such as school zones and parks, ensure proper visibility of pedestrian crossing areas (particularly on high volume roadways). It is also recommended that the Town begin implementing aspects of the bike plan including route designations, prepare mapping, and storage facilities at key locations such as public buildings, transit stops, etc. A proposed Townwide bike route map is included in Part 3. The Town on its own or with the TMA, should also investigate the feasibility of an area-wide advance traveler information system (ATIS) to serve the public and employees in the community. The ATIS would utilize new technologies to provide the traveler information before the trip begins and during the trip. With an ATIS, it is intended that decisions on when a trip occurs or by what route will be made on a more informed basis and congested times or roadways could be avoided.

Lastly, parking has a large effect on travel through and about Town. During the master plan study effort, a demand for parking by Burlington residents who commute south to work via transit was identified. There was also much discussion regarding a potential regional park and ride facility off Route 128 at the end of Route 3. The major developments in the community provide substantial amounts of parking to meet their respective needs, but this also results in high levels of vehicular movement along the major arterials to reach the parking facilities. While much discussion on these issues occurred during the study process, a complete resolution on the parking issues could not be accomplished. It is, however, recommended as an area for further study. The key focus of the studies and planning discussion should be to determine the level of resident commuter parking needs and where it best be located; the possible development of a long range fringe parking...
policy (i.e. abutting the major activity centers in close proximity to the major regional highways) to reduce local arterial congestion and enhance TDM; and, determine the local Town needs and required mitigation if the State ever advances the major regional park and ride facility near Route 128/Route 3.

prioritizing actions in the recommended plan
From Table 1, there are approximately 50 different actions recommended as part of the Burlington Transportation Master Plan. Implementation of each will require different levels of effort, involve different agencies or staff, and use funding from a variety of sources. Recognizing that the plan will be implemented over a relatively long period of time, the actions need to be prioritized for an initial guideline for expending resources. Priorities were generally developed for the actions by taking into account the following:

- high accident location
- right of way impacts
- time required to implement
- level of congestion
- satisfaction of goals/objectives
- environmental/social issues

Some of these considerations are related, however, they provide a basis for the decision making. The priority listing does not make decisions that any one action is more important than another. Rather, it is a priority schedule in that the recommended projects have been categorized into three basic timeframes for actual implementation: I for 1 to 5 year period, II for the 6 to 10 year period, and III for the post 10 year action. The timeframe is the anticipated actual implementation period. Certain projects will require design and environmental analysis prior to implementation and sufficient lead time will have to be included into the schedule by the town.

As can be seen in Table 1, most of the actions tend to fall within the first (1 to 5 years) or second (6 to 10 years) time period. This is due to several factors including the typical ability for most communities to schedule several projects per year, the design period for most of the roadway projects requires 12 months or less, and the demand management and system management are actions that can be initiated by Town staff in the immediate future.

Of the ten individual intersections listed, four are recommended for the short range period, while it is anticipated that the remaining six locations could be addressed in the mid-range timeframe. Highest priority intersections include Middlesex Turnpike at Bedford Street, Bedford Street at Terrace Hall Avenue, Cambridge Street at Bedford Street and Mill Street at Locust Street.

In terms of the major corridors, the Cambridge Street corridor is the highest priority. However, if the corridor is divided into three separate design projects for funding reasons, it is conceivable that it could take approximately 3 to 8 years to complete the entire corridor. The other actions scheduled with a higher priority are studies to examine the engineering and economic feasibility of extending North Avenue (or some variation) to Route 62 and a monitoring study of the recent Winn Street improvements.

Regarding Middlesex Turnpike/Route 3 corridor, the recommendations include a new direct
connection to Route 3 which will also require modifications to the Route 128 interchange. With this improvement, the section of Middlesex Turnpike north of Lexington Street is recommended to remain a two lane highway with left turn lanes and right turn lanes as appropriate. Recognizing the direct access issue is a major action requiring both State and Federal Highway approval, it is an action that requires immediate activity and coordination with State officials. However, it will also require the longest time to complete which is why it is scheduled as a long range (post 10 year project).

Other corridors are scheduled out over the mid to long range time periods such as rehabilitation work on Bedford Street or Center Street as well as developing the improved Wheeler Road/Blanchard Road network with Van de Graf Drive and Muller Road.

funding
One of the greatest challenges, considering the cost of the recommended actions in total, will be to secure funding for the improvements. The Intermodal Surface Transportation and Efficiency Act (ISTEA) of 1991 currently provides the best opportunity to meet the needs. However, to accelerate the implementation and recognizing the broad spectrum of the plan, it is essential that all potential State, local and private monies be considered. The following paragraphs summarize the more common sources of funding that are likely to be applicable for implementing the Burlington Transportation Plan. Table 1 outlines the potential sources of funding for each action. Table 2 summarizes the various funding sources currently available to the Town to pursue for implementing the recommended plan.

As stated, ISTE A provides the Town an excellent opportunity to fund a variety of projects. ISTE A, in contrast to previous funding bills, encourages flexibility and has designated funds for air quality improvement type projects such as transit and parking management as well as enhancement funds for such actions as bicycle facilities. The availability of these funds in the current ISTE A bill are anticipated to peak in the 1995-1996 time period for Massachusetts, however, Burlington must compete for them with other communities in the Metropolitan Boston region. It, therefore, behooves the Town to set priorities and move to advance several projects on an annual basis.

The first section of the Table indicates several programs related to the intermodal Surface Transportation and Efficiency Act of 1991 or ISTE A. The programs most likely to provide a large portion of construction funding for the Town is the Congestion Management/Air Quality (CMAQ) and Surface Transportation Program (STP). Transit related projects and other alternative mode projects such as ridesharing, parking and facility treatments are eligible for the same programs.

The State also tends to allocation its own funds towards some improvements. Typically this has included relatively low cost intersection and signal upgrade projects. Transportation Bonds have generally been passed every two to three years by the State Legislature to help finance the projects. Other State funds that exist have been either not fully funded for the past five years (PWED and Off-Street Parking) or are limited to planning studies and are not eligible for engineering nor construction aspects of projects.
Local aid (Chapter 90) provides a significant portion of funding for various improvements, particularly resurfacing and minor rehabilitation projects. These funds are not generally used to fund major, high cost capacity enhancement or safety related projects eligible for federal aid. The Chapter 90 funds can, however, be used for engineering studies and management/programming studies. Other local resources tend to be budget items or local bonds.

The private sector offers a substantial opportunity to aid in the development of the transportation plan. The Town of Burlington has worked closely with the private sector over the years to develop and implement various transportation improvements. These have largely been accomplished through developer negotiation rather than the other techniques listed in the Table 2.
### Table 2: Potential Transportation Funding Sources

<table>
<thead>
<tr>
<th>Funding Level/Name</th>
<th>Type of Projects Eligible/Notes</th>
</tr>
</thead>
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<tr>
<td><strong>Federal Programs</strong></td>
<td></td>
</tr>
<tr>
<td>National Highway System (NHS)</td>
<td>interstate and major highway projects - can shift up to 50% to Surface Transportation program (STP)</td>
</tr>
<tr>
<td>Surface Transportation Program (STP)</td>
<td>used for any surface transportation capital project on any roadway except those designated as local or rural collector - 10% of these funds set aside for safety and 10% set aside for enhancements - flexibility allows use in transit related and alternative mode projects</td>
</tr>
<tr>
<td>Congestion Management/Air Quality (CMAQ)</td>
<td>for projects in non-attainment areas that will contribute to an area's compliance with the Clean Air Act</td>
</tr>
<tr>
<td><strong>Mass Transit</strong></td>
<td>programs are generally funded through the flexibility provision of the above described programs - once project selected and funds to be committed, then the funds are administered as Federal Transit Authority (FTA) Sections 3, 9 and 18 funds, depending on type of project and location of project. Eligible projects include new buses and related equipment.</td>
</tr>
<tr>
<td>Intelligent Vehicle Highway Systems (IVHS)</td>
<td>projects include major demonstration in corridors that deploy IVHS technologies to improve travel - this may include preliminary engineering of advanced traffic management systems</td>
</tr>
<tr>
<td><strong>State Programs</strong></td>
<td></td>
</tr>
<tr>
<td>Transportation Bond/Trust funding (MHD)</td>
<td>the State Highway Department allocates some funds to assist the communities in upgrading the traffic signal equipment</td>
</tr>
<tr>
<td>Public Works Economic Development (PWED)</td>
<td>administered by the State Highway Department - awards grants to municipalities which are intended to leverage private investment due to providing sound and responsive transportation access and infrastructure - has not been funded</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>funding level/name</th>
<th>type of projects eligible/notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strategic Planning (STRT)</td>
<td>covers planning studies that address issues related to land use management, development planning and natural resource protection - Typically up to $30,000 - not for engineering</td>
</tr>
<tr>
<td>Off-Street Parking Program (PARK)</td>
<td>administered by the Executive Office of Administration and Finance - requires project to be part of a commercial area revitalization district - allows local match to be land - has not been funded in several years</td>
</tr>
<tr>
<td>Downtown Revitalization Program (DRP)</td>
<td>to assist communities in developing a coordinated effort to strengthen the economic vitality of the downtown and traditional central business districts - eligible projects include developing parking strategies, making streetscape improvements and planning for downtown economic development</td>
</tr>
<tr>
<td>Chapter 90 (CH90)</td>
<td>covers roadway resurfacing and reconstruction projects, pavement management studies, and design of improvements eligible for federal construction funds</td>
</tr>
<tr>
<td>General Obligation Bonds (GOB)</td>
<td>to be used for capital projects and would typically require town meeting approval</td>
</tr>
<tr>
<td>Town Budget Item/Capital Improvement (TWN)</td>
<td>may be part of an overall capital improvements program that still may require annual review and approval as part of the town's annual budget</td>
</tr>
</tbody>
</table>
### Table 2 (continued)

**Potential Transportation Funding Sources**

<table>
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<th>Funding Level/Name</th>
<th>Type of Projects Eligible/Notes</th>
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</thead>
<tbody>
<tr>
<td>Private Sector (PS)</td>
<td></td>
</tr>
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</table>

There are several different programs or tools to use in obtaining private sector funding or participation in funding projects. These include but are not limited to:

- developer negotiated contributions/actions
- impact fees
- exaction
- annual donation requirements
- right of way/easement donations
- transportation development districts (special assessments)

Many of these tools are currently in use in Burlington like many of the other communities in the Commonwealth. Some actions such as impact fees and transportation development districts require State or local legislative approvals. While enabling legislation exists for special assessment districts, it does not exist specifically for impact fees. It should be noted that some of the costs associated with the recommended plan, particularly in evaluating, testing or advancing certain actions could be sponsored by the North Suburban Transportation Management Association which its membership is geared to the private sector.
part 3 preferred conceptual plans
and mapping
Modify Corners and Provide Improved Bedford Street Alignment

Proposed Flashing Beacon

High Visibility Crosswalks

Proposed Left-Turn Bay

Construct New Sidewalks and Wheelchair Ramps

SIGN LEGEND
R1-1 STOP SIGN

Conceptual Improvement Plan Option B
Bedford Street at Terrace Hall Avenue

Transportation Master Plan
Burlington, Massachusetts

MCDONOUGH & SCULLY, INC. Framingham, Massachusetts
Upgrade Traffic Signal Control

Remove Existing Island

Modify Corner and Existing Island to Provide Tighter Terrace Hall Avenue Approach

Legend

- Existing
- Post
- Signal
- Pedestrian

Conceptual Improvement Plan
Middlesex Turnpike at Terrace Hall Ave.

Transportation Master Plan
Burlington, Massachusetts

MCDONOUGH & SCULLY, INC. Framingham, Massachusetts
Conceptual Improvement Plan Option C
Bedford Street at Middlesex Turnpike

Transportation Master Plan
Burlington, Massachusetts

SCALE: 1" = 40'

MCDONOUGH & SCULLY, INC. Framingham, Massachusetts
Conceptual Improvement Plan Option A Bedford Street at Cambridge Street

Transportation Master Plan Burlington, Massachusetts

MCDONOUGH & SCULLY, INC. Framingham, Massachusetts

SCALE: 1" = 40'
Conceptual Improvement Plan
Mill Street at Locust Street

Transportation Master Plan
Burlington, Massachusetts

MCDONOUGH & SCULLY, INC.  Framingham, Massachusetts

SCALE: 1" = 40'

FIGURE
Conceptual Improvement Plan Option B
Peach Orchard Road at Winter Street

Transportation Master Plan
Burlington, Massachusetts

MCDONOUGH & SCULLY, INC. Framingham, Massachusetts
Conceptual Improvement Plan Option C
Bedford Street at Francis Wyman Road

Transportation Master Plan
Burlington, Massachusetts

MCDONOUGH & SCULLY, INC. Framingham, Massachusetts

SCALE: 1" = 40'

FIGURE
Conceptual Improvement Plan
Town Center
Long Range Option B
part 4 task 1
inventory and analysis
transportation master plan
burlington

technical report no. 1
inventory and analysis

Prepared for

Master Plan Committee
Burlington Planning Board
Town of Burlington, Massachusetts

December 1993
March 1994 revised

mcdonough & scully, inc.
Transportation Master Plan
Burlington

Technical Report No. 1
Inventory and Analysis

December 1993
March 1994 Revised

Prepared For

Master Plan Committee
Burlington Planning Board
Town of Burlington, Massachusetts

Prepared By

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(508) 875-1720
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**introduction**

The manner in which traffic flows through and within our nation's cities and towns continues to be a concern for traffic engineers, planners, public decision-makers, private investors and employers, as well as the residents of a community. This is particularly true in the northeast where a sharp rate of growth in residential and commercial land use occurred during the 1970's and 1980's. More important is the substantial growth in automobile ownership, as many households today have two or more vehicles, unlike 15 or 20 years ago. This growth has resulted in added pressure on a municipality's arterials, to a point where vehicular flow moves sluggishly along the roadway competing for the same space with parked cars, pedestrians, and delivery vehicles. In many situations, the transportation infrastructure has not been able to keep pace with the growth in demand.

The Town of Burlington, located approximately 13 miles from Boston, has experienced these same issues. Figure 1 shows Burlington relative to adjoining towns and cities. In Burlington, there is an added conflict between the through movement of vehicles largely by non-residents and the local travel demands of its residents. The issues of travel congestion, safety, and demand conflicts in Burlington has consequently resulted in the need for a comprehensive examination of its transportation facilities and needs.

Objectives of this study include:

- identify present and project future traffic and circulation problems and needs;
- determine suitable and feasible measures to ameliorate existing inadequacies and to minimize future transportation deficiencies, with a logical sequencing and timing of improvements and actions, and with an identification of costs and funding sources;
- enhance opportunities for alternative travel modes including ridesharing, public transit, walking and bicycling; and
- to develop realistic traffic and transportation actions which are fully compatible with Town's Master Plan.

**study process**

The analysis and resulting plan should be comprehensive in nature, addressing not only vehicular flow and safety conditions, but also public transportation, pedestrian and bicycle facilities. The plan should be viewed as a tool and guideline. It represents a new starting
point to be periodically revisited. Figure 2 provides a simplified overview of the overall study process. Products of the study will ultimately consist of several items including:

- an assessment of current and future travel conditions along critical roadways in the community;
- specific recommendations pertaining to transportation service, roadway, public transportation and travel demand management of the Town’s transportation system;
- order of magnitude cost estimates for implementing improvements of the plan;
- an identification of potential funding sources; and
- documentation to be used in support of funding applications.

![INVENTORIES ASSESSING EVALUATE PREPARE NEEDS ALTERNATIVES PLAN](image)

**Burlington Transportation Study Process**

Figure 2

The overall study is being conducted in five basic tasks. Task 1, which began during September 1993, consisted of an evaluation of existing transportation conditions in the Town. A Public Information Meeting at which residents could express their own views regarding some of the specific transportation problems in the Town was included in Task 1. Other specific tasks in Task 1 included data collection and inventories to obtain current traffic volumes, accident experience, travel speeds, circulation patterns, and roadway geometry. The analysis focused on the major roadways in the Town in terms of function and volume as identified on Figure 3. Part of this task included reviewing previous studies
and reports to obtain as much existing data as possible. This information was compiled and analyzed utilizing standard traffic engineering techniques for level of service and safety analysis. Task 1 also included an assessment of the existing public transportation service. These analyses resulted in the identification and definition of the existing and future problem locations in the Town of Burlington. The final element of Task 1 included developing travel forecasts based on the potential buildout of the community under current zoning, and determining the long range transportation needs of the community.

Task 2 will be comprised of developing short-term recommendations for the Town as well as the analysis of specific long term actions. These alternatives, which will form one component of the ultimate plan, will range from simple, low cost measures (i.e. pavement markings, signing, and circulation changes) that can be implemented in the short term to more capital intensive projects which require longer periods of time to implement.

Task 3 specifically addresses travel demand management (TDM). TDM is defined as strategies and actions intended to reduce or spread out the demand of private, single occupant vehicles. It is made up of a number of different types of strategies including but not limited to ridesharing, public transit, land use management, and parking.

Tasks 4 and 5 represent finalizing the results from previous tasks to formulate the draft and final plans, respectively. The plan will outline strategies, specific actions, schedules for implementation, estimated costs and potential funding sources. Input from the residents and business community will be solicited throughout the process, and presentation of the plan to the public will occur during these tasks.

**task 1 study report**

This technical report documents the existing transportation system inventories and analysis as well as the evaluation of long range travel conditions. It is the first in a series of reports for this study. Technical Report No. 1 is organized into four sections including this Introduction. A summary of the major transportation deficiencies currently experienced or anticipated in the Town of Burlington is included, followed by a section which details an inventory of the current roadway and the public transportation systems. The last section provides descriptions of the travel patterns, and future roadway travel forecasts.
executive summary

The Burlington Transportation Master Plan Study was initiated as a result of the overall Townwide Master Plan effort. The location of Burlington with respect to the regional highway system has resulted in substantial economic growth over the past thirty years. There remains a potential for significant new growth as well. Because of economic activity, significant demands are created on the area's infrastructure and transportation services. Consequently, traffic operations can be expected to deteriorate as additional development occurs in the future unless improvements in transportation service are provided. While the general area around the Route 128/Route 3 and Route 3A corridors have been studied periodically over the past several years as a result of private development projects, consensus with regard to the transportation needs and the solutions for the Town as a whole has not resulted. It is hoped that through this study and the other planning efforts being conducted by the Master Plan Committee, the transportation needs of the community will be clearly defined and prioritized.

The study process has been designed to develop a comprehensive database, analysis, and consideration of alternative improvements to address current and future needs. The analysis builds upon previous efforts as part of the Master Plan process. The details regarding the assessment of needs are included in the following sections of the report. The next several pages briefly highlight the Task 1 findings.

Existing Conditions

The analysis conducted has focused on the major roadways in the community and the key intersections and segments along the roadways. Available data was compiled and new data was collected where needed. Current traffic volumes vary by roadway due to the location and function of adjacent land uses. The major north-south arterials (Middlesex Turnpike, Cambridge Street, and Winn Street) presently carry daily volumes ranging from approximately 20,000 to 30,000 vehicles per day. The northern section of Middlesex Turnpike and several sections of Cambridge Street, where each roadway operates as a two lane facility, experience relatively high levels of congestion and delay with sluggish movement. The high volumes on each of these three roadways result in substantial delay to side street traffic attempting to enter the major roadway. Most of the key intersections along these three major routes operate at congested levels during peak travel hours.

Roadways such as Bedford Street, Center Street and Lexington Street, with generally east-west orientations, function with a greater emphasis to locally generated (i.e. Burlington)
traffic. While important, they carry much lower volumes (range from 9,000 to 14,000 vehicles per day) than the major north-south routes.

Analysis of accident data revealed a number of locations in need of safety improvements. Twelve (12) locations in the Town including the four Route 128 interchanges have been identified as high accident locations by the Massachusetts Highway Department (MHD). Improvements at these locations will be eligible for federal aid. Research resulted in a number of additional locations deserving attention as well. Figure 4 summarizes some of the current roadway conditions found as a result of this review and assessment. More detail regarding the analysis results are found later in the report.

In addition to roadway conditions, transit networks and facilities to accommodate pedestrians and bicycles were reviewed. While the Town is well covered in area by either the MBTA or the community’s own B-Line Bus service, use of the systems to commute to and from the work place located in Burlington is low. Local routes are circuitous resulting in long trip times, particularly in relation to the work trip. B-line service has served primarily the transit dependent population, including senior citizens and youth. At the time of this inventory there was no commuter service to Burlington from outlying areas nor a connection between the Town and the Mishawum Rail Station in Woburn. Subsequently, a connection to the Mishawum Station is being provided under the auspices of the North Suburban Transportation Management Association. In addition, limited service provided by the Lowell Regional Transit Authority has recently been authorized.

The provision of sidewalks or bike routes/storage facilities in relation to the communities residential areas and key land uses (i.e. schools, parks) were reviewed. The analysis showed many discontinuities in the sidewalk system. In addition, there is a lack of bicycle facilities within the Town. A local bike committee has worked towards developing an initial bike path in Town located off Mountain Road. More effort in this area is required if safe bicycling is to be encouraged for both recreation as well as commuting purposes.

Future Travel Conditions

In examining future growth, extensive research was completed to identify area-specific projects currently underway or being planned. The recently completed land use element of the Master Plan provided key input related to potential buildout. Also, background growth based on historical trends and anticipated changes in surrounding communities was incorporated. Background growth is considered the growth likely to occur naturally as a result of regionwide growth in travel. It may also account for development growth in adjacent communities which may effect roadways in Burlington.
summary of problems and needs

transportation master plan
burlington, massachusetts

not to scale

figure 4
While current vacancy rates remain relatively high, the potential exists for more than 3 million square feet of additional industrial and commercial development beyond that which is currently in some form of planning or construction. This new space could potentially result in 7650 new employees in the area. In addition, there is the potential for more than 800 new housing units to be built in the Town. Simply considering this buildout potential, approximately 42,600 new vehicle trips could be added to the Burlington network on a daily basis. The eventual filling of existing vacancies and the currently planned projects result in another 21,000 daily vehicle trips. Figure 5 illustrates estimated changes in traffic volumes on various roadways considering both the buildout and the full occupancy of currently planned or standing buildings. The analysis of projected volumes shows that without major changes in the roadway network, buildout conditions will result in a demand on Middlesex Turnpike and Cambridge Street in excess of 40,000 vehicles per day. Other sections of these roadways as well as Burlington Mall Road and Winn Street are projected to carry between 28,000 and 41,000 vehicles per day. As indicated in the figure, two lane roadways are inadequate to efficiently accommodate these high levels of demand. At these levels, severe congestion will occur along the roadways, substantial delays will be incurred by motorists attempting to exit minor side streets or driveways, and noticeable diversion onto more locally oriented streets is probable.
Assuming unconstrained roadway capacity, future volumes along Bedford Street and Center Street are expected to approach 20,000 vehicles per day. While growth in traffic volumes along Lexington Street, Terrace Hall Avenue, and Blanchard Road are also anticipated, they are expected to remain below 15,000 vehicles per day.

In summary, the analysis of existing and future base conditions indicates that:

- the current north-south circulation and access is constrained;
- in the future, the capacity of the present roadways will be inadequate to meet the travel demands;
- without major improvements, the result will be severe congestion; and
- alternatively, if major improvements cannot be made, substantially reduced growth plans may be required to minimize the effect on congestion and related environmental factors.

Assuming the Town’s economic and land use goals are desirable and/or inevitable, there is a clear need for additional roadway capacity along the sections of Middlesex Turnpike, Cambridge Street, and possibly Winn Street. Certain levels of improvements to Middlesex Turnpike and Cambridge Street may reduce the pressure on parallel roadways such as Winn Street and Lexington Street. In addition, improved east-west movement will be desirable as the only high type east-west roadway facility that currently exists is Burlington Mall Road.

At the same time, there will be a limit on the level of new roadway improvements that can be implemented due to several factors, including costs, environmental impacts, and political feasibility. Consequently, there is a need to optimally manage the roadway system that currently exists as well as better manage the demand. Results of Task 1 have shown that opportunities to improve management in both areas exist. Tasks 2 and 3 will examine the potential alternatives available in order to meet community needs.
existing transportation system

This section of the report presents results from the study inventory and the analysis of the existing transportation system in the Town of Burlington. It includes a presentation of the data observed and researched as part of the study, as well as an assessment of how well the transportation system serves the current needs. The assessment of operating characteristics takes into account the regional highway system, key Town roadways, public transit service currently available in the community, and bicycle and pedestrian conditions. A number of historical study documents were reviewed as part of this effort and are listed at the end of this report. Pertinent information was obtained from the previous studies.

Roadway System Inventory

The analysis includes the major roadways that serve key land uses or provide connections between residential areas and the major local and regional system. Major roadways have been generally defined in this study as arterial or major collector type roads. The study area (previously shown in Figure 3) includes several important streets in the community including:

- Middlesex Turnpike
- Cambridge Street
- Winn Street
- Wheeler Road
- Blanchard Road
- South Bedford Street
- Terrace Hall Avenue
- Mill Street
- Locust Street
- Burlington Mall Road
- Lexington Street
- Bedford Street
- Center Street
- Francis Wyman Road
- Peach Orchard Road
- Skilton Lane
- Wilmington Road

Key intersections along these roadways were included in the assessment. The following narrative briefly describes the roadways included in this inventory. Later in the report, traffic volumes and accident data are reported for each roadway.

1. Regional Highways

Two major regional limited access highways (Route 3 and Interstate Route 95/128) traverse the Town of Burlington. Route 3 has a north-south orientation and is located on the western side of the Town near the Bedford townline, while I-95/128 has a general east-west orientation and is located across the southern side of the Town. These two limited
access highways meet at an interchange near the southwest corner of Burlington. At this interchange, the Route 3 divided highway ends and the Route 3 designation is carried eastward along I-95/128 to the Cambridge Street interchange where the Route 3 designation is carried southward along Cambridge Street. Cambridge Street is a major arterial connecting through Burlington, Woburn, Winchester and other communities to the south.

**Route 3**

Route 3, north of I-95/128 is a four lane limited access highway, connecting from I-95/128 through Burlington northward to Lowell and beyond into New Hampshire. It eventually connects with I-93 in Manchester, New Hampshire. Except for the interchange with I-95/128, there is no direct access to Route 3 in the Town of Burlington. Approximately 2.1 miles north of I-95/128, there is a partial cloverleaf interchange in Bedford, just west of the Burlington townline, at Route 62 (Bedford Street). It is approximately 6/10 of a mile to the west of Middlesex Turnpike. The next interchange to the north is at Concord Road in Billerica. Severe traffic congestion is experienced on Route 3 on a daily basis. As a result, the Massachusetts Highway Department is conducting the preliminary work to add one lane in each direction to this facility. The Draft Environmental Impact Report for this project is expected to be completed during 1994.

**Interstate Route 95/128**

Through Burlington, I-95/128 is an eight lane limited access highway. I-95 and Route 128 are both designated for this facility between the two junctions of I-95 in Canton to the south and Lynnfield to the north. Route 128 is a circumferential highway around the City of Boston, connecting from Quincy/Braintree on the south to Gloucester on the north. Including the Route 3 interchange, I-95/128 has four interchanges in Burlington: at Middlesex Turnpike; Cambridge Street; and, Winn Street. The Middlesex Turnpike interchange is located adjacent to the Route 3 interchange. The two interchanges share common frontage roads along I-95/128. The Middlesex Turnpike interchange is a partial cloverleaf configuration providing access to the highly commercial and industrial section of Burlington and southerly into Lexington. The Cambridge Street interchange, approximately 1.6 miles east of Middlesex Turnpike, is a nearly full cloverleaf serving the commercial Cambridge Street area as well as residential areas of Burlington. The Winn Street interchange, approximately 9/10 of a mile east of Cambridge Street, is a nearly full cloverleaf which serves the primarily residential areas of Burlington and Woburn. The I-95/128 facility is heavily used and experiences congestion on a daily basis. The Massachusetts Highway Department is currently evaluating the potential to add a lane in each direction to this highway. The Winn Street Interchange has undergone some modifications recently as part of the Winn Street project.
2. Local Roadways

**Middlesex Turnpike**
Middlesex Turnpike is a major arterial connecting through Burlington from Lexington on the south to and through Bedford on the north. It is a two to six lane roadway depending on location. South of Second Avenue/Lexington Street, it is a four to six lane, divided roadway. North of Second Avenue, Middlesex Turnpike has one through lane in each direction. This roadway is under the jurisdiction of the Town of Burlington with the exception of the Route 128 interchange area. The roadway surface along most of the roadway length is composed of bituminous concrete pavement in good condition. Sidewalks exist primarily along the eastern side of the road between Terrace Hall Avenue and Bedford Street. With the exception of some short walks beneath the I-95/128 overpass and south of Wheeler Road, sidewalks generally do not exist south of Terrace Hall Avenue.

Key intersections along Middlesex Turnpike are located at I-95/128, Wheeler Road, Second Avenue/Lexington Street, Terrace Hall Avenue and Bedford Street. Each of these intersections is under traffic signal control. The signal equipment at the Bedford Street intersection is dated and does not meet current design standards. Middlesex Turnpike provides access to and from the Northwest Park industrial/office area at several locations including South Avenue, Second Avenue, Third Avenue and Fourth Avenue, all of which are unsignalized. Land uses along Middlesex Turnpike consists of a mixture of commercial, industrial office and retail with access to some residential areas in the northern part of the Town. Major facilities along Middlesex Turnpike include the Burlington Mall and the Northwest Park industrial/office area.

**Cambridge Street**
Cambridge Street is a major north-south arterial roadway through Burlington extending from Woburn and points south to Billerica and the north. It operates as a two to four lane roadway depending on location. Through much of Cambridge Street, the lane use is undefined with some drivers using it as two lanes and others as a four lane roadway. This roadway is under the jurisdiction of the Massachusetts Highway Department. The roadway surface along most of the roadway length is composed of bituminous concrete pavement in fair to good condition.

Cambridge Street has sidewalks along both sides of the roadway from the Billerica Townline southward to Skilton Lane. Sidewalks are also provided along both sides from the vicinity of Bedford Street, southward to Rita Avenue. South of Rita Avenue sidewalks are sporadically located on one side of the road or the other.
Key intersections along Cambridge Street are located at I-95/128, Burlington Mall Road, Burlington Center Office Park Drive, Bedford Street, Center Street, Winn Street, Skilton Lane, Terry Avenue, Wilmington Road, and Francis Wyman Road. With the exception of Center Street and Skilton Lane, these intersections are under traffic signal control. The intersection of Bedford Street has only post mounted signal heads and only partial pedestrian control. Land uses along Cambridge Street consists of a mixture of concentrated commercial/retail with some office space and residential uses.

**Winn Street**

Winn Street is under the jurisdiction of the Town of Burlington and connects in a north-south direction from Woburn on the south to its intersection with Cambridge Street on the north. This arterial roadway generally operates as a two lane roadway with the exception of the section in the immediate vicinity of I-95/128, where four travel lanes exist. The roadway surface is composed of bituminous concrete pavement in generally fair condition. Sidewalks exist along the eastern side of the road from Cambridge Street to the I-95/128 interchange. Limited sections of sidewalks exist on the west side of Winn Street in the vicinity of the Center Street and Peach Orchard Road intersections. The roadway between Peach Orchard Road and Route 128 has recently been reconstructed which included new curbing, sidewalks, upgraded signalization and minor modifications to the Route 128 interchange ramps.

Key intersections along Winn Street are located at I-95/128, Peach Orchard Road, Center Street and Cambridge Street. All of these intersections are under traffic signal control except for the Center Street intersection. Winn Street also connects into residential areas via Mill Street and Locust Street, with each forming unsignalized ‘T’ type intersections. Land use along Winn Street is primarily residential, however, a significant level of the traffic stream also appears to be generated by local businesses. The interchange with I-95 also attracts motorists to Winn Street who are ultimately destined for points north along the regional highway.

**Burlington Mall Road**

Burlington Mall Road is a major arterial which connects from Lexington Street on the west to Cambridge Street on the east and is a four lane divided roadway. At major intersections the median narrows to provide exclusive left-turn lanes in each direction. This roadway is under the jurisdiction of the Town of Burlington although generally constructed by private interests over the years. The roadway surface along the roadway length is composed of bituminous concrete pavement in good condition. Sidewalks exist along the south side of...
Burlington Mall Road from Lexington Street to Cambridge Street and along the north side from Stony Brook Road to Middlesex Turnpike.

Key intersections along Burlington Mall Road occur at Lexington Street, the Lahey Clinic Main Drive, South Bedford Street, and Cambridge Street. All of these intersections are signalized. Land use along Burlington Mall Road consists of a mixture of retail, office and medical/research facilities.

**Lexington Street**

Lexington Street which connects from Middlesex Turnpike and Mall Road on the west to Bedford Street on the east, is a two to four lane major arterial roadway. Only the section of Lexington Street between Middlesex Turnpike and Burlington Mall Road has four lanes with a median. At Burlington Mall Road, the Lexington Street alignment changes to the north. From this point, Lexington Street carries two lanes to Bedford Street through a residential area. This roadway is under the jurisdiction of the Town of Burlington. The bituminous concrete pavement is in fair condition along most of the roadway length. Lexington Street has sidewalks along both sides of the roadway from Middlesex Turnpike to Burlington Mall Road. Between Burlington Mall Road and Stony Brook Road, there are intermittent sidewalks along one side of the road or the other. No sidewalks exist from Stony Brook Road to Spruce Hill Road. Sidewalks exist along the eastern side from Spruce Hill Road to McGinnis Road and along both sides of the roadway from McGinnis Road to Bedford Street. A recent improvement by the Town improved the northern section of Lexington Street with new pavement, curbing, and sidewalks. Similar type of improvements are programmed for the southern section.

Major intersections along Lexington Street are located at Middlesex Turnpike, Burlington Mall Road, Stony Brook Road and Bedford Street. The Middlesex Turnpike and Burlington Mall Road intersections are under traffic signal control while the other intersections are unsignalized. Land use along Lexington Street consists of a mixture of commercial and retail in the vicinity of the Burlington Mall, and residential uses to the north of Burlington Mall Road.

**Bedford Street**

Bedford Street connects from Route 3 in Bedford and Middlesex Turnpike on the west to Center Street on the east. It is a two lane arterial roadway. From Route 3 to Frances Wyman Road, it is designated as State Route 62 as well. This roadway is under the jurisdiction of the Town of Burlington. The bituminous concrete roadway surface is in fair condition. From Middlesex Turnpike to Humbolt Avenue, Bedford Street has a sidewalk along the southerly side of the roadway. A sidewalk also exists along the southerly side of
the roadway from Terrace Hall Avenue to Lexington Street. From Lexington Street to Cambridge Street, there is a sidewalk along the northerly side of Bedford Street. Between the townline and Middlesex Turnpike, the roadway consists of numerous curbcuts that are not well defined. Sidewalks do not exist.

Key intersections along Bedford Street are located at Middlesex Turnpike, Francis Wyman Road, Terrace Hall Avenue, Lexington Street, Cambridge Street and Center Street. The Middlesex Turnpike and Cambridge Street intersections are under traffic signal control while the other intersections are unsignalized. Both signalized intersections have old, outdated equipment in a post mounted layout which affects visibility. Land use along Bedford Street is primarily residential except for the Town Center where public buildings and grounds exist and west of Middlesex Turnpike, where industrial and commercial uses occur.

**Center Street**

Center Street, which connects from Cambridge Street on the west to Winn Street on the east, is a two lane arterial roadway. This roadway is under the jurisdiction of the Town of Burlington. The roadway surface is composed of bituminous concrete pavement in fair condition. Sidewalks exist along the northerly side of Center Street.

Key intersections along Center Street are located at Cambridge Street, Bedford Street and Winn Street. Land uses along Center Street consist primarily of single family dwellings, with municipal and office buildings in the vicinity of the Town Center.

**Francis Wyman Road (Route 62)**

Francis Wyman Road, which connects from Bedford Street on the south to Cambridge Street on the north, is a two lane arterial roadway under the jurisdiction of the Town of Burlington. The bituminous concrete pavement is in fair condition. Sidewalks exist along the westerly side of Frances Wyman Road between Bedford Street and Foster Road and along the easterly side between Foster Road and Cambridge Street.

Key intersections along Frances Wyman Road are located at Bedford Street and Cambridge Street. The Cambridge Street intersection is under traffic signal control, while the Bedford Street intersection is unsignalized. Land use along Frances Wyman Road is primarily residential.

**Wilmington Road (Route 62)**

Wilmington Road, which connects from Cambridge Street eastward into Wilmington is a two lane arterial roadway. This roadway is under the jurisdiction of the Town of
Burlington. The bituminous concrete pavement is in good condition. Sidewalks exist along the northerly side of Wilmington Road between Cambridge Street and the Wilmington townline.

The only key intersection along Wilmington Road is at Cambridge Street where there is traffic signal control. Land use along Wilmington Road is primarily residential although a small retail/commercial area (Plaza 62) also exists.

**Wheeler Road (North)**

Wheeler Road (North) is a short (approximately 750 feet) two lane roadway connecting from Middlesex Turnpike westward. This roadway is under the jurisdiction of the Town of Burlington. The roadway surface is composed of bituminous concrete pavement in fair condition. No sidewalks exist along either of the sides of this roadway.

The Middlesex Turnpike/Wheeler Road (North) intersection is signalized. Land use along Wheeler Road Road consists primarily of commercial businesses and retail uses.

**Wheeler Road (South)/Blanchard Road**

Wheeler Road (South) connects from Middlesex Turnpike eastward to Muller Road, at which point the roadway changes name to Blanchard Road, which is continued to its end at South Bedford Street. This two lane roadway functions as a minor arterial which is under the jurisdiction of the Town of Burlington. The roadway surface is composed of bituminous concrete pavement in fair condition. No sidewalks exist along either site of this roadway.

Key intersections along the Wheeler Road/Blanchard Road alignment are located at Middlesex Turnpike, South Bedford Street, and Muller Road. Muller Road serves residential uses and also provides an alternate connection between Blanchard Road and Middlesex Turnpike. The intersection of Muller Road and Middlesex Turnpike is under traffic signal control. Land use along Wheeler Road/Blanchard Road currently consists of some commercial/industrial uses, a hotel, and publicly owned open space.

**South Bedford Road**

South Bedford Street, connects from Cambridge Street on the south to Lexington Street on the north. It is a two lane roadway under the jurisdiction of the Town of Burlington. It functions as a minor arterial between Burlington Mall Road and Cambridge Street (at the Woburn Townline) and as a collector between Burlington Mall Road and Lexington Street. The alignment of South Bedford Street includes an offset of approximately 100 feet.
between the two sections. As one proceeds from Woburn, South Bedford Street is directly opposite Stony Brook Road when Burlington Mall Road is reached. This is more clearly shown on the report graphics depicting the study network. The roadway surface along most of the roadway length is composed of bituminous concrete pavement in fair to poor condition. Sidewalks exist along the east side of South Bedford Street between Burlington Mall Road and Wayside Road and along the western side between Wayside Road and Blanchard Road.

Key intersections along South Bedford Street are located at Cambridge Street, Wayside Road, Blanchard Road, Burlington Mall Road, and Lexington Street. The Cambridge Street and Burlington Mall Road intersections are under traffic signal control while the Lexington Street intersection is unsignalized. Land use along South Bedford Street consists of a mixture of office and limited residential to the south of Burlington Mall Road while primarily residential uses exist to the north of Burlington Mall Road.

**Stony Brook Road**
Stony Brook Road, which connects from Burlington Mall Road on the south to Lexington Street on the north, is a two lane roadway. This roadway is under the jurisdiction of the Town of Burlington. Stony Brook Road serves primarily residential uses and functions as a connector road between Lexington Street and Burlington Mall Road. The roadway surface is composed of bituminous concrete pavement in poor to fair condition. No sidewalks are available along either side of the roadway.

Key intersections are with Burlington Mall Road and Lexington Street. The intersection with Burlington Mall Road is currently signalized, while the intersection with Lexington Street is unsignalized.

**Terrace Hall Avenue**
Terrace Hall Avenue, which connects from Middlesex Turnpike on the west to Bedford Street on the east, is a two lane minor arterial roadway. This roadway is under the jurisdiction of the Town of Burlington. The roadway surface along most of the roadway length is composed of bituminous concrete pavement in fair condition. No sidewalks exist along Terrace Hall Avenue.

Key intersections along Terrace Hall Avenue are located at Middlesex Turnpike and Bedford Street. The Middlesex Turnpike intersection is under traffic signal control, while the Bedford Street intersection is unsignalized. Land use along Terrace Hall Avenue is primarily residential, including apartments and single family dwellings. However, at the intersection with Middlesex Turnpike, commercial, office and general business space exists.
Mill Street
Mill Street, which connects from Winn Street on the west into Wilmington on the east, is a two lane residential roadway. Along most of its length, Mill Street has somewhat narrow lane widths as well as several abrupt or short vertical and horizontal curves. This roadway falls under the jurisdiction of the Town of Burlington and functions as a collector roadway. The roadway surface along most of the roadway length is composed of bituminous concrete pavement in fair condition. No sidewalks exist along Mill Street.

Key intersections along Mill Street are located at Winn Street, Locust Street and Skilton Lane, all of which are unsignalized. Land use along Mill Street consists primarily of single family dwellings.

Locust Street
Locust Street, which connects from Winn Street on the south to Mill Street on the north, is a narrow two lane roadway. This roadway is under the jurisdiction of the Town of Burlington. Locust Street which serves residential uses, is narrow and has several curves along its length. The roadway surface is composed of bituminous concrete pavement in poor to fair condition. Sidewalks do not exist along the roadway.

Key intersections are with Winn Street and Mill Street. Both of the intersections are currently unsignalized.

Peach Orchard Road
Peach Orchard Road, which connects eastward from Winn Street into Woburn, is a two lane collector roadway and is under the jurisdiction of the Town of Burlington. The bituminous concrete roadway surface is in fair condition. Sidewalks exist along the north side of Peach Orchard Road between Winn Street and Oak Street. Sidewalks extend along the southerly side of the road from Winn Street to the first driveway.

One key intersection along Peach Orchard Road is located at Winn Street and is under traffic signal control. Land use along Peach Orchard Road consists primarily of single family dwellings. At the intersection with Winn Street, a school and church exist.

Skilton Lane
Skilton Lane, which connects from Cambridge Street on the west to Mill Street on the east, is a two lane collector roadway. This roadway is under the jurisdiction of the Town of Burlington. This roadway serves a relatively large residential area. The roadway surface is
composed of bituminous concrete pavement in poor to fair condition. A sidewalk exists along the south side of Skilton Lane between Grant Avenue and Patriot Road.

A key intersection along Skilton Lane is located at Cambridge Street, which is an unsignalized intersection. Land use along Skilton Lane consists primarily of single family dwellings.

**Land Use**

As part of the inventory, major community land uses in Burlington were identified. Included are the local parks, schools, and community centers which represent the locations to which residents of the Town are expected travel via automobile, bus or as pedestrians. This inventory assists in understanding travel demand patterns and characteristics. Figure 6 identifies the locations of major land uses. It is important to identify these locations as part of the master planning process in order to be sensitive to their access needs. The figure also illustrates locations of major or neighborhood commercial/economic activity centers. The numbers on the diagram refer to specific buildings or names of the land uses and are listed in Table A of Appendix A.

**Existing Traffic Volumes and Patterns**

A major part of the Task 1 analysis included compiling information on existing traffic volumes for study area roadways. This information was obtained through research of previous studies as well as a limited number of new automatic traffic counts and manual peak period turning movement counts at key intersections. Based upon this information, daily traffic volumes were determined along the major roadways of Burlington. Figure 7 presents a summary of the existing average daily traffic volumes in Burlington. Table 1 provides a summary of the daily total and peak hours of existing traffic volumes on various study area roadways. The volume data was used to evaluate the operating conditions on the study area roadways. Not only was the magnitude of volume considered, but the peaking characteristics, the variation over the day, and the directional flow patterns were also examined.

From Figure 7 and Table 1, it can be seen that the major north-south arterials (i.e. Middlesex Turnpike, Cambridge Street and Winn Street carry volumes in the range of 24,000 to 30,000 vehicles per day along most roadway sections. Burlington Mall Road is another important roadway which serves a demand of more than 20,000 vehicles per day. The significance of the volume levels relate to the capacities of the roadways and ultimately, the level of congestion during the peak volume hours. For example, a two lane road will
NOTE: Reference Numbers Pertain to List In Table A of the Appendix

summary of key land uses and major generators

transportation master plan
burlington, massachusetts
existing average daily traffic

transportation master plan
burlington, massachusetts

figure 7
The more predominant value in the 8% to 9% range. In the area of the Burlington Mall, the morning peak hour is much lower than the afternoon peak hour as the retail stores are not open until after the typical commuter peak period. Figures 8 through 11 illustrate examples of the hourly variation of traffic flow on several roadways in the study area including Cambridge Street, Burlington Mall Road, Middlesex Turnpike and Skilton Lane. From these charts, it can be seen that as the volumes increases along the major roadways, such as Middlesex Turnpike, hourly variation does not change substantially between the morning and afternoon peak hours. In fact, both Burlington Mall Road and Middlesex Turnpike exhibit relatively high volumes in the midday period which we would expect near the major retail area. In contrast, the northern section of Cambridge Street has more noticeable morning and evening peaking conditions. Roadways which function as important collectors in residential areas, such as Skilton Lane, much more pronounced morning and afternoon peaking conditions.
Assessment of Existing Roadway Conditions

In addition to reviewing the traffic volume levels, the roadway system was assessed in terms of the quality of flow, safety, and geometric conditions. This was accomplished by compiling recent analyses completed as part of other projects, by conducting new analysis, and through field observations. In addition, public input obtained at the Master Plan Committee meetings and the Public Forum served to verify and/or help identify areas of concern or problems.

1. Level of Service

Capacity and delay characteristics of the study area intersections were reviewed in order to determine the Level of Service (LOS) provided under existing conditions. "Level of Service" is an indicator of the operating conditions that occur on a given roadway or intersection when accommodating various traffic volumes. It is a qualitative measure that accounts for a number of operational factors, including roadway geometrics, speed, travel delay, freedom to maneuver, and safety. When the criteria are assessed and a Level of Service is assigned to a roadway or intersection, it is equivalent to presenting an “index” to the operational qualities of the network component under study. Level of Service is defined in the 1985 Highway Capacity Manual\(^1\) by six levels, ‘A’ to ‘F’.

In practice, any given roadway or intersection may operate at a wide range of Level of Service depending upon time of day, day of week or period of year. Level of Service ‘C’, a condition of stable flow, is generally considered desirable for peak or design flow in rural areas. LOS ‘D’ (more significant delays than ‘C’) is sometimes considered acceptable in urban areas during peak travel times. LOS ‘A’ is the optimum condition of free flow. LOS ‘E’ represents unstable flow conditions, indicating near or at maximum utilization of a roadway facility under less than ideal conditions. LOS ‘F’ generally indicates severe congestion and insufficient capacity, or a condition in which external factors (i.e. breakdown) result in forced flow illustrated by long delays and vehicle queues. The Level of Service criteria for signalized and unsignalized intersections are presented in Table 2.

Using recent results from past studies as well as new analysis conducted as part of this study, the evening peak hour Level of Service has been identified for each of the key study area intersections that had sufficient data available. Figure 12 summarizes the results of the analysis.

---

### TABLE 2
LEVEL OF SERVICE CRITERIA

<table>
<thead>
<tr>
<th>SIGNALIZED INTERSECTIONS</th>
<th>UNSIGNALIZED INTERSECTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Stopped Delay per Vehicle</strong> (seconds)</td>
<td><strong>Reserve Capacity</strong></td>
</tr>
<tr>
<td>Level of Service</td>
<td>Reserve Capacity</td>
</tr>
<tr>
<td>A</td>
<td>≤5.0</td>
</tr>
<tr>
<td>B</td>
<td>5.1 to 15.0</td>
</tr>
<tr>
<td>C</td>
<td>15.1 to 25.0</td>
</tr>
<tr>
<td>D</td>
<td>25.1 to 40.0</td>
</tr>
<tr>
<td>E</td>
<td>40.1 to 60.0</td>
</tr>
<tr>
<td>F</td>
<td>&gt;60.0</td>
</tr>
</tbody>
</table>


As can be seen on the Figure, most of the key intersections along the north-south arterials are experiencing delay and congestion as indicated by the LOS "F" and can be considered deficient. At many unsignalized intersections along Middlesex Turnpike, Cambridge Street and Winn Street there is substantial difficulty in exiting the minor streets during peak hours as well. In addition to the intersections shown in Figure 12, peak hour field observations of other intersections including Winn Street at Mill Street, Winn Street at Locust Street, Terrace Hall Avenue at Bedford Street, and Lexington Street at Bedford Street exhibit some operational difficulties such as side street delay. The analysis has indicated numerous congestion related deficiencies in terms of level of service. Older signal installations including Middlesex Turnpike at Bedford Street, Cambridge Street at Bedford Street and Cambridge Street at Winn Street and Terry Avenue operate at LOS 'F'. Most unsignalized intersections along Middlesex Turnpike, Cambridge Street and Winn Street experience long delays and poor levels of service. Winn Street intersections with Center Street, Peach Orchard Street and the Route 128 ramp were at LOS 'F' prior to recent improvements. The improvements did not substantially increase capacity and consequently, significant improvements to level of service cannot be expected.

Previous analysis results indicated the intersections along the southern part of Middlesex Turnpike operate adequately. However, field observations have shown some deficiencies in relation to the signal operations in terms of less than optimal coordination.

One effect of the major arterials functioning poorly is a diversion of additional traffic onto more local roadways that may not be designed for the demand. The more local roadways are not intended to carry the higher level of volume. An example of this may be the northern section of Lexington Street.
existing level of service summary
average weekday evening peak hour

transportation master plan
burlington, massachusetts

figure 12
2. Accident Experience

Data on accident history for the study area roadways was researched through the Massachusetts Highway Department (MHD) records for the period January 1, 1989 through December 31, 1991. In addition, the MHD Statewide High Accident Listing was also reviewed. Intersections included on the MHD High Accident Listing are eligible for federal aid for constructing safety improvements. The purpose of this research was to identify the potentially hazardous locations on the study area roadways which would require further examination and the evaluation of improvements in Task 2 of the study. Figure 13 presents an accident spot map of the thirty-three (33) intersections evaluated and showing the number of accidents which occurred at the key intersections over this three year period.

The MHD High Accident Listing indicated that 12 locations in Burlington were eligible for federal aid to correct the safety deficiencies due to their placement on the State's listing of 1000 highest accident locations. Eight (8) of the twelve involved intersections on the local roadway system while the remaining four (4) locations were related to the highway interchanges along I-95/128. The high accident locations involving local roadways are listed in Table 3.

| TABLE 3 |
| HIGH ACCIDENT LOCATIONS |
| (Source: MHD Top 1000 Locations) |
| Cambridge Street at Burlington Mall Road | Winn Street at Peach Orchard Road |
| Cambridge Street at Bedford Street | Winn Street at Center Street |
| Cambridge Street at Winn Street | Middlesex Turnpike at Bedford Street |
| Cambridge Street at Skilton Lane | Middlesex Turnpike at Burlington Mall Road |

A summary of the findings for all locations is contained in Table 4, which indicates the three year total and average number of accidents per year at each location. In addition, all of the accidents were categorized by severity, accident type, hour of day, weather conditions, and the season in which each accident took place. The information indicates that a total of 764 accidents were reported at the study intersections for the analysis period. This translates into an average of approximately 254 accidents per year. In terms of the number of reported accidents, the top five accident locations are: I-95/128 at Route 3, Bedford Street at Cambridge Street, Route 128 at Middlesex Turnpike, Cambridge Street at Winn Street and I-95/128 at Cambridge Street. Considering only local roads and not interchanges, the top five accident locations are: Bedford Street at Cambridge Street, Cambridge Street at Winn Street, Burlington Mall Road at Cambridge Street, Winn Street at Peach Orchard Road, and Middlesex Turnpike at Bedford Street.
number of reported accidents over three year period (1989-1991)

transportation master plan
burlington, massachusetts

figure 13
## TABLE 4
SUMMARY OF REPORTED ACCIDENTS¹
(1989 - 1991)

<table>
<thead>
<tr>
<th>Locations</th>
<th>Number of Reported Accidents</th>
<th>3 Year Total</th>
<th>Avg. # Per Year</th>
<th>Potential Safety Problem Warranting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Middlesex Turnpike at Bedford Street</td>
<td>22</td>
<td>7.3</td>
<td>0.61</td>
<td>Yes</td>
</tr>
<tr>
<td>Middlesex Turnpike at Terrace Hall Avenue</td>
<td>24</td>
<td>8.0</td>
<td>0.66</td>
<td>No</td>
</tr>
<tr>
<td>Middlesex Turnpike at Lexington Street</td>
<td>4</td>
<td>1.3</td>
<td>0.13</td>
<td>No</td>
</tr>
<tr>
<td>Middlesex Turnpike at Wheeler Road (North)</td>
<td>10</td>
<td>3.3</td>
<td>0.29</td>
<td>No</td>
</tr>
<tr>
<td>Middlesex Turnpike at Wheeler Road (South)</td>
<td>14</td>
<td>4.7</td>
<td>0.47</td>
<td>No</td>
</tr>
<tr>
<td>South Bedford Street at Blanchard Road</td>
<td>6</td>
<td>2.0</td>
<td>0.61</td>
<td>No</td>
</tr>
<tr>
<td>Mountain Road at Winn Street</td>
<td>22</td>
<td>7.3</td>
<td>0.80</td>
<td>Yes</td>
</tr>
<tr>
<td>Burlington Mall Road at Lexington Street</td>
<td>15</td>
<td>5.0</td>
<td>0.61</td>
<td>No</td>
</tr>
<tr>
<td>Burlington Mall Road at Lahey Clinic</td>
<td>8</td>
<td>2.7</td>
<td>0.27</td>
<td>No</td>
</tr>
<tr>
<td>Middlesex Turnpike at Bedford Street</td>
<td>3</td>
<td>10.3</td>
<td>1.01</td>
<td>Yes</td>
</tr>
<tr>
<td>Middlesex Turnpike at Bedford Street</td>
<td>22</td>
<td>7.3</td>
<td>0.61</td>
<td>Yes</td>
</tr>
<tr>
<td>Middlesex Turnpike at Terrace Hall Avenue</td>
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</tr>
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<td>No</td>
</tr>
<tr>
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<td>15</td>
<td>5.0</td>
<td>0.61</td>
<td>No</td>
</tr>
<tr>
<td>Burlington Mall Road at Lahey Clinic</td>
<td>8</td>
<td>2.7</td>
<td>0.27</td>
<td>No</td>
</tr>
</tbody>
</table>

### Severity:
- Property Damage Only: 506 (66%)
- Personal Injury: 257 (33%)
- Fatality: 1 (1%)

### Weather:
- Cloudy: 435 (57%)
- Clear: 136 (18%)
- Rain/Snow: 193 (25%)

### Hour of Day:
- 7:00 AM - 7:59 AM: 115 (15%)
- 4:00 PM - 4:59 PM: 176 (23%)
- Remainder: 473 (62%)

### Accident Type:
- Rear End: 160 (21%)
- Angle: 451 (59%)
- Fixed Object: 8 (1%)
- Head On: 30 (4%)
- Other: 115 (15%)

¹ Source: Massachusetts Highway Department (1989 - 1991), Intersections identified by MHD as one of the "Top 1000 High Accident Locations" in Massachusetts are shown in italic.

² ACC/MEV = Number of Accidents per Million Entering Vehicles. The 1983 estimated Statewide average is 1.74 for signalized and 0.79 for unsignalized intersections.

³ One fatal accident occurred at this intersection within the survey period (1989-1991).

⁴ Current Traffic Control: S - Signalized, U - Unsignalized

- Interchange with regional highway and rate not computed

* Location has either undergone recent improvement/modification or one is programmed which the effect may not be reflected in the 1989-1991 data.
Of the 764 accidents, 66 percent resulted in property damage only, and 33 percent in personal injury. There was one reported fatality during this period at the I-95/128 at Route 3 interchange. Overall, the predominant accident type was the angle or crossing movement type at 59 percent of the total. The rear-end collision type was the second highest at 21 percent of the total. The remaining 20 percent of the accidents were split between fixed objects, head-on collisions and other. A majority of the accidents (62 percent) occurred during non-peak hours. Fifty-seven (57) percent of the accidents occurred during times with cloudy skies, 25 percent during rain or snow, and the remaining 18 percent under clear skies. The peak accident season is winter, with 36 percent of the accidents.

As can be seen in both the Table and Figure, there are a number of locations experiencing more than five (5) accidents per year, which represents the selected criteria for this study.

In general at or above five accidents per year, a hazardous location may exist and further investigation and analysis may be warranted. Similarly, when accident rates approach 1.5 accidents per million entering vehicles (MEV) for signalized intersections and 1.0 per MEV for unsignalized intersection, it may be reasonable to conduct further study to determine if a safety problem does in fact exist, and if so, to determine the nature of the problem.

Those locations, in addition to the MHD High Accident locations, exhibiting potentially hazardous conditions based on reported accident experience include:

<table>
<thead>
<tr>
<th>TABLE 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>POTENTIAL HAZARDOUS LOCATIONS</td>
</tr>
<tr>
<td>BASED ON LOCAL DATA</td>
</tr>
</tbody>
</table>

**Signalized**

(5 accident/year or rate >1.2/MEV)
- Middlesex Turnpike at Terrace Hall Avenue
- Burlington Mall Road at Lexington Street
- Cambridge Street at Wilmington Road
- Cambridge Street at Terry Avenue

**Unsignalized**

(5 accident/year or rate >0.80/MEV)
- Mountain Road at Winn Street
- Cambridge Street at Wayside Road

The findings from the review of MHD accident data was reviewed with the Burlington Police Department and generally verified.

**Public Transportation System**

The Transportation and Circulation Element of the Master Plan Study is a comprehensive examination of the transportation facilities and service provided in the Town. In addition to
roadway analysis, Task 1 also included a review of existing public transit services, and an identification of existing service needs, issues and options. As part of this, existing transportation demand management (TDM) programs designed to reduce the demand on the roadway system were also reviewed. Attention to transit and demand-management in Burlington’s townwide transportation element will be useful as the alternatives to the private automobile for residents and commuters can help to relieve the Town’s current and future traffic congestion. Task 3 will discuss the TDM strategies in greater detail.

1. Existing Service

The Town of Burlington is located within the Massachusetts Bay Transportation Authority (MBTA) district. The MBTA provides some bus service to the Town. In addition to the MBTA service, Burlington provides a local bus service known as the B-Line. While some major employers in and near Burlington have provided employees with ridesharing information, the level of any ongoing employer-based programs to promote carpooling and vanpooling is currently low. Lahey Clinic has been among the more active employers in this effort. Existing fixed-route transit service is shown on Figure 14, while potential transit trip generators (activity centers) were shown previously on Figure 6.

In general, the study area is served by fixed route bus, express bus service, regional vanpooling service, and taxis. In addition, demand-responsive service, primarily related to the elderly and/or handicapped citizens, also serves the area. Similar to many suburban locations in the region, a significant amount of transit service is oriented radially between Boston and the study area rather than within the study area will be discussed. The B-Line does provide service coverage for much of the Town.

- **MBTA Bus Routes**

There are several MBTA bus routes that serve the Town of Burlington. These include Route Nos. 350, 352, 353 and 354. These essentially connect Burlington with downtown Boston. The bus routes in Burlington serve Cambridge Street (Route 3A), Middlesex Turnpike, Burlington Mall Road and Second Avenue. The four bus routes combine for over thirty stops within Burlington, twenty of which are along Cambridge Street (Route 3A) and five along Burlington Mall Road. Figure 14 shows the existing MBTA Bus stops located within Burlington.

MBTA Bus Routes 350 and 352 both terminate at the intersection of Wilmington Road at Cambridge Street (Route 3A) in North Burlington. Bus Route 350, classified as a local route, is the only route of the four serving Burlington that operates on weekdays and weekends (both Saturday and Sunday) as well as running every 20 minutes during the rush
existing transit system

transportation master plan
burlington, massachusetts

LEGEND

<table>
<thead>
<tr>
<th>MBTA Bus Routes</th>
<th>Notation</th>
</tr>
</thead>
<tbody>
<tr>
<td>352</td>
<td>MBTA Bus Stops</td>
</tr>
<tr>
<td>350, 353, 354</td>
<td>MBTA Local Bus</td>
</tr>
<tr>
<td>350 &amp; 352</td>
<td>MBTA Bus Routes</td>
</tr>
<tr>
<td>353 &amp; 354</td>
<td>MBTA Local Bus</td>
</tr>
</tbody>
</table>

figure 14

not to scale
hour. During non-peak hours, the Route No. 350 bus runs every sixty minutes, fifty on Sundays, as it travels along Route 3 in Woburn, Winchester, and Arlington before arriving at the Alewife T Station. The Alewife T Station is the northern end of the rapid transit systems Red Line that extends from Alewife in Cambridge, on the north, to both Braintree and Dorchester, south of Boston. Unlike Route 350, Bus Route 352 is classified as an express bus route. Bus Route 352 enters Burlington via the regional highway system, I-95/128, then proceeds to travel along Route 3A in Burlington and terminates in north Burlington. Bus Route 352 operates every fifteen minutes during the rush hour and runs from north Burlington to Haymarket Station in downtown Boston.

Bus Routes 353 and 354 enter Burlington via Route 3 from Woburn. Similar to Bus Route 352, Bus Routes 353 and 354 are classified as express bus routes. This means that Bus Routes 353 and 354 only operate during the peak periods. Route 353 runs every 30 minutes and travels from the Burlington Industrial Area, located between Route 3 and the Middlesex Turnpike, express to Haymarket Square in Boston. Bus Route 354 travels the same pattern as Route 353 and operates every 15 minutes in the peak periods. Both 353 and 354 terminate at Oak Park located along Route 62 near the Bedford/Burlington TownLine. Route 354 extends through Woburn onto Haymarket or Park Square in Boston.

All the MBTA Bus Routes, except for Route 352, have a route variation associated with their flow pattern. At certain times of the day, Route 350 turns onto Burlington Mall Road then onto Middlesex Turnpike and then loops back around to Route 3 south via Route 128. The Burlington Mall Road pattern is omitted primarily between 6:00AM and 8:00AM and between 4:30 PM and 6:00PM. Bus routes 353 and 354 vary their routes about every other bus. The Route varies along Middlesex Turnpike by either staying on Middlesex Turnpike or by turning onto Crosby Drive for its length, and then rejoining Middlesex Turnpike for the remaining route.

Route 350 operates primarily as radial service feeding the Red Line at Alewife Station. It also provides access to destinations in Woburn and Winchester and limited service within Arlington. The most recent ridership counts for Route #350, 352, 353 and 354 were taken in December of 1992 as part of the MBTA's Ridership and Service Statistics program. On a typical weekday, 1,203 passengers boarded the Route 350 Bus, 453 passengers boarded the 352 Bus, 733 boarded the 353 Bus, and 536 boarded the Route 354 Bus.

Passengers on Bus Route 350 pay $0.60 to travel between Burlington and Winchester, or $1.00 between Burlington and Arlington Center and beyond. Passengers wishing to travel to Alewife from Burlington also pay $1.00. Trip rates for Bus Routes 352, 353 and 354
are $2.25 to travel between Burlington and all destinations in Boston (i.e. Haymarket Square, Park Plaza and Copley Square). A 10 ride ticket is available for $20.00 or a monthly pass may be purchased for $72.00 and is valid on both bus and transit within Zone 2. Exact change or a valid pass is required when using MBTA Services.

Presently, there are limited public or private parking facilities located along portions of the existing MBTA Fixed Bus Routes in Burlington. One such facility is the Presbyterian Church on Cambridge Street near the terminus of MBTA Routes 350 and 352. Public comments during the study process have indicated an unmet demand, however.

- Burlington B-Line

The Town of Burlington presently provides local bus service to its residents through a service called The Burlington B-Line. The Burlington B-Line, formally known as the People Mover, has been in operation for six years. Presently, Burlington provides the service through a limousine company in Medford, Massachusetts. The limousine service has been under contract to the Town for two years with one year remaining on the current contract.

The limousine service supplies and stores three 22 foot long diesel fueled Eldorado Ford buses. Each bus accommodates 19 passengers, and is wheelchair equipped with power lifts to accommodate handicapped people. The buses are essentially modified vans.

The cost associated with operating the B-Line is $23.85 per bus per hour plus fuel costs. Therefore, the Town of Burlington is charged $71.55 per hour, plus fuel expenses, to operate the B-Line service on a daily basis with three bus routes. With an annual operating cost of over $200,000.00, plus vehicle fuel, this service costs approximately $1.56 per vehicle mile travelled. A comparison of B-Line costs with national averages was completed. As shown in Table 6 the B-Line costs per hour are within the range of average costs, however, the B-Line costs per mile are somewhat higher than average. It should be noted this comparison is for guideline purposes only.

**TABLE 6**

<table>
<thead>
<tr>
<th>National Data ¹</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Low</strong></td>
</tr>
<tr>
<td>$19.90</td>
</tr>
<tr>
<td>$0.43</td>
</tr>
</tbody>
</table>

Presently, the B-line has six routes. Routes 1, 2 and 3 operate during the first half of the hour, while 4, 5 and 6 operate during the latter half of the hour. Service is provided from 8:00 AM to 6:30 PM on weekdays, and from 11:00 AM to 6:30 PM on Saturdays during the holiday season. All six routes originate at the Center School located off of Center Street. The Center School is also the central connection point for all B-Line Bus transfers.

B-Line Bus Route 1, known as the Mall Route, travels south along Cambridge Street, under Route 128, through the Blanchard Road industrial areas until turning north on Middlesex Turnpike. From Middlesex Turnpike, the route continues east on Burlington Mall Road, stopping at all the major land uses (i.e. Tower Records, Burlington Mall and Lahey Clinic). It finishes the run by returning to Center School within the half-hour, and then the same bus begins B-Line Bus Route 4.

B-Line Bus Route 2, known as the Fox Hill via Cambridge Street Route, primarily serves the residential neighborhoods in the northern and north-eastern areas of Burlington. Passengers utilizing this route and wishing to travel to the Burlington Mall must transfer at Center School to either Bus Routes 1, 5 or 6.

B-Line Bus Route 3, known as the Bedford Line via Francis Wyman Road Route, is a neighborhood collector serving the west central portion of Burlington. Again, like on Route 2, passengers wishing to travel to the mall must transfer to either Routes 1, 5 or 6.

B-Line Bus Route 4, the Winnmere via Winn Street Route, is also a neighborhood collector. It serves the central eastern and southeastern portions of Burlington. It primarily travels along Winn Street, underneath Route 128, and circles back and returns to the Center School.

B-Line Bus Routes 5 and 6, the Lahey Clinic & Malls via Lexington Street and the Burlington Mall via Terrace Hall Avenue Routes, respectfully, are similar in that they both travel Burlington Mall Road and serve the Malls and Lahey Clinic. Route 5 is also very similar to Route 1 except that Route 1 utilizes Cambridge Street while Route 5 uses Lexington Street. Bus Route 6 serves the northern portion of Middlesex Turnpike and Terrace Hall Avenue. Routes 5 and 6 primarily serve the mall and industrial areas of Burlington.

Reviewing Figure 14, it is clear that Routes 2, 3 and 4 serve the neighborhoods while Routes 1, 5 and 6 serve the industrial areas and the malls. The routes are designed so passengers picked up on the neighborhood routes can remain on the buses as they start
their second route. This allows the passengers to travel from the neighborhoods to the retail and industrial areas without switching buses. The disadvantage to this type of system, is that it can take as long as one hour for the bus to pick up passengers in the neighborhood, complete its route, start the new route and drop off the passengers at the mall. Compared to driving a car to the mall which takes approximately 10 minutes or less from most locations in Town, the bus service becomes an unattractive alternative to most people.

The Burlington B-Line operates as a flag down system, meaning that there are no pre-defined stops. Instead passengers wishing to utilize the B-Line must wave it down as it travels by. Assuming that passengers will walk a distance of a 1/4 of a mile or less to get to any bus route, the B-Line coverage of Burlington is very complete at 88% of the entire town.

In 1992, the Burlington B-Line’s ridership was 44,513 passengers, an average of 3,710 passengers per month. In 1993, ridership increased to 70,532 passengers, an average of 5,880 passengers per month. Figure 15 graphically shows a comparison of the B-Line’s ridership for all routes during 1992 and 1993. Over this one year period ridership increased by 2,170 passengers per month or by over 58%. With the B-Line’s 1993 ridership at approximately 70,000 passengers, the average cost per passenger was around $2.90, down $1.70 per passenger from 1992. The months of January and February saw the fewest passengers (3,870 and 4,259), while August and December saw the greatest number of passengers, 7,761 and 7,943 respectively.

Ridership data was also collected for each bus route combination. Bus Routes 1/4, which travels approximately 164 miles per day, had an annual ridership of approximately 26,500 passengers in 1993, up 85% from 1992. Bus Routes 2/5 travels approximately 178 miles per day and has an annual ridership of approximately 20,000 passengers, an increase of 50% over 1992. Bus Routes 3/6, like Routes 1/4, travels approximately 164 miles per day and has an annual ridership of approximately 24,000 passengers, up 47% from 1992. Figures 16 and 17 show the B-Line ridership by month for each combination of routes, 1/4, 2/5, and 3/6, by month of the year for both 1992, and 1993 respectively.

Comparing the two figures shows that ridership has significantly increased on all three buses. In 1993, Routes 1/4 had the greatest number of passengers, followed by Routes 3/6, then Routes 2/5. In 1992, Routes 3/6 had the greatest number of passengers, with Routes 1/4 and 2/5 following close behind. The change in the order could be the result of a route change between 1992 and 1993 service.
1992 - 93 B-Line Ridership Comparison

B-Line 1992-1993 Ridership Comparison
Figure 15

1992 B-Line Ridership By Route

B-Line 1992 Ridership Comparison By Route
Figure 16
1993 B-Line Ridership By Route

B-Line 1993 Ridership Comparison By Route

Figure 17

The B-Line service receives its funding from the Town of Burlington, the MBTA, and by private donations from Lahey Clinic, General Cinema and the Burlington Mall. Fares range from 75 cents for Adults, to 60 cents for students and 10 cents for transfers. Exact change is required, however, drivers do make change from time to time. For the past two years during the months of December and January, the B-Line has provided free service. The schedule was also extended to Saturdays for the month of December with funds donated by the malls. Figures 16 and 17 show a relatively large increase in ridership in December which results from these modifications.

In summary, the B-Line is a service that while not geared to the resident commuter, has continued to increase ridership. The current route structure covers most of the community. If it is desirable to also serve residents who work in Burlington, then problems with the service include the start/end times of daily service, the circuitous routes resulting in excessive trip times, and the highly probable need to transfer to another bus. In addition, the added cost to transfer, while only $0.10, represents another disincentive. These issues would need to be satisfactorily addressed to serve the intown commuter market segment.

* Burlington RaiLink

The Burlington RaiLink, a new service provided by the North Suburban Transportation Management Association (an affiliate of the North Suburban Chamber of Commerce), is
now providing a shuttle service Monday through Friday from the Mishawum commuter rail station in Woburn to Burlington businesses. Service began during March of 1994.

Presently, the Burlington RaiLink has one route that completes a circle through the Town of Burlington before reaching Mishawum Station. Service is provided from 6:00 AM to 9:00 AM in the morning and from 3:30 PM to 7:00 PM in the afternoon.

Burlington RaiLink travels from Mishawum Station in Woburn west along School Street to Park Road. From Park Road, the RaiLink continues to travel west along Beacon Street to Winn Street then Center Street before connecting with Cambridge Street (Route 3A). From Cambridge Street the RaiLink travels south until it intersects with Mall Road. It then travels west along Mall Road until Middlesex Turnpike where it turns left and travels south until Wheeler Road. Once on Wheeler Road, the RaiLink travels east to north east along Blanchard Road, Bedford Street and Wayside Road finally to arrive back on Cambridge Street (Route 3A). The RaiLink finishes the run by traveling north on Cambridge Street, completing the loop, and returning to Mishawum Station via the same route, Winn to Beacon to Park to School Street.

Presently, the service is funded through a grant from the U.S. Department of Transportation and Massachusetts Highway Department. Private contributions from many area companies have also been made as part of the local match.

2. Regional Transit Service

In addition to the more localized routes, there are regional services of some significance near Burlington.

* MBTA Commuter Rail

The Mishawum Station of the Lowell Commuter Rail Line is located off Mishawum Road in Woburn, Massachusetts. Currently, there are approximately 400 parking spaces at the station. Observations indicate that approximately 50 percent of the spaces are full. Train service includes 6 peak period trains during the weekday. Weekend service is also provided on a more limited basis. The rail line’s use is primarily by patrons with a Boston or Cambridge destination. Reverse commuting patterns are very low in numbers. In November 1993, the North Suburban Chamber of Commerce, through its Transportation Management Association (TMA), secured a federal congestion management grant to help fund a local shuttle connecting the station with Burlington. Again, his shuttle system began service in the Spring of 1994.
• **Logan Express**

Massport has been operating a Logan Express service between Woburn and Logan Airport for approximately the past year. The service is operated out of the Mishawum Station site in Woburn, Massachusetts. Massport plans to continue operations out of this location for about another 4 years. Since the service is operated out of the rail station parking facility, it will also benefit from the new bus service linking Mishawum Station to Burlington.

**Summary of Transit Analysis**

In summary, the review of transit services available in Burlington indicated that while the study area is well served geographically by transit, several potential areas of concern or deficiencies relate to that service, as follows:

- much of the transit service is radially oriented to Boston and not to the high activity centers within the community;

- prior to the Railink there had not been shuttle service to the rail station serving the region at Mishawum Station in Woburn;

- direct convenient connections among the local and regional transit services is not present;

- a combination of the operating times and circuitous routes discourages work commute trips within the Town;

- a need exists for off-street commuter parking for residents using public transportation; and,

- amenities such as shelters are not generally non-existent.

**Transit Related Parking**

With the exception of a few, small unpaved parcels located along Cambridge Street or the Presbyterian Church, transit related parking within Burlington does not generally exist. Comments made by residents at the public workshop as well as discussions with the Master Plan Committee, it indicates that there is a unmet demand for parking areas along transit routes, especially along the MBTA Routes to Boston.
Burlington residents who presently wish to use the MBTA bus service must live within walking distance of the bus stops or be dropped off near the route.

In February 1991, the MAPC conducted a study called “Commuter Parking in Metropolitan Boston”. The study identified areas for commuter parking lots within suburban points where drivers can change modes to transit or ridesharing. One of these locations was in Burlington at the Route 3/128 interchange. This location has been generally discussed for many years. If constructed, it would have a capacity of approximately 1,000 parking spaces based on MAPC plans. Though it would be a regional facility by location, it would also serve Burlington residents who work within Boston.

The construction of the lot in this location could also become part of a demand management plan designed to serve commuters who work within Burlington. Commuters parking in this lot would then transfer onto a shuttle to reach their respective work place. The incentive for the commuters would be easy access to the regional system without being delayed in local street congestion within Burlington. It could also benefit Burlington by eliminating vehicles from the local roadway network. As of this writing, the regional agency has not advanced this proposed parking lot beyond the early planning stage.

**Taxicab Service**

There is presently one company operating under four different names that offers taxi service in Burlington. The names are Brentwood Taxi Company, Burlington Center Taxi, Burlington Taxi Incorporated and Airport Service. The Town of Burlington regulates taxi rates and operations through its “Policy on Taxi and Vehicle for Hire Licenses”. It has established a fare rate of $2.50 per mile within the Town of Burlington, with senior citizens receiving a 10% discount. Fares for trips outside Burlington are fixed rates based on destination. For example, passengers wishing to travel to Boston from Burlington are charged $37.00. The Town's regulations restrict ridesharing except with the consent of the first passenger. However, up to four individuals in the same party, with the same origin and destination, may travel for a single fare. Taxi service is entirely on demand.

**Bicycle Transportation**

During the last few years, the demand of the bicycle community for recreation use has greatly increased. This increase is partly the result of an ever increasingly health conscience society, the increase in vehicular traffic, and development of new, multispeed, lightweight bicycles. While traditionally not a major element in the transportation system in the northeast, bicycle transportation does offer an alternative mode for local travel, and
would have a positive effect on reducing vehicular travel particularly during the non-winter months.

In general, bike trips can be divided into three types: recreational, commuter, and neighborhood. Recreational bike trips are usually trips of a longer length, often in conjunction with an automobile, and involve a preplanned origin, destination and route. Commuter bike trips are just that, trips from home to school or work. Neighborhood trips are generally recreational type trips in one’s own neighborhood, with no clear preplanned route or destination.

The potential exists for a significant amount of bicycle use. It is important that biking facilities be adequate to accommodate the users.

The Town does have a significant amount of conservation land and parks and recreational biking could be potentially high for Burlington. While a bike path has recently been designated in the Mountain Road area, there are currently no operational bike paths in the Town. There have also been conceptual plans developed for bicycle routes on the Blanchard Road area.

While most school areas have sidewalks in their vicinity that could be used by bicyclists (i.e. school children), in many locations the provision of sidewalks is not continuous. On narrow roadways with or without sidewalks, it is difficult to accommodate bicyclists in an ideal manner.

This analysis of bicycle transportation has also identified that there are generally no bicycle storage facilities provided at locations of major activity such as the MBTA stops, the Town Center, post office, shopping areas, etc. Without these types of facilities, it is difficult to encourage the use of bicycles as an alternative mode of transportation.
future travel conditions

In developing this plan element, consideration was given to future travel demands and conditions. Initially, future demands were estimated based on historical growth, known development projects and the anticipated buildout potential under the current land use plan and zoning regulations. The Burlington Planning Board Office provided a future year buildout analysis which included information about the present and future land use in the town. The land use analysis was completed for the Burlington Master Plan Committee as part of the Land Use Element of the Master Plan. In addition to the potential buildout, trends with respect to socio-economic data were also reviewed. The results formed a basis for projecting traffic. The findings are briefly summarized in this section.

Area Population, Households, Employment, and Traffic Trends

It is well recognized that land use and transportation demand are interrelated. As development occurs and the use of land becomes more intense, travel demand also increases and available roadway capacity is used. Congestion occurs when a roadway's capacity is reached, resulting in increased inconvenience for both residents and businesses.

Forecasting traffic volumes into the future, especially 20 years into the future, is by no means an exact science. It involves the use of socio-economic indicators or land use projections that deal with growth for the specific area in question. For this study, data was obtained from many sources, including the Metropolitan Area Planning Council (MAPC), Spaulding and Slye Real Estate, and the Burlington Planning Board Office. Data obtained from MAPC consisted of census data for population and households, and journey to work data for both residents and workers of Burlington. Spaulding and Slye supplied a report dated April 1993 which shows a quarterly review of commercial real estate trends in the office, research & development (R&D) and industrial markets in the Greater Boston area. This report was used to estimate the existing vacancy rates within Burlington. These data and information, along with historical traffic volume data, enabled site specific projections and background growth rates to be completed.

1. Population/Household Data

Burlington's year-round residential population is approximately 23,500, which is three-fourths of the workforce figure of approximately 31,500. Presently, Burlington has approximately 8,050 dwelling units, but has the potential for another 780 units in the future.
In terms of population, the forecasts for Burlington prepared by the MAPC indicate that by the Year 2013, population will have dropped by approximately 500 people. Over this same period, the Town of Burlington indicated that the number of households are expected to increase by about 780 Dwelling Units. As shown on Figure 18, Burlington's greatest period of growth in population took place during the 1960's and early 1970's, when it grew from approximately 13,000 in 1960 to 22,000 in 1970. Also shown in this figure, is the constant growth in households since 1960 with the trend continuing through to the year 2020.

2. Employment

Burlington's commercial/industrial base is also quite substantial compared to other communities, both within the area and within Massachusetts. The existing commercial and industrial space in Burlington is approximately 12.1 million square feet. Approximately 10 percent or 1.2 million square feet was vacant at the time of this report. Based on 1990 Census data, there are approximately 31,500 employees working in Burlington. Of this total, 3,650 or 11.6% also reside in Burlington. Under current zoning, Burlington has the potential to expand its commercial and industrial base by another 3.3 million square feet. The employment estimates for Burlington project an increase in the number of available jobs within Burlington to approximately 40,000 under full buildout. While population in Town is to experience a small increase over time, employment is expected to increase by
approximately 29 percent. Consequently, there will be an increased number of people will have to commute into Burlington, placing additional pressure on the regional roadway network as well as the local network.

3. Historical Traffic Volume Trends

In addition to reviewing the socio-economic data including population projections for abutting communities, traffic count data from permanent count stations maintained by the Massachusetts Highway Department were also reviewed. This data, along with past studies for the area, was used to determine the annual percentage of background growth. The data collected suggests a one percent per year growth in traffic for the area. The twenty year buildout analysis included within this study assumed the one percent per year for the first five years. However, since the population in the area is expected to remain stable, it is unlikely that general background growth would continue to grow at a rate of one percent per year for a period of twenty years. Therefore, the remaining fifteen years were projected to grow at a rate of a half percent per year.

4. Current Land Use Plan

In addition to background traffic growth, there are a number of other concerns that must be addressed when forecasting future traffic volumes. For instance, there are a number of existing and proposed developments, in and around the study area, that will generate new traffic on roadways within Burlington. For this analysis, we have assumed that all areas will be fully built-out by the year 2013, and that all existing vacant properties and ongoing or planned developments in the area will also be filled and operational.

Under full buildout, another 3.3 million square feet of commercial/industrial development combined with another 780 dwelling units could be constructed in Burlington. The Land Use element of the master plan included an estimate of the Town’s buildout potential. The Town was divided into five areas. Area One is defined as the area west of the Middlesex Turnpike, north of I-95 and south of Route 62, or simply just the Middlesex Turnpike North Area. Area Two is the area defined by Middlesex Turnpike on the West, I-95 on the South, Cambridge Street to the east and just past Burlington Mall Road on the north. Area Three is the area known as Middlesex Turnpike South and Wheeler Road/Blanchard Road Area. Area Four is defined as the Cambridge Street South Area. Finally, Area Five is the Town Center plus the remaining area within the Town which is not included within areas one through four. Figure 19 reflects the areas as described above. Table 7 shows a summary of the future potential land use as it relates to all five planning areas.
### TABLE 7
SUMMARY OF FUTURE POTENTIAL LAND USE CHANGES

<table>
<thead>
<tr>
<th>Area</th>
<th>Land Use Category</th>
<th>Infill of</th>
<th>Currently</th>
<th>Zoning Buildout</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Industrial</td>
<td>167,683</td>
<td>0</td>
<td>990,000</td>
<td>1,157,683</td>
</tr>
<tr>
<td></td>
<td>Business</td>
<td>32,080</td>
<td>80,000</td>
<td>100,000</td>
<td>212,080</td>
</tr>
<tr>
<td></td>
<td>Residential</td>
<td>0</td>
<td>0</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>2</td>
<td>Industrial</td>
<td>0</td>
<td>0</td>
<td>60,000</td>
<td>60,000</td>
</tr>
<tr>
<td></td>
<td>Business</td>
<td>567,400</td>
<td>100,000</td>
<td>440,000</td>
<td>1,107,400</td>
</tr>
<tr>
<td></td>
<td>Residential</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>Industrial</td>
<td>84,400</td>
<td>0</td>
<td>410,000</td>
<td>494,400</td>
</tr>
<tr>
<td></td>
<td>Business</td>
<td>192,000</td>
<td>308,000</td>
<td>220,000</td>
<td>720,000</td>
</tr>
<tr>
<td></td>
<td>Residential</td>
<td>0</td>
<td>0</td>
<td>139</td>
<td>139</td>
</tr>
<tr>
<td>4</td>
<td>Industrial</td>
<td>62,050</td>
<td>0</td>
<td>840,000</td>
<td>902,050</td>
</tr>
<tr>
<td></td>
<td>Business</td>
<td>23,180</td>
<td>0</td>
<td>50,000</td>
<td>73,180</td>
</tr>
<tr>
<td></td>
<td>Residential</td>
<td>0</td>
<td>0</td>
<td>75</td>
<td>75</td>
</tr>
<tr>
<td>5</td>
<td>Industrial</td>
<td>16,900</td>
<td>0</td>
<td>40,000</td>
<td>56,900</td>
</tr>
<tr>
<td></td>
<td>Business</td>
<td>37,550</td>
<td>0</td>
<td>170,000</td>
<td>207,550</td>
</tr>
<tr>
<td></td>
<td>Residential</td>
<td>0</td>
<td>0</td>
<td>557</td>
<td>557</td>
</tr>
</tbody>
</table>

**TOTALS**

<table>
<thead>
<tr>
<th></th>
<th>Square Footage</th>
<th>Dwelling Units</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1,183,243</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>488,000</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>3,320,000</td>
<td>780</td>
</tr>
<tr>
<td></td>
<td>4,991,243</td>
<td>780</td>
</tr>
</tbody>
</table>

1. Assumes current vacant floor space is fully occupied in the future
2. Approved projects or those in planning process as of 12/93
3. Potential building construction under land use plan

#### Long Range Traffic Forecasts

With the understanding gained related to potential land use changes and anticipated growth in households, employment, and background traffic, the next step in this process was to forecast the long range traffic volumes for the community's roadway system. This consisted of estimating the traffic specifically generated by the various land uses, determining a trip distribution pattern, and assigning the new volumes to the roadway network.

**1. Trip Generation**

In forecasting the area generated traffic volumes, standard procedures for trip generation, trip distribution and trip assignment were followed. The following summarizes the procedures and results.
Area 5
19% Change in Growth
Additional Trips = 10,500
(remaining section of town w/exception of Town Center)

Skilton Lane
Mill Street
Locust Street
Winn Street
Peach Orchard Road

 Wickford Road
Route 128

Additional Trips = Additional Trips per Day

Projected land use changes
not to scale

Figure 19
Traffic generated by various types of land uses have been observed over time with respect to magnitude, duration and temporal distribution. Measurements of numerous such developments conducted by members of the Institute of Transportation Engineers (ITE) have established trip generation rates\(^2\) which have been compiled for transportation analysis. Included in the database is information regarding trip activity for commercial and industrial facilities as well as for dwelling units.

There is over 1.5 million square feet of vacant and planned building space presently available in Burlington. For this study, it was assumed that this space would be occupied over the next twenty year period resulting in added trips for those areas. Consequently, trip generation estimates for the infill of vacant space and planned developments were completed, and are shown in Table 8.

<table>
<thead>
<tr>
<th>Area</th>
<th>Daily</th>
<th>AM</th>
<th>PM</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2,780</td>
<td>330</td>
<td>320</td>
</tr>
<tr>
<td>2</td>
<td>9,590</td>
<td>1,080</td>
<td>990</td>
</tr>
<tr>
<td>3</td>
<td>7,775</td>
<td>885</td>
<td>820</td>
</tr>
<tr>
<td>4</td>
<td>765</td>
<td>95</td>
<td>90</td>
</tr>
<tr>
<td>5</td>
<td>660</td>
<td>80</td>
<td>75</td>
</tr>
<tr>
<td>Total</td>
<td>21,570</td>
<td>2,470</td>
<td>2,295</td>
</tr>
</tbody>
</table>

As indicated earlier, there is the potential for 3.3 million square feet of new, additional floor space. Trip estimates were completed for the potential build-out conditions by geographic area. Table 9 summarizes the number of trips generated in each analysis area for the future build-out analysis.

<table>
<thead>
<tr>
<th>Area</th>
<th>Daily</th>
<th>AM</th>
<th>PM</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>8,425</td>
<td>1,040</td>
<td>1,060</td>
</tr>
<tr>
<td>2</td>
<td>6,740</td>
<td>765</td>
<td>705</td>
</tr>
<tr>
<td>3</td>
<td>12,125</td>
<td>1,390</td>
<td>1,395</td>
</tr>
<tr>
<td>4</td>
<td>7,290</td>
<td>875</td>
<td>915</td>
</tr>
<tr>
<td>5</td>
<td>8,040</td>
<td>725</td>
<td>850</td>
</tr>
<tr>
<td>Total</td>
<td>42,620</td>
<td>4,795</td>
<td>4,925</td>
</tr>
</tbody>
</table>

Combining the build-out potential with the infill of vacant space and planned development results in a considerable amount of new traffic which may be generated during the next twenty years and needs to be accommodated by the local street network. The total amount of new traffic associated with the infill of vacant space and new development is expected to be more than 64,000 vehicle trips per day. Additional new peak hour traffic is approximately 7,200 vehicle trips during the morning and afternoon peak hour.

### TABLE 10
TOTAL OF ESTIMATED NEW TRIPS UNDER ZONING BUILD-OUT AND VACANT INFILL/PLANNED DEVELOPMENTS CONDITIONS

<table>
<thead>
<tr>
<th>Area</th>
<th>Daily</th>
<th>AM</th>
<th>PM</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>11,205</td>
<td>1,370</td>
<td>1,380</td>
</tr>
<tr>
<td>2</td>
<td>16,330</td>
<td>1,845</td>
<td>1,695</td>
</tr>
<tr>
<td>3</td>
<td>19,900</td>
<td>2,275</td>
<td>2,215</td>
</tr>
<tr>
<td>4</td>
<td>8,055</td>
<td>970</td>
<td>1,005</td>
</tr>
<tr>
<td>5</td>
<td>8,700</td>
<td>805</td>
<td>925</td>
</tr>
<tr>
<td>Total</td>
<td>64,190</td>
<td>7,265</td>
<td>7,220</td>
</tr>
</tbody>
</table>

2. Trip Distribution/Assignment

Once the estimate of new trips was completed, the anticipated new traffic volume was distributed over the Burlington roadway network. A trip distribution pattern was determined by reviewing existing travel patterns, analyzing 1990 census work trip data, and evaluating employee zip code data of several major employees. The assignment of new trips assumed an unconstrained and unimproved roadway network.

Figure 20 illustrates the estimated trip pattern used to assign new traffic to the network. In general, it was estimated that 53% of the new traffic would be oriented to the regional highway system, with 19% related to Route 3. Also, 12% of the new traffic is expected to be locally generated within the community. The remaining 35% of the new traffic would be distributed to nearby communities and utilize the various alternative roadways (i.e. Cambridge Street, Route 62, Middlesex Turnpike, etc.) to reach respective destinations in Burlington.

### Traffic Volume Analysis

As discussed above, volumes on the street network will continue to grow over the next 20 years, particularly due to the large growth in employment. The initial step in analyzing the impact of long term growth was to examine the change in roadway volumes between today and the Year 2013. This analysis assumes the current network remains in place without significant changes.
trip distribution

transportation master plan
burlington, massachusetts

figure 20
Table 11 presents a summary of the expected increases in traffic volumes at key locations in Burlington for both commuter peak hours between existing conditions and the Year 2013. As shown, there is a varying degree of increased traffic on various roadways. However, the analysis results indicate that the general magnitude of volume increases on area roadways over the next 20 years could be substantial. Figure 21 illustrates the estimated increases on many of the key Town roadways.

### Table 11

#### SUMMARY OF FUTURE BASE TRAFFIC INCREASES

<table>
<thead>
<tr>
<th>Location</th>
<th>Existing Volume</th>
<th>Estimate Volume 2013</th>
<th>Change in Volume</th>
<th>Percent in Change</th>
<th>Future Capacity Constraint</th>
</tr>
</thead>
<tbody>
<tr>
<td>Middlesex Turnpike North</td>
<td>14800</td>
<td>19900</td>
<td>5100</td>
<td>34.5%</td>
<td></td>
</tr>
<tr>
<td>Middlesex Turnpike North of Third Avenue</td>
<td>29450</td>
<td>41250</td>
<td>11800</td>
<td>40.0%</td>
<td>Yes</td>
</tr>
<tr>
<td>Middlesex Turnpike North of Second Avenue</td>
<td>27300</td>
<td>39250</td>
<td>11950</td>
<td>43.8%</td>
<td>Yes</td>
</tr>
<tr>
<td>Middlesex Turnpike South</td>
<td>25600</td>
<td>31100</td>
<td>5500</td>
<td>21.5%</td>
<td></td>
</tr>
<tr>
<td>South Avenue</td>
<td>3500</td>
<td>7150</td>
<td>3650</td>
<td>104.3%</td>
<td></td>
</tr>
<tr>
<td>Lexington Street</td>
<td>9100</td>
<td>13700</td>
<td>4600</td>
<td>50.5%</td>
<td></td>
</tr>
<tr>
<td>Terrace Hall</td>
<td>6300</td>
<td>11900</td>
<td>5600</td>
<td>88.9%</td>
<td></td>
</tr>
<tr>
<td>Bedford Street East of Middlesex Turnpike</td>
<td>13100</td>
<td>19800</td>
<td>6700</td>
<td>51.1%</td>
<td></td>
</tr>
<tr>
<td>Bedford Street East of Center Street</td>
<td>9000</td>
<td>13300</td>
<td>4300</td>
<td>47.8%</td>
<td></td>
</tr>
<tr>
<td>Bedford Street at West of Center Street</td>
<td>14100</td>
<td>22250</td>
<td>8150</td>
<td>36.6%</td>
<td></td>
</tr>
<tr>
<td>Blanchard Road</td>
<td>1700</td>
<td>11900</td>
<td>10200</td>
<td>600.0%</td>
<td></td>
</tr>
<tr>
<td>Skilton Lane</td>
<td>3400</td>
<td>6200</td>
<td>2800</td>
<td>82.4%</td>
<td></td>
</tr>
<tr>
<td>Cambridge Street North</td>
<td>22200</td>
<td>28800</td>
<td>6600</td>
<td>29.7%</td>
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</tr>
<tr>
<td>Cambridge Street at Terry Avenue</td>
<td>30000</td>
<td>42000</td>
<td>12000</td>
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</tr>
<tr>
<td>Cambridge Street at Center Street</td>
<td>25600</td>
<td>38150</td>
<td>12550</td>
<td>49.0%</td>
<td>Yes</td>
</tr>
<tr>
<td>Cambridge Street at Burlington Mall Road</td>
<td>26600</td>
<td>39600</td>
<td>13000</td>
<td>48.9%</td>
<td></td>
</tr>
<tr>
<td>Burlington Mall Road</td>
<td>24000</td>
<td>31500</td>
<td>7500</td>
<td>31.2%</td>
<td></td>
</tr>
<tr>
<td>Peach Orchard Road</td>
<td>4000</td>
<td>5150</td>
<td>1150</td>
<td>28.8%</td>
<td></td>
</tr>
<tr>
<td>Mill Street</td>
<td>1700</td>
<td>4000</td>
<td>2300</td>
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<td></td>
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<tr>
<td>Winn Street North</td>
<td>22000</td>
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<td>5950</td>
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<td>Winn Street South of Peach Orchard Road</td>
<td>27800</td>
<td>35100</td>
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<tr>
<td>Winn Street South</td>
<td>23700</td>
<td>27950</td>
<td>4250</td>
<td>17.9%</td>
<td>Yes</td>
</tr>
<tr>
<td>Mountain Road</td>
<td>4200</td>
<td>6550</td>
<td>2350</td>
<td>56.0%</td>
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As indicated in both Figure 21 and Table 11, several sections of two lane roadways located in the Town are expected to experience volumes in excess of the desirable capacity, particularly of two lane roadways. These include the northern section of Middlesex Turnpike, all of Cambridge Street and Winn Street. In general, increases in volumes range from approximately 18% to 600% (Blanchard Road). Blanchard Road volumes are expected to increase by 6 times from the current 1700 vehicles per day to nearly 12,000, given the potential economic growth.

Collector roadways which also serve as residential streets, such as Mill Street, Skilton Lane and Peach Orchard Road, are expected to experience relatively high increases, but have daily volumes remaining at or under 6200 vehicles per day.

As congestion intensifies over the years, drivers will tend to seek alternative routes, diverting onto the more local roadways, even though this may result in longer travel distances. This consequence of increasing volumes clearly deserves attention in considering improvements as part of the transportation element of the Master Plan.
conclusion

Task 1, the Inventory and Analysis, was the initial step in developing the Transportation and Circulation Element of the Master Plan. As described in the previous pages, it was a comprehensive effort in terms of reviewing not only roadway conditions, but also public transit, bicycle and pedestrian conditions. Long range, build-out forecasts based on the current land use plan and zoning were also completed as part of Task 1.

Overall, the results of this effort indicated that while there are positive aspects regarding the transportation system, there is a clear need for safety and service improvements to meet both current and future needs.

The analysis has shown that the roadway system, particularly the major north-south arterials, exhibits high volumes that contribute to sluggish movement during peak periods, high levels of delay to side street volume, and less than desirable congestion and safety characteristics along certain sections and at key intersections. These include Cambridge Street, the northern section of Middlesex Turnpike, and Winn Street. The two lane sections of the north-south arterials are at or nearing constrained conditions. Numerous and/or poorly defined driveways further exacerbate this condition. With poor operating conditions on the major roadways, greater use of the more local streets occurs. These local streets are generally located in residential areas, and are not necessarily designed to safely accommodate substantially more traffic. Future build-out conditions are expected to add significant amounts of traffic to the Town's roadway system. The analysis of future conditions indicate that capacity constraints will occur on Cambridge Street, Middlesex Turnpike, Bedford and Center Streets and Winn Street. At this stage in the study effort, priorities in terms of roadway improvements would appear as follows:

Short Range Roadway Priorities

- address the eight (8) local high accident intersections as identified by the MHD and that are eligible for federal aid funding;
- improve signal systems including better monitoring and coordinating operations;
- modify the geometry of several local intersections in an effort to better define travel paths; and
- detail a comprehensive roadway and Transportation Demand Management (TDM) plan for the Blanchard Road/Wheeler Road redevelopment area that
satisfies the anticipated demands, while minimizing impacts on the residential area.

A summary listing of the study roadways and intersections along with their respective deficiencies or needs is included in the Appendix.

**Long Range Roadway Priorities**

- the major north-south arterials, particularly Cambridge Street and Middlesex Turnpike, need major improvement plans that will improve levels of service, safety, and aesthetics through a range of options, such as providing better definition of travel lanes and side streets/driveways, improving key intersections, and/or reducing volumes.

The transit system, though served by both the MBTA and the Town's own B-Line service, is not geared to meeting employee related demands in Burlington storage and designated routes. Consequently, a small percentage (3%) of Burlington employees use transit to reach work, regardless of whether residing in or out of Burlington. The analysis indicated that deficiencies that can be attributed to frequencies and time of service, circuitous routings, inadequate coordination among modes or services, or no service at all. If vehicular volumes are to be reduced to any extent on the local roadway system, public transit will need to be an important element of the travel demand management (TDM) program.

Other problem areas identified that relate to TDM include:

- the lack of any substantive bicycle related facilities in terms of; and

- locations of sidewalk discontinuities along key sections of roadways or lack of any sidewalks where they would be desirable.

Task 2 and 3 will involve identifying and evaluating various options to alleviate the problems, and to meet the short and long range needs identified in Task 1.
part 5 task 2
roadway alternatives
transportation master plan element
burlington

technical report no. 2
road alternatives

Prepared for

Master Plan Committee
Burlington Planning Board
Town of Burlington, Massachusetts

June 1994

mcdonough & scully, inc.
Transportation Master Plan
Burlington

Technical Report No. 2
Road Alternatives

June 1994

Prepared For

Master Plan Committee
Burlington Planning Board
Town of Burlington, Massachusetts

Prepared By

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<td>Figure 24</td>
<td>Summary of Long Range Analysis - Middlesex Turnpike Corridor - Segment 2</td>
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<td>Figure 25</td>
<td>Summary of Long Range Analysis - Middlesex Turnpike Corridor - Segment 3</td>
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<td>Wheeler Road Two Lane Option</td>
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**introduction**

The transportation and circulation element of the Burlington Master Plan included a number of steps before finalizing the short and long range plans for meeting the transportation needs of the community. The intent of the Master Plan Committee is to be comprehensive and address all modes of transportation. Figure 1 illustrates the overall study process.

<table>
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<th>evaluate alternatives</th>
<th>prepare plan</th>
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<tr>
<td>* safety</td>
<td></td>
<td>* system management</td>
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</table>

**Figure 1**

*Public participation and input*

**Burlington Transportation Study Process**

Objectives of the study include:

- identify present and future traffic and circulation problems and needs;
- determine suitable and feasible measures to ameliorate existing inadequacies and to minimize future transportation deficiencies, with a logical sequencing and timing of improvements and actions, and with an identification of costs and funding sources;
- enhance opportunities for alternative travel modes including ridesharing, public transit, walking and bicycling; and,
- to develop realistic traffic and transportation actions which are fully compatible with the Town's Master Plan.

The initial task consisted of an inventory and analysis of the transportation facilities and services including roadway, transit, pedestrians and bicyclists. That has been completed and is documented in Technical Report No. 1, *inventory and analysis*. Task 1 included a compilation of various traffic data such as volumes, accidents and physical conditions. All the major roadway corridors have been incorporated into the study. The existing public transportation service was evaluated in the initial task. The final key item in the first study task was to forecast potential traffic volumes based on a buildout of land under current zoning.
A series of problems and needs identified in Task 1 have become the basis of evaluating alternative improvements in Task 2. Key findings from the analysis conducted in Task 1 included:

- the major corridor of Middlesex Turnpike, Cambridge Street and Winn Street all carry volumes well in excess of 20,000 vehicles per day which creates serious congestion and delay, particularly on the two lane sections of the roadways;

- twelve (12) intersections have been identified on the Massachusetts Highway Department’s high accident listing along with an additional five locations that appear problematic based on recent accident experience reported by the Burlington Police Department;

- the existing signal controls are not functioning as efficient as desired due in part to being antiquated equipment; and

- a number of locations have less than desirable geometric design and/or inadequate curb management.

Figure 2 summarizes the roadway deficiencies in Task 1 by location. Evaluation of build out conditions indicated substantial potential growth in traffic volumes along Middlesex Turnpike, Cambridge Street, Bedford Street, Blanchard Road and others. The analysis showed that the capacity of the existing two lane sections of Middlesex Turnpike, Cambridge Street and Winn Street would be exceeded, assuming a daily capacity of a two lane being in the 20,000 to 25,000 vehicles per day range.

Task 2, which is documented in this report, focused on developing alternative improvements to the roadway system. These included intersections and corridors as a whole for the major roadways facing capacity, safety and management deficiencies. In addition, physical conditions of roadways and adjacent sidewalks were also included in Task 2. The demand management actions including transit, ridesharing, etc. are included in Task 3. However, as major roadway alternatives were developed, the applicability of alternative modes in terms of design and/or operations were taken into consideration.

**task 2 study report**

This technical report documents the process of developing the roadway alternatives and summarizes the results of the analysis. Also included is a description of the evaluation process and the transportation goals and objectives developed as part of this task. The primary purpose of the task was to identify options and consider advantages and disadvantages of the options as well as key issues related to implementation. The results of the task were extensively reviewed with the Master Plan Committee and presented at the public forums. The output from the task provided input to the final roadway recommendations.
summary of problems and needs

transportation master plan
burlington, massachusetts

not to scale
figure 2
goals and objectives

Once an understanding of the transportation problems and needs was gained, goals and objectives of the transportation master plan could be developed. They were developed in concert with the Master Plan Committee, with input from the general public, and following the development of an understanding of the transportation needs identified in Task 1. The transportation goals take into account the economic and land use goals that were developed and endorsed by the Master Plan Committee over the past year. Some of the objectives developed as part of the economic and land use plans have been initiated as a result of the transportation plan development.

Ultimately, the goals are used to guide the Town in meeting its transportation needs and also, allow the Community to measure the achievement of the plan.

The following lists the set of transportation goals and objectives.

goal #1 promote a transportation plan and system that is intermodal and encourages safe, effective alternatives for travel, reduces the need to drive alone, and maximizes the integration of all modes.

- Enhance the integration and coordination of various modes of travel including walking, bicycling, ridesharing and transit.
- Increase the use of public transit for commuting purposes.
- Ensure continuous, adequate sidewalks exist along all major arterials and collectors and that safe crossing areas are appropriately highlighted at major demand locations.
- Create a safe, visible bicycle network between neighborhoods, schools, parks, and community and employment centers.
- Work with the regional Transportation Management Association (TMA) to develop and implement appropriate employer participation in managing demand.
- Encourage land use types, designs, and regulations that support alternative travel demand programs, particularly in the commercial and business zones.
- Develop demand management regulations to be incorporated into the site plan review process and town bylaws.

goal #2 Implement a transportation plan which is consistent with the community’s economic and land use plan and which is sensitive to the needs of abutting communities in the region.
Develop a final transportation plan for Wheeler Road/Blanchard Road business zone to accommodate large potential for growth and include adequate, feasible roadway system from the perspective of physical capacity, neighborhood impact and financing ability.

• Assure multimodal access to the park, open space, and recreation areas within the Town.

**Goal #3** create a transportation system that provides safe and efficient arterials to accommodate through movement and movement to major commercial and business centers while minimizing unnecessary traffic through neighborhoods.

• Improve locations identified as high accident intersections.

• Implement improvements along Cambridge Street to alleviate congestion, improve safety and support the "Town Center" concept.

• Reduce pressure along Middlesex Turnpike and Bedford Street by improving Route 3 accessibility.

• Reduce traffic diversion through neighborhoods.

**Goal #4** develop a transportation system that is cost-effective and affordable, that maximizes the use of federal and state transportation funds, that equitably incorporates private financing, and minimizes town expenditures.

• Identify and pursue federal and state funding programs to support roadway, transit and TDM actions.

• Develop a local funding mechanism for local public and private contribution to implementing the transportation improvement plan.

**Goal #5** implement actions that minimize the negative impact on the community, the environment, and Town resources.

• Avoid significant impacts on Town's aquifer and water resource areas and wetlands.

• Incorporate streetscaping and landscaping plans in all roadway improvement projects.
evaluation process

The work in this task focused primarily on the roadway system and the areas of analysis were further categorized by: major corridor; key intersections; and, system management actions. The development of improvement plans for treating entire corridors was somewhat more complex than for isolated intersections or system management actions. Consequently, the evaluation process developed for major corridor analysis was also more complex in that it considered several major areas including:

- travel impacts
- resource impacts
- potential amenities

Treatment at isolated intersections and actions under system management are typically considered minor actions which have a minimal negative impact on the environment and property. Thus, a complex evaluation for these types of projects is generally not required. They must, however, still be consistent with the Goals & Objectives developed as part of this study.

The specific criteria for the impact areas included in the major corridor evaluation process are summarized in Figure 3 and are further explained below.

corridor evaluation criteria

The following criteria were developed for the major impact areas. A qualitative measure was assigned depending upon whether the alternative had a major, minor or no impact.

travel impacts

- A roadway corridor is impacted either negatively or positively by increases or decreases in traffic volume. In this study for example, a decrease in traffic volume was considered a positive impact while increases due to an improvement were considered a negative impact. Traffic volume impacts were categorized as follows:

  major impact - +/- 5,001 or more vpd
  minor impact - +/- 501 to 5,000 Vehicles Per Day (vpd)
  no impact - +/- 0 to 500 vpd

While an improvement on one roadway may result in increased volume on that roadway, it may also result in reducing traffic on other roadways. This is noted where appropriate.
**Corridor capacity** was quantified to determine a level of impact on the operations of a particular corridor as follows:

- **major impact** - +/- 11% or more of original capacity
- **minor impact** - +/- 1 to 10% of original capacity
- **no impact** - +/- no change in original capacity

The quality of flow along a particular corridor is largely dependant on not only the number of lanes available, but also the impedance to through traffic.

- **major impact** - (pos.) The addition of one travel lane in each direction with or without a center two-way-left-turn lane. (neg.) Reduction of one or more travel lanes per direction.
- **minor impact** - (pos.) no new roadway lanes but new median with left-turn storage lanes at major intersections or a new center two way left-turn lane. (neg.) Construction of lanes with no special lanes to facilitate turning vehicles.
- **no impact** - no change in the number of lanes/geometry

Local access however, may be affected by an improvement along a corridor and this needs to be recognized and considered.

High accident locations can be positively or negatively impacted by the addition or subtraction of travel lanes. For example it is known that providing center two way turning lanes and protected left-turn lanes at intersections improves the safety for vehicles making turning movements and decreases the incidence of rear-end type collisions.

Intermodal capabilities along a particular corridor were assessed based on the available right-of-way as bus turnouts, bus shelters, sidewalks, and bike lanes require additional roadway width at intervals.

- **major impact** - 13 feet or more of right of way required
- **minor impact** - 0 to 12 feet of right of way required
- **no impact** - no additional row required

Impacts of roadway widening on the right-of-way (ROW) required may be major consideration in selecting an alternative. Depending on the particular corridor cross-section that is developed, the level of roadway widening will vary. The impact of the options with respect to widening were determined using the following criteria.

- **major impact** - 13 feet or more of right of way required
- **minor impact** - 0 to 12 feet of right of way required
- **no impact** - no additional row required
resources

- Water resource areas (districts) may be affected by the widening of roadways in a number of ways. Widening of roadways which abut water resource areas could involve the filling of potential flood plain space, an increase in roadway area requiring drainage, increased road-salt runoff, etc. Assessing the impact on water resources was a combination of roadway widening and the location of work with respect to the wells and their respective protection zones:

<table>
<thead>
<tr>
<th>Impact</th>
<th>Description</th>
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<tbody>
<tr>
<td>Major impact</td>
<td>+/- 13 feet or more of roadway widening or within well protection zone</td>
</tr>
<tr>
<td>Minor impact</td>
<td>+/- 0 to 12 feet of roadway widening and within 50 feet of well protection zone boundary</td>
</tr>
<tr>
<td>No impact</td>
<td>No change in the roadway width or drainage area</td>
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</table>

- Wetlands which abut an existing roadway would be impacted in much the same way as water resource areas discussed above and hence, similar impact criteria are applied:

<table>
<thead>
<tr>
<th>Impact</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major impact</td>
<td>Roadway widening within wetland</td>
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<tr>
<td>Minor impact</td>
<td>Roadway widening within buffer</td>
</tr>
<tr>
<td>No impact</td>
<td>No change in the roadway width or no work near wetlands</td>
</tr>
</tbody>
</table>

- A roadway improvement project could impact public open space and/or private property. Widening a roadway may involve the taking of public open space and/or private property both of which could signify a negative impact. Narrowing the road width does not necessarily mean gains in public open space or private property, although the additional space gained from a reduced width could be used for additional sidewalk space or bike path, etc, in which it could be considered it a positive impact. A project that provides new or better access to public open space may be considered a positive impact although it may be using a portion of public land for transportation.

The impact on public open space or private property was determined from estimating a direct impact of the improvement option (i.e. widening will require private taking).

potential amenities

- Amenities considered in the evaluation of the roadway alternative options are those that could improve the conditions for pedestrians and bicyclists as well as the general aesthetics of the area. While most projects will include the provisions of sidewalks and aesthetics, the assessment or corridor options took into account the right-of-way requirement in order to provide the amenity. For example, if a significant amount of right of way was required to provide a safe bike route along a certain corridor, a major
negative impact would occur under this option. Criteria is as follows:

- major neg. impact: 13+ feet or more of right of way widening
- minor neg. impact: 0 to 12 feet of right of way widening
- positive impact: no change in the right of way width

**key intersection/system management evaluation criteria**

The analysis of improving key intersections or overall system management is generally not as complicated as examining corridors as a whole. In many instances, addressing specific intersections does not require major right of way considerations or widening of the roadway. The analysis of these locations focuses on the level of service and safety aspects of the alternative. It was noted, however, if the location abutted wetlands or were near the wells. For the unsignalized intersections being evaluated for potential signalization, the signal warrants criteria as defined in the Manual on Uniform Traffic Control Devices (MUTCD) were taken into account.

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major corridor alternatives evaluation

The following pages summarize the major corridors evaluated for treatment under the work plan. The specific corridors given detailed attention include:

- Cambridge Street;
- Middlesex Turnpike;
- Wheeler Road/Blanchard Road;
- Bedford Street/Center Street;
- Winn Street;
- Burlington Mall Road; and,
- Lexington Street.

Prior to discussing each corridor, general information on the typical types of cross-section options that were considered for the various roadways is presented. In addition, special design treatments or features such as bicycle treatments along a corridor and bus turnouts are also provided. The reader should refer to these descriptions while reviewing the corridor options.

typical corridor cross-sections

In addressing each corridor, consideration was given to the existing traffic levels and safety record, projected volumes, and the land use and economic development plan elements of the Town's Master Plan. Typical types of corridor treatments were developed and evaluated against the criteria discussed in the previous report section. The typical types of treatment included: two (2) lane, three (3) lane, four (4), and five (5) lane cross-sections.

The two lane cross-section (Figure 4) would include two lanes (one per direction) and require a shoulder of at least two (2) feet. Shoulder width would vary depending on the function, location and volume of the roadway. Two lane roadways can generally accommodate up to 15,000 or 20,000 vehicles. As the volume increases beyond 10,000, however, one could expect increases in congestion and delay along the corridor due to turning volume or stopping vehicles, particularly during peak times. Also included in this option, as well as all of the wider roadway options, is a separation (4 feet minimum) between the roadway and a six (6) foot sidewalk.

Variations of the two lane concept is the two lane roadway with a center median or a center two way left turn lane. In the options evaluated, the median option (Figure 5) was of sufficient width to accommodate a left turn lane where needed. With the median, a wider shoulder (7-10 feet) is required to accommodate vehicle flow around any possible obstruction (i.e. breakdown, accident). Including the separation space, which can also be a planting area, and the sidewalk, the right of way under the two lane with a median option would be at least 76 feet. By providing for left turning vehicles at key locations, there would be a small increase in capacity realized and reduction in delays due to turning vehicles. However, by installing a median and consolidating...
Summary

- can accommodate 15,000 to 20,000 vpd

Advantages:
- Least expensive alternative.
- Minimal right-of-way required.

Disadvantages:
- Minimal capacity for through traffic movement.
- Delay to through vehicles by left-turning vehicles.
two lane with raised center median

Summary

- can accommodate up to 22,000 vpd

Advantages:
- Reduces frequency of rear-end and angle type accidents.
- Provides physical separation to reduce head-on accidents.
- Provides a median refuge area for pedestrians and streetscape.
- Discourages strip commercial development.

Disadvantages:
- Requires wider pavement and shoulders.
- Increased pavement and right of way may not be available.
- Indirect routing required for large trucks.
- Increased delay to left-turning vehicles.

corridor treatments - alternative cross-sections

transportation master plan
burlington, massachusetts
locations where left-turn movement or reverse direction movement is allowed, there will be some increase in the level of inconvenience to those who live or conduct business along the corridor. Care in identifying the turning locations and the design of these locations is critical from a traffic flow, traffic safety, convenience, local access and ROW considerations.

The two lane roadway option with a center two way left turn lane (Figure 6) has some of the advantages of the median option while requiring less right of way (approximately 62 feet). The effect this option has on local access or inconvenience is usually minimal. It has been shown to have a significant impact on improving safety, primarily by removing the turning vehicle from the through lane in an efficient manner. By removing the turning vehicle, delay to the through movement is also reduced. This design option increase capacity slightly more than the median option as the left turning vehicle can conduct its movement as desired along the corridor. Disadvantages of this option would be the lack of pedestrian refuge or center streetscape. In addition, this option tends to encourage or retain the strip type development pattern due to the lack of restrictions placed on access.

In addition to the two lane options, four lane alternatives were also examined. Once a roadways daily volume exceeds 25,000, severe congestion is experienced - usually over many hours of the day. The result is typically excessive delay to both the major street flow as well as the side street volume, increased emissions and fuel consumption, and a diversion of traffic from the major street to side streets in an attempt to avoid the congestion. The four lane option (Figure 7) consists of two lanes per direction and can easily accommodate flows up to 40,000 vehicles per day or more. Depending on the locations and funding source, the width of the roadway would vary from approximately 52 feet (urban design with 2 foot curb offsets) to 68 feet (which includes 10 foot shoulders). With the separation or planting strip and the sidewalks, the required right-of-way would be a minimum of 72 feet. While this option would enhance capacity and through traffic movement, it may not have a positive effect on safety since turning vehicles are not removed from the main traffic stream. An option would be to incorporate special design treatment at the major intersections only, and outside that area, provide a standard four lane cross section. Without the median, there is also no separation of opposing flows. This may not be a major problem in lower speed areas or where appropriate design standards are used and good visibility exists.

Similar to the two lane roadway types studied in this analysis, variations of the four lane concepts that incorporate the median or center two way left turn lane were also considered. The four lane option with a median (Figure 8) has the same advantages of enhancing capacity, but also has a generally positive effect on safety by physically separating opposing flows and designing protected left turn lanes at key locations. The median provides a refuge for pedestrians as well as an area for streetscape. The ROW required would be 90 feet including the separation strip and sidewalks as well as only a two foot curb offset. The effect on local access or inconvenience would be similar to the two lane option with a median. The impact on land may be more substantial at the key turning locations as well.
two lane with center two way left-turn lane

Summary
- Can accommodate up to 26,000 vpd.

Advantages:
- Reduces delay to through vehicles by left-turn motorists.
- Reduces frequency of rear-end and angle type accidents.
- Provides spatial separation between opposing directions which reduces head-on accidents.
- Increases operational flexibility.

Disadvantages:
- No refuge area in median for pedestrians.
- May encourage strip commercial development.

corridor treatments - alternative cross-sections
Summary

- can accommodate up to 40,000 vpd

Advantages:
- Provides additional lanes to increase capacity for through traffic movement.
- Requires less width than 4 lane divided and 5 lane with center turn lane alterations.

Disadvantages:
- Delay to through vehicles by left-turning vehicles.
- May generate safety problems associated with rear-end and lane-changing conflicts.
- No separation of directional flow.
four lane with raised center median

Summary
• can accommodate 40,000 + vpd

Advantages:
• Provides additional lanes to increase capacity for through traffic movement.
• Reduces rear-end and angle accidents associated with left-turn maneuvers.
• Provides physical separation to reduce head-on accidents.
• Discourages strip commercial development.
• Provides a median refuge area for pedestrians.

Disadvantages:
• Required pavement and right-of-way width may not be available.
• Increased delay to left-turning vehicles.
• Indirect routing required for large trucks.
• Lack of operational flexibility due to fixed median.
The variation that includes a center two way left turn lane (Figure 9) has a substantial positive impact on enhancing capacity and safety without the inconvenience or restrictions placed on local access. At the same time, however, the pavement area is approximately 66 feet in width. There would be no refuge area for pedestrians and crossing a roadway such as this would be difficult at best except at signalized intersections. The right of way required would be slightly less (86 feet) that the median option. The turn lane does provide the separation of opposing traffic streams.

**special design treatments/amenities**

In each of the major cross-section design alternatives, special features can also be incorporated. These include sidewalks, bus turnouts and shelters, streetscaping, and bicycle facilities. Figures 10 and 11 illustrate typical details or alternative approaches to designing bikeways and bus stop turnouts along major corridors.

As illustrated in Figure 10, bikeways can be designed on exclusive ROW or within the roadway itself. Up until the present, they have not been viewed as serious alternatives to commuting and consequently, this has resulted in limited consideration in the roadway design process. As a result, most bike routes in this region, with the exception of the major recreational bike paths, are generally signed routes along an existing roadway.

If the bike route is to be within the paved section of roadway, there should be a minimum of 4 to 5 feet of pavement width devoted to the bike lane. Some areas simply stripe the lane while others may use a different texture to denote the different use. If along the sidewalk, the sidewalk needs to be between 8 to 11 feet in width. A separate two way bikeway requires a width of 7 to 8 feet at a minimum although a somewhat greater width enhances the bike safety. The exclusive bikeway or the bikeway along the sidewalk should also include 1 to 2 foot graded areas on the sides.

Figure 11 illustrates a typical bus turnout which would be located at a stop. There would be a need to accommodate 1 to 2 buses. With the transition tapers, a one bus turn out would be approximately 60 feet in length. It would add approximately 8 feet to the overall width of the roadway in that immediate area. With a shelter, the additional right of way required would be approximately 18 feet. Wherever bus stops are located along the major arterials, care must be taken for pedestrian safety as they embark on or depart from the bus.

**cambridge street corridor**

In studying alternatives for the Cambridge Street corridor, the roadway was divided into three basic segments. These are shown in Figure 12 along with some general information on the roadways physical and operational characteristics. The first segment was the southern section between Route 128 to the intersection with Bedford Street in the Town Center. The second section was in the area considered the Town Center from Bedford Street to approximately Skilton Lane. The third and final section was the northern section between Skilton Lane and the Billerica Townline. The following discussion addresses each segment. For each corridor and their respective segments, a brief summary of the conditions is reviewed and the results from evaluating the different options is summarized.
Summary
- can accommodate 44,000 to 50,000 vpd

Advantages:
- Provides additional lanes to increase capacity for through traffic movement.
- Reduces delay to through vehicles by left-turning vehicles.
- Reduces frequency of rear-end and angle type accidents.
- Provides spatial separation between opposing lanes to reduce head-on collisions.
- Increases operational flexibility

Disadvantages:
- Required pavement and right-of-way width may not be available.
- No refuge area in median for pedestrians.
- May generate safety problems at closely spaced driveways and intersections.
- May encourage strip commercial development.

corridor treatments - alternative cross-sections

transportation master plan
burlington, massachusetts
alternative bikeway concepts

Transportation Master Plan
Burlington, Massachusetts


**typical bus-stop area**

transportation master plan  
burlington, massachusetts
Summary of Conditions

Existing (Future-2013) Volumes
North of Route 62 ADT = 22,200 (27,628)
North of Mall Road ADT = 26,600 (37,168)

Accident History
5 Locations on MHD Top 1000 High Accidents List

Level of Service
As indicated at key locations

Right of Way
Segment 1 - Route 128 to Bedford Street
(varies between 50 to 100 feet)
Segment 2 - Bedford Street to Skilton Lane
(varies between 55 to 80 feet)
Segment 3 - Skilton Lane to Billerica Townline
(varies between 50 to 60 feet)

Other
Lack of defined lane width in both directions; road is driven on some sections as one lane in each direction and others as two lanes in each direction.

There are numerous curb cuts along both sides of Cambridge Street which increase the likelihood of accidents.

LOS...Level of Service During Evening Peak Hour

not to scale
figure 12
Cambridge Street - Segment 1 - Route 128 to Bedford Street
The following highlights the findings from Task 1 with respect to this section of Cambridge Street.

- This segment ranges in width from 42 to 52 feet; which approximates an undivided four lane cross-section while the roadway right-of-way along this segment ranges in width from 50 to 100 feet. Shoulders are not present.
- Approximately 27,000 vehicles travel this segment on a daily basis under present conditions increasing to more than 37,000 in the future.
- A substantial number of curb-cuts along this segment serving commercial abutters; some of which may need consolidation to improve access/egress safety.
- High accident locations were identified along this section at Route 128, at Burlington Mall Road and at Bedford Street.
- Sidewalks are inconsistently present and/or in need of repair.
- Bus stops exist along the arterial without turn out areas or shoulders for bus loading/unloading.

This segment is presently functioning as a narrow four lane section. A reduction in lanes to two or three lanes would reduce the capacity and worsen corridor congestion, particularly given the projected future traffic volumes.

Figure 13 presents the evaluation matrix for this section. As described earlier in this report, the matrix summarizes the impact of the different options on various criteria. The impact areas include travel, resources, and amenities.

The evaluation of options in this section revealed that the two lane options while having a minimal effect on resources, will have a substantial negative impact on corridor congestion. Although some traffic may divert to other roadways (i.e. Winn Street, Lexington Street), it will be a limited amount. The current and projected traffic volume cannot be easily accommodated by a two lane roadway. The four lane alternatives with either the median center turn lane require additional right of way but also have the most positive impact on corridor capacity and quality of flow. The wider options may require work within a wetlands buffer as well.

Cambridge Street - Segment 2 - Bedford Street to Skilton Lane
The following highlights the findings from Task 1 with respect to this section of Cambridge Street.

- Cambridge Street along this segment ranges in width from 50 to 70 feet and is generally a four lane roadway with additional exclusive left turn lanes at the intersections with Winn Street and Terry Avenue.
### SUMMARY OF LONG RANGE ANALYSIS - CAMBRIDGE STREET CORRIDOR - SEGMENT I

Route 128 to Bedford Street

<table>
<thead>
<tr>
<th>Options</th>
<th>Cambridge Street Volume</th>
<th>Corridor Capacity</th>
<th>Quality of Flow</th>
<th>High Accident Locations</th>
<th>Intermodal Concept</th>
<th>Roadway Widening</th>
<th>Estimated Costs</th>
<th>Water/Resource Areas</th>
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**Options:**

1. Two Lane
2. Two Lane w/ Median
3. Two Lane w/ TWLTL
4. Four Lane
5. Four Lane w/ Median
6. Four Lane w/ TWLTL

**figure 13**
The roadway right-of-way along this segment ranges in width from 55 to 80 feet.

Approximately 25,000 vehicles travel this segment on a daily basis under existing conditions which will exceed more than 30,000 in the future.

High accident locations were identified at the intersections with Winn Street and Skilton Lane.

A majority of the curb-cuts along this segment serve commercial abutters; most of which need consolidation to improve access/egress safety; particularly in the vicinity of Winn Street and Skilton Lane.

This segment currently functions as a four lane section with some exclusive left-turn lanes in the Winn Street area. The two or three lane options would worsen congestion, particularly given the projected traffic volumes.

This is probably the more difficult section of the corridor to address. At the southern end of the section, a park and Town Common abut the roadway. North of the Town Common, the roadway includes a downgrade with a number of curb cuts serving commercial establishments. Signals exist at Winn Street and Terry Avenue and could be considered at Skilton Lane. A major commercial area is located adjacent to these intersections.

While a "difficult" section, it also presents a good opportunity to design a transportation improvement that is compatible with the master plan goal of enhancing the Town Center. A number of options were evaluated including the general cross-section options (i.e. 2 to 5 lanes). Figure 14 presents the evaluation matrix for the general corridor treatments.

The impacts of the cross-section options are similar to Segment 1. The two lane options will have a negative impact on corridor capacity and congestion, since it represents a reduction from the four lanes currently driven. The four lane option with the center turn lane requires substantial right-of-way and consequently, could impact the common, the park and private property.

The four lane with or without the median do not have severe impacts on abutting land uses but offer some positive effects on the quality and safety of traffic flow.

Figures 15, 16 and 17 present more detailed alternative conceptual plans for the section between Winn Street and Skilton Lane. These plans attempt to accomplish similar items such as reducing conflicts, better managing commercial access, potentially guiding or enhancing future revitalization efforts and providing areas for streetscape. Each concept illustrates a raised center median from just south of Winn Street to north of Skilton Lane. Openings vary under the plans and may include one at Terry Avenue and/or Skilton Lane. Options also exist to not provide openings at these locations but require right in-right out movement. The plans also show relocating the shopping center drive on Winn Street to the east and possibly extending Murray...
**SUMMARY OF LONG RANGE ANALYSIS - CAMBRIDGE STREET CORRIDOR - SEGMENT 2**

Bedford Street to Skilton Lane

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<th>Cambridge Street Volume</th>
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Options:
1 - Two Lane
2 - Two Lane w/ Median
3 - Two Lane w/ TWL TL
4 - Four Lane
5 - Four Lane w/ Median
6 - Four Lane w/ TWL TL

**figure 14**
Conceptual Improvement Plan
Town Center
Long Range Option A

SCALE 1" = 150'
Conceptual Improvement Plan
Town Center
Long Range Option B

SCALE 1" = 150'
Conceputal Improvement Plan
Town Center
Long Range Option C

SCALE 1" = 150'

figure 17
Avenue to Cambridge Street. New signals could be placed at the new Murray Avenue intersection with Cambridge Street and the shopping center driveway with Winn Street. As long as the existing Terry Avenue opening exists, improved alignment with the opposite shopping center driveway is required. Each of these options require refinement including input from the residential and commercial abutters as well as State Highway officials as Cambridge Street is under State jurisdiction.

Longer range options could explore realigning Terry Avenue opposite Winn Street and extending Grant Avenue. These actions would require removal of certain buildings and some creative land use planning (i.e. land swap, transfer developer rights, higher density bonuses, etc) so the economic impact remains at least no net loss if not positively enhanced. This action could, however, improve the “village” type concept discussed in the master plan by creating a small network of streets and sidewalks off of Cambridge Street. The environment would become more friendly to pedestrians. Relocating Terry Avenue would also improve traffic flow and the signal operations at Winn Street.

cambridge street segment 3 - skilton lane to billerica townline
The following highlights the findings from Task 1 with respect to this section of Cambridge Street.

- Cambridge Street along this segment ranges in width from 35 to 45 feet; which approximates a wide two lane cross-section.
- The existing observations indicate that 22,000 vehicles travel this segment on a daily basis and is expected to increase to 27,000.
- A majority of the curb-cuts along this segment serve residential abutters.
- The roadway right-of-way along this segment ranges in width from 50 to 60 feet.

This segment currently functions as a wide two lane section with traffic volumes that exceed the 20,000 vehicles per day. The right-of-way is generally less than the southern segments. The options to be considered for this section in addition to the two lane roadway are the two lane with a median or center two-way left-turn lane, four lane undivided, four lane divided and the four lane with center two-way left-turn lane.

The traffic characteristics and demands in this segment are somewhat different in terms of both number and patterns than the two southern sections. Only a small amount of commercial land use exists adjacent to the roadway. North of Wilmington Road, the volumes are further reduced. Consequently, the lane requirements for this section are less than to the south. Currently operating as a two lane roadway, the two lane options present viable alternatives with special treatment (i.e. storage or bypass lanes) at key locations. The four lane option with the center turn lane potentially represents an “overkill” at the present time. However, it may be reasonable to carry four lanes to Wilmington Road since turn lanes are needed at the intersection.
Figure 18 summarizes the evaluation for this segment.

None of the two lane options are expected to require land takings and will at minimum, retain the character of the area as seen today. The median or center turn lane options will have positive impacts on corridor capacity quality of flow and safety. The median option also presents an opportunity to enhance aesthetics. With fewer businesses and opportunities to accommodate the need for vehicles to reverse direction, the two lane roadway with a median may offer a good transition into the Town Center plans.

**Middlesex Turnpike**

The other major north-south arterial roadway currently serving the community is the Middlesex Turnpike. Paralleling Route 3, current volumes between Bedford Street and Wheeler Road range from 25,000 to 29,000. They are expected to increase from 37,000 to 39,000. Four locations along the corridor are listed on the MHD High Accident list. Figure 19 graphically summarizes the corridor characteristics. For evaluation purposes, the corridor was divided into four (4) segments from Wheeler Road north to the Bedford Townline.

The general approach in evaluating alternatives included considering the alternative cross-sections (i.e. 2 to 5 lanes) to meet the needs. However, because this corridor is substantially affected by Route 128 and Route 3 and serves as the local connection to the Town’s major commercial activity centers, other options including different connections to the regional highway system and collector-distributor road concepts were also considered.

The options for this corridor between Bedford Street and Wheeler Road are listed in Table 1 and shown graphically in Figure 20.

<table>
<thead>
<tr>
<th>Alternative 1.</th>
<th>Three lane cross-section</th>
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<tbody>
<tr>
<td>Alternative 2.</td>
<td>Four lane cross-section</td>
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<tr>
<td>Alternative 3.</td>
<td>Five lane cross-section</td>
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<td>Alternative 4.</td>
<td>Fourth Avenue connector to Route 62</td>
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<td>Alternative 5.</td>
<td>Second Avenue connector Route 3 northbound</td>
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<td>Alternative 6.</td>
<td>Route 128 southbound to Middlesex Turnpike southbound off-ramp</td>
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<tr>
<td>Alternative 7.</td>
<td>Fourth Avenue connector to Route 3 northbound</td>
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<td>Alternative 8.</td>
<td>Route 3 to Middlesex Turnpike south of Route 128</td>
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<tr>
<td>Alternative 9.</td>
<td>Extend Route 128 interchange to Second Avenue with modified diamond geometry</td>
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### SUMMARY OF LONG RANGE ANALYSIS - CAMBRIDGE STREET CORRIDOR - SEGMENT 3

Skilton Lane to Billerica Townline

<table>
<thead>
<tr>
<th>Options</th>
<th>Cambridge Street Volume</th>
<th>Corridor Capacity</th>
<th>Quality of Flow</th>
<th>High Accidental Locations</th>
<th>Intermodal Concept</th>
<th>Roadway Widening</th>
<th>Estimated Costs</th>
<th>Water Resource Areas</th>
<th>Public Open Space</th>
<th>Private Property</th>
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<th>Local Plans</th>
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- **Major Negative Impacts**
- **Minor Negative Impacts**
- **No Impacts**
- **Major Positive Impacts**
- **Minor Positive Impacts**

Options:
1. Two Lane
2. Two Lane w/ Median
3. Two Lane w/ TWLTL
4. Four Lane
5. Four Lane w/ Median
6. Four Lane w/ TWLTL

**Figure 18**
Summary of Conditions

Existing (Future-2013) Volumes

*Middlesex Turnpike*
- North of Bedford Street ADT = 14,800 (19,470)
- North of Third Avenue ADT = 29,450 (38,980)
- South of Wheeler Road ADT = 25,600 (37,280)

*Route 3*
- North of Route 128 ADT = 73,600
- North of Bedford Street ADT = 73,000

**Accident History**
4 Locations on MHD Top 1000 High Accidents List

**Right of Way**
- Segment 1 - Townline to Lexington Street
  (varies between 70 to 105 feet)
- Segment 2 - Lexington Street to Fourth Avenue
  (varies between 60 to 70 feet)
- Segment 3 - Fourth Avenue to Route 62
  (varies between 65 to 75 feet)
- Segment 4 - Route 62 to Bedford Townline
  (varies between 55 to 65 feet)

**Level of Service**
As indicated at key locations

**Other**
There is a need for improved access between Route 3 and Middlesex Turnpike north of Route 128.

Middlesex Turnpike constricts from a four lane to a two lane roadway north of Second Avenue which restricts traffic flow during the peak hours.

LOS...Level of Service During Evening Peak Hour
As can be seen in the Table, there are major options related to modifying the Town's accessibility to the regional highway system in addition to the three cross-section alternatives. These options are described below with expected travel-related impacts outlined. The respective impacts on resolving transportation problems on the various sections of the corridor follow this brief description.

**fill out cloverleaf** (see figure 21)

- Allows U-Turns on Route 128
- Allows Access to Potential Park & Ride Facility at the End of Route 3
- Allows access to/from Route 128 southbound for the potential access to Middlesex Turnpike south of Route 128

**wheeler road connection from route 3 to middlesex turnpike** - (see figure 21)

- Reduces traffic loadings at the Middlesex Turnpike/Route 128 interchange
- In conjunction with the filling out of the Cloverleaf Option, eliminates the need for the existing signal at the Middlesex Turnpike/Route 128 Southbound Ramps intersection
- Increases Vehicle Miles Traveled (VMT)

**fourth avenue to route 62 connection (option 4)**

- Reduces traffic on Middlesex Turnpike from industrial/office areas to the west of Middlesex Turnpike
- Provides relief to the Middlesex Turnpike/Route 62 Intersection

**second avenue (option 5) and/or fourth avenue (option 7) ramp to route 3 northbound** (see figure 22 - foldout in back pocket)

- Direct connection from industrial/office area reduces traffic volumes on Middlesex Turnpike
- Reduces volumes on Middlesex Turnpike and the Route 128 interchange
- Second Avenue ramp connection would be expected to reduce volume on Middlesex Turnpike north and south of Lexington Street as well as provide opportunity to access Town's landlocked parcel
- Fourth Avenue Ramp may draw traffic from Mall area, increasing volumes on Middlesex Turnpike north of Lexington Street
Provide New Ramp From Route 128 SB To Middlesex Turnpike

Fill Out Cloverleaf

Connect Route 3 With Wheeler Road

Middlesex Turnpike/Route 128/Route 3 Ramp Alternatives

Transportation Master Plan
Burlington, Massachusetts

Reference: MAPC

Not to Scale
Figure 21
new ramp connection from existing route 128 sb to route 3 nb ramp to middlesex turnpike sb (option 6) - (see figure 21)

- Improves signal operation at the Middlesex Turnpike/Route 128 SB Ramp intersection

connection to middlesex turnpike south of route 128 (option 8)

- Reduces the turning movements at the Route 128 Ramps/Middlesex Turnpike intersection signals
- In conjunction with the Filling the Cloverleaf Option can eliminate the need for the signals at the Route 128 Ramps/Middlesex Turnpike intersections
- Increases vehicle miles traveled (VMT), making funding questionable

extend route 128 interchange northward along route 3 (option 9)

- Allows a direct connection into and out of the industrial/office area for both directions on Route 3 and southbound on Route 128
- Reduces traffic on Middlesex Turnpike
- Provides a direct connection from Route 3 to Burlington Mall Road
- Possibly provides access to the west of Route 3

The discussion by segment is contained in the following paragraphs.

**middlesex turnpike segment 1 - burlington/woburn townline to lexington street**

The following highlights the findings from Task 1 with respect to this section of Middlesex Turnpike.

- Middlesex Turnpike south of Wheeler Road ranges in width from 66 to 68 feet. North of Wheeler Road, Middlesex Turnpike is approximately 80 to 90 feet in width, which approximates a partially divided/undivided four lane cross-section with turning lanes.
- Approximately 25,600 vehicles travel this segment on a daily basis. As many as 38,000 vehicles are projected to use this segment in the future under full buildout.
- A majority of the curb-cuts along this segment serve commercial abutters - some of which may need consolidation to improve access/egress safety.
- The roadway right-of-way along this segment ranges in width from 70 to 105 feet.
Few geometric improvements are required along this segment. Given that this segment of Middlesex Turnpike is presently a full four lane roadway with turning lanes at major intersections, it is likely that this segment would need only minor geometric improvements which potentially would be limited to a 4 foot wide planting strip along the curb and 6 foot wide sidewalk on each side. Coordination of the seven existing traffic signals along this section of Middlesex Turnpike to improve corridor progression should be considered, however, under any improvement plan. The remaining options to be considered all revolve around modifying the connection to the regional highway.

Figure 23 summarizes the evaluation of various improvement alternatives. As shown in the matrix, all options with the exception of Alternative 8 (extension of Route 3 ramp south of Route 128 to Middlesex Turnpike) have a positive impact on traffic flow along this segment. Only Alternative 4, which extends beyond this segment, will potentially affect wetlands. Alternative 5 (Second Avenue connection to Route 3) or Alternative 7 (Fourth Avenue connection to Route 3) would have the most substantial impact on traffic volume and the resulting quality of flow along this section as these two options would divert traffic off of the Turnpike.

**middlesex turnpike segment 2 - lexington street to fourth avenue**

The following highlights the findings from Task 1 with respect to this section of Middlesex Turnpike.

- Middlesex Turnpike between Lexington Street and Fourth Avenue ranges in width from 35 to 45 feet, which approximates a wide two lane cross-section.
- Approximately 29,000 vehicles travel this segment on a daily basis with projections to exceed 40,000 in the future under buildout and no major changes to the system.
- A majority of the curb-cuts along this segment serve commercial and industrial abutters.
- The roadway right-of-way along this segment ranges in width from 60 to 70 feet.
- The intersection of Middlesex Turnpike and Terrace Hall Avenue is controlled by an outdated signal.
- Significant delays are experienced at major unsignalized intersections including Third and Fourth Avenues.

This segment currently functions as a two lane section with traffic volumes exceeding the 20,000 vehicles per day threshold for two lane capacity. Cross-section options to be considered are the three lane with center two-way left-turn lane, four lane undivided, and the five lane with center two-way left-turn lane. Similar to the southern section, the connections to Route 3 potentially have a substantial impact on reducing volume on the is section and thereby reducing the lane requirements.

The major options which incorporate some form of Route 3 connection from either Second
SUMMARY OF LONG RANGE ANALYSIS - MIDDLESEX TURNPIKE CORRIDOR - SEGMENT I
B/W Town Line to Lexington Street

<table>
<thead>
<tr>
<th>Options</th>
<th>Middlesex Trip Volume</th>
<th>Corridor Capacity</th>
<th>Quality of Flow</th>
<th>High Accident Locations</th>
<th>Intermodal Concept</th>
<th>Roadway Widening</th>
<th>Estimated Costs</th>
<th>Water Resource Areas</th>
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Options:
1 - Two lane w/TW/LTL
2 - Four Lane
3 - Four Lane w/TW/LTL
4 - Fourth Ave. Connector to Rte 62
5 - Second Ave. Connector to Rte 3 NB
6 - Rte 128 SB to Middlesex Turnpike SB Off-ramp
7 - Fourth Ave. Connector to Rte 3 NB
8 - Rte 3 to Middlesex Turnpike south of Rte 128
9 - Extend Route 128 interchange to Second Ave. with modified diamond

△ Major Negative Impacts  ○ No Impacts  ● Major Positive Impacts
★ Minor Negative Impacts  ○ Minor Positive Impacts

figure 23
Avenue or Fourth Avenue are expected to have the most positive impact on reducing Middlesex Turnpike volume in this segment as shown in Figure 24. The Second Avenue access point appears to be the most positive of the two locations. Direct improvements to capacity of the corridor include any of the widening options, however, beyond three lanes (two through lanes with a center turn lane), the widening options have more potential negative impacts on wetlands, private property and aesthetics.

Modifying the existing Route 128 interchange with Middlesex Turnpike, providing a connection to the Turnpike south of Route 128, or simply providing a Fourth Avenue connection to Route 3 northbound are not expected to have major positive effects on the corridor.

As shown in Figure 24, the most positive options for treating this segment of the Middlesex Turnpike appear to be Option 1 (provide a three lane cross-section) and the Option 5/9 combination which incorporates a diamond interchange at Second Avenue with Route 3 and also provides a connection from Route 128 to the north. Constructing a new connection between Fourth Avenue and Route 62 enhances the option and reduces certain treatments along the Turnpike.

**middlesex turnpike segment 3 -fourth avenue to bedford street**

The following highlights the findings from Task 1 with respect to this section of Middlesex Turnpike.

- Middlesex Turnpike along this segment ranges in width from 35 to 45 feet, which approximates a wide two lane cross-section.
- Approximately 29,500 vehicles travel this segment on a daily basis. As many as 39,000 vehicles may use this segment in the future.
- A majority of the curb-cuts along this segment serve commercial/industrial abutters, with some residential along the eastern side of the roadway.
- The roadway right-of-way along this segment ranges in width from 65 to 75 feet.
- The intersection of the Turnpike with Bedford Street (Route 62) has been identified as a high accident location.

This segment currently functions as a two lane section with traffic volumes exceeding the 20,000 vehicles per day threshold for two lane capacity. The remaining options to be considered are the three lane with center two-way left-turn lane, four lane undivided, and the five lane with center two-way left-turn lane. Its characteristics and needs are similar to Segment 2 as are the impacts of the major options.

Figure 25 summarizes the evaluation of this section of Middlesex Turnpike. In this section, Option 4 (constructing an extension from Fourth Avenue to Route 62) would be expected to have a
### SUMMARY OF LONG RANGE ANALYSIS - MIDDLESEX TURNPIKE CORRIDOR - SEGMENT 2
Lexington Street to Fourth Avenue

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<th>Travel</th>
<th>Resources</th>
<th>Potential Amenities</th>
<th>Other</th>
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**Options:**

1 - Two lane w/1WLTL
2 - Four Lane
3 - Four Lane w/2WLTL
4 - Fourth Ave. Connector to Rte 62
5 - Second Ave. Connector to Rte 3 NB
6 - Rte 128 SB to Middlesex Turnpike SB Off-ramp
7 - Fourth Ave. Connector to Rte 3 NB
8 - Rte 3 to Middlesex Turnpike south of Rte 128
9 - Extend Route 128 interchange to Second Ave. with modified diamond

**Legend:**
- ▲ Major Negative Impacts
- ▼ Minor Negative Impacts
- ○ No Impacts
- ● Major Positive Impacts
- ○ Minor Positive Impacts

**Figure 24**
### SUMMARY OF LONG RANGE ANALYSIS - MIDDLESEX TURNPIKE CORRIDOR - SEGMENT 3

Fourth Avenue to Route 62

<table>
<thead>
<tr>
<th>Options</th>
<th>Middlesex Trip Volume</th>
<th>Corridor Capacity</th>
<th>Quality of Flow</th>
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**Options:**

1. Two lane w/TWLTL
2. Four Lane
3. Four Lane w/TWLTL
4. Fourth Ave. Connector to Rte 62
5. Second Ave. Connector to Rte 3 NB
6. Rte 128 SB to Middlesex Turnpike SB Off-ramp
7. Fourth Ave. Connector to Rte 3 NB
8. Rte 3 to Middlesex Turnpike south of Rte 128
9. Extend Route 128 interchange to Second Ave. with modified diamond

**Legend:**

- ▲ Major Negative Impacts
- △ Minor Negative Impacts
- ○ No Impacts
- • Major Positive Impacts
- ○ Minor Positive Impacts

*figure 25*
major impact on traffic volume. It would also have a major impact on the intersection of Middlesex Turnpike with Bedford Street as the major movements would be substantially reduced and consequently, the widening requirements at the intersection lessened substantially. The connector roadway from of Fourth Avenue to Route 62 will also have a major effect on lane requirements on the Middlesex Turnpike between Route 62 and Fourth Avenue or even Lexington Street to the south. The three lane cross-section option does have a positive impact on traffic flow and safety while minimizing the impact on property, environmental resources and allowing for amenities.

summary of middlesex turnpike alternatives

The Middlesex Turnpike currently experiences high traffic volumes and is expected to continue to do so as full buildout advances within the community. It is an important roadway to the community serving both residents and a large business area. There are also several safety related problems and critical intersections that require improvements. A series of alternatives were evaluated including different cross-sections to accommodate various lane configurations as well as new connections to Route 3 and a collector-distributor road concept. The results of the evaluation have indicated that improved connections to Route 3 are warranted. That action coupled with the connecting roadway between Fourth Avenue and Route 62 and minor widening of the Turnpike between Lexington Street and Bedford Street to provide for a safe turn lane, the corridor will be significantly improved with a minimum of negative impacts.

wheeler road/blanchard road

The Wheeler Road/Blanchard Road corridor currently serves an area that has limited development with a hotel, and several underutilized office buildings. However, this area has a very high potential for major growth in the future. Besides serving this office and commercial zone, Wheeler Road presently connects with the adjacent residential area via the Muller Road intersection. That creates a conflict between residential areas and commuter related through traffic. As part of past development proposals, it was suggested to revise Wheeler Road to connect with a new street (Van de Graf Drive) and be physically disconnected from Blanchard Road as well as Muller Road. Figure 26 illustrates how this would potentially occur. The positive aspects of this proposal is that commercial travel access needs can be satisfied and at the same time, have minimal impact on the residential street. Muller Road would be returned as a local residential street although connected to the north through Blanchard Road. The Wheeler Road/Van de Graf corridor design plan could vary, however, with a projected total volume of approximately 12,000 vehicles per day, a two lane configuration would be adequate. Alternative configurations for the corridor were examined as shown in Figures 27 and 28 and included a two lane with a median and a two lane without a median. The median option again provides areas for streetscape as well as pockets for left turn vehicles at key locations whereas the two lane option without a median uses less right of way. Utilizing less area for roadway will allow for accommodating other amenities such as bike paths and sidewalks.
eliminate connection between wheeler and muller

proposed new connection

wheeler road

van de graf

muller road

blanchard road

wheeler road / van de graf concept

transportation master plan
burlington, massachusetts

not to scale
figure 26
two lane with median

Sidewalk Planting Strip

10'

7'

12'

16'

12'

7'

OFFSET

1'

Sidewalk Planting Strip

wheeler road two lane with median option

transportation master plan
burlington, massachusetts

not to scale
figure 27
two lane with two foot offsets

Planting Strip
Sidewalk

10
2
12

5
2
12

5

LANDSCAPING & SIDEWALK
14'

48'

LANDSCAPING & SIDEWALK
14'

wheeler road two lane option

transportation master plan
burlington, massachusetts

not to scale
figure 28
other corridors

The remaining corridors include Bedford Street, Center Street, and Winn Street. Both Bedford and Center Streets are currently carry less than 20,000 vehicles per day and are generally expected to remain as two lane roadways. There is a need for some general maintenance and minor improvements to curbing, visibility, sidewalks, etc. along each street as well as isolated improvements to intersections. Minor increases in width to allow a wider shoulder for bicycle travel should be considered on any rehabilitation project.

Winn Street between Center Street and Route 128 has recently undergone improvements including new traffic signals, some geometric modifications at the interchange with Route 128 and new curbing and sidewalks. Consequently, the roadway as a whole was not evaluated in the same level of detail as the other roadways. However, this is an important north-south roadway for the Town and provides a connection into the Town Center. It is expected that future volumes will generally exceed the two lane capacity of the roadway. While the need may exist in the future for more than two lanes of through travel, it is hoped that, by upgrading the other north-south corridors, the need for added capacity on Winn Street would be diminished. There may, however, be isolated locations, such as at Center Street or at Mill Street, where improvements such as turn lanes, signalization and minor geometry are necessary in the short to medium time frame.
key intersections

In addition to the overall long term corridor treatments that needed to be addressed, there are many specific locations that require attention. Many of these locations can have improvements developed and implemented in a relatively short time frame. The intersections included in this category include those that are experiencing congestion deficiencies, high accident experience, or have geometric related characteristics that could be improved. These intersection locations are listed in Table 2 which also indicates the particular problem area(s) and the general type of improvement. Conceptual sketches where appropriate were prepared and are included in the Appendix of this report. Each location is briefly discussed below.

**Bedford Street at Cambridge Street**

This location has been identified as a high accident location. The equipment is outdated and physical constraints (i.e. Town common, historic property) exist adjacent to the intersection. The focus of improvements at this location is on upgrading the traffic control equipment and improving visibility. Signal timing will be optimized providing for lead/lag protected left turn phasing. Geometric options that could be explored further in the design phase would include a right turn lane in the SB approach and an increased corner radius on the NB approach. Preliminary cost estimates show a range of $150,000 to $250,000 without major roadwork.

**Bedford Street at Middlesex Turnpike**

This highly congested, high accident location should be improved in the short term while long range corridor solutions are studied in more detail. Options at this location incorporate upgrading the signal equipment to a modern fully actuated controller. Visibility would be improved with the use of mast arms. Alternative lane configurations were evaluated to accommodate turning movements. At the same time, the right of way is limited and major widening cannot take place without land takings. Sidewalks, pedestrian signal control, local access driveways and possible rehabilitation on Route 62 to the Bedford townline should be considered in the design stage. Preliminary cost estimates range from $300,000 to $400,000.

**Middlesex Turnpike at Terrace Hall Avenue**

Problems at this location revolve around outdated signal equipment and less than optimal geometric conditions. An improvement alternative at this location include
improving the alignment of the Terrace Hall Avenue approach to the intersection, better definition of the curb lines as well as modernizing the equipment. Preemption related to the nearby fire station needs to continue under any improvement. Estimate costs for these improvements are $150,000 to $200,000.

**Bedford Street at Francis Wyman Road**

This unsignalized location accommodates high peak hour flows on each approach. Turning lanes are not provided. However, if a vehicle is stopped on the eastbound approach, substantial delay to the through movement can occur. Options at this location included a number lane or median configurations. One option may be to provide a two lane approach on Francis Wyman while a left turn lane on the eastbound approach is being considered. A flashing beacon for improving visibility has been reviewed as well as a full signal installation. Without the signal, the estimated costs for making these improvements range from $20,000 to $60,000.

**Bedford Street at Terrace Hall Avenue**

This intersection is in the center of a horizontal curve. The intersection is not well defined and a visibility problem exists. Observations reveal that motorists turning left from Bedford Street onto Terrace Hall Avenue conduct the turn at high speeds and well before the intersection. Options involve better definition of the intersection, possibly increasing the curve radius, and possibly installing a flashing beacon. The objective of these improvements is to provide better guidance to the motorist and enhance the visibility of the intersection.

**Peach Orchard Road at Winter Street**

The most significant issue at this location is the geometry and the resulting emphasis of movement. Two options were developed. One option involved retaining Winter Street as the major movement. The second option would include Peach Orchard Road as the major movement. It is estimated that the improvement could cost approximately $20,000 to $30,000.
### Table 2

**Summary of Isolated Intersections**

<table>
<thead>
<tr>
<th>Name</th>
<th>Nature of Problem</th>
<th>General Type of Improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bedford Street at Cambridge Street</td>
<td>safety, congestion</td>
<td>install modern signal equipment with improved visibility</td>
</tr>
<tr>
<td>Bedford Street at Middlesex Turnpike</td>
<td>safety, congestion</td>
<td>new signal, turn lanes pedestrian protection</td>
</tr>
<tr>
<td>Middlesex Turnpike at Terrace Hall Avenue</td>
<td>outdated equipment, less than desirable geometry</td>
<td>new signal, minor geometric changes</td>
</tr>
<tr>
<td>Bedford Street at Francis Wyman Road</td>
<td>significant delays caused by high through and turning volumes</td>
<td>provide turn lanes improve visibility</td>
</tr>
<tr>
<td>Bedford Street at Terrace Hall Avenue</td>
<td>poorly defined intersection</td>
<td>improve geometry install beacon</td>
</tr>
<tr>
<td>Peach Orchard Road at Winter Street</td>
<td>geometry less than desirable</td>
<td>modify geometry modify traffic control</td>
</tr>
<tr>
<td>Mill Street at Locust Street</td>
<td>less desirable geometry</td>
<td>reconstruct intersection</td>
</tr>
<tr>
<td>Winn Street at Mountain Street</td>
<td>safety, visibility, less desirable geometry</td>
<td>modify geometry</td>
</tr>
<tr>
<td>Winn Street at Center Street</td>
<td>less than desirable geometry, poor visibility</td>
<td>install beacon, change control, provide turn lane</td>
</tr>
</tbody>
</table>
Mill Street at Locust Street

This unsignalized intersection is located in a neighborhood. While the level of volume through this intersection is much lower than other projects along the corridor. However, the geometry is not optimal and contributes to confusion that may exist at this location. Options for this location revolve around include different geometric reconfiguration. Improvements at this location are expected to be in the $10,000 to $25,000.

Winn Street at Mountain Street

This location is in a small commercial area. Winn Street is generally two lanes in this section with curb openings to commercial businesses either non-defined or poorly defined (i.e. too wide, too many) The unsignalized intersection of Winn Street at Mountain Street is a 'Y' type design with all movements allowed on each side of the island. A plan for this section of roadway is needed with the objective to better define the access drives and reconstruct the intersection to a 'T' type design.

Winn Street at Center Street

Winn Street in the vicinity of Center Street was recently improved, however, no major action occurred specifically at this location. The intersection is characterized with poor visibility along with a winding downgrade on the Center Street approach to the intersection. The geometry hinders the traffic operations. Potential improvements include modifying the traffic control, installing a flashing beacon and advance warning signs to improve intersection visibility and possibly installing a left turn storage lane on Winn Street. Estimated costs for these actions would be in the range of $30,000 to $40,000.
transportation system management

The final area of study involved transportation system management (TSM) options. Many of these concepts and principles that fall under TSM would be incorporated into the roadway and intersection improvements previously discussed. Actions could include the following:

- optimizing the signal timing plans
- coordinating traffic signals along the major arterials
- providing turn lanes along the major arterials and on the minor intersection street approaches
- providing acceleration/deceleration lanes
- turn restrictions
- consolidating and better defining driveways to abutting land uses

These types of actions are focused on improving safety and reducing delay through relatively low cost, quick implementation timeframe measures.

In addition to the alternatives previously discussed, the major TSM alternative is to upgrade all the traffic signal control equipment in the community and develop coordinated systems. The improvement would be what is called a "closed loop" signal system which essentially is a computerized system that can be monitored and changed if necessary from a remote control center (i.e. the public works department). These types of systems use the latest technology and can have a major effect on reducing overall delay throughout the roadway system. This advanced type of traffic signal control can also be combined with other TSM or demand management actions as part of an areawide advanced traffic management system. Again, many of the above concepts or actions would be considered under any major roadway design alternative.
conclusions

The previous pages have discussed in some detail the various options that were examined as part of the Burlington transportation plan study. The options ranged from simple low cost solutions to the more major options that would require more extensive feasibility, environmental, and design studies before they can be implemented. This evaluation, however, will form the basis for selecting roadway actions as part of the plan.

The primary purpose of the task was to identify options and consider advantages and disadvantages of the options as well as key issues related to implementation. Utilizing the findings from the inventory and analysis task and considering the goals and objectives developed for the transportation plan, the preferred options would then be identified. Based on this evaluation, it would appear that the ultimate plan would be a combination of minor and major actions and the treatment along a corridor would also be a mix of widening, traffic control and using transportation system actions.
part 6 task 3
travel demand management
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introduction

The Town of Burlington is in the process of updating its overall master plan and as part of that effort, a transportation component has been included. The townwide transportation master plan component was envisioned to be conducted in three phases. This document presents the Transportation Demand Management (TOM) portion of the study. It represents the final task of the project.

a. purpose of study

The Town of Burlington has grown substantially over the years due to the construction of Route 128 and the suburbanization of the area in general. The high technology industry developed around the highway system. Other major generators, such as retail centers like the Burlington Mall, have also contributed to the growth in Burlington. It has reached a point now where traffic on sections of Route 128 in Burlington exceed 160,000 vehicles, sections of Cambridge Street exceed 27,000 vehicles, and sections of Middlesex Turnpike are approaching 30,000 vehicles per day. Average travel speeds are generally below the posted speed limit during the peak hours on the major arterials. When an accident or breakdown occurs on any of these roadways, severe congestion takes place leading to a diversion of traffic onto residential streets. Recognizing the growth and the effect that the resulting congestion can have on realizing the full potential of the economic base as well as the effect on simply the quality of life for Burlington residents and employees, this TOM study was undertaken.

TOM planning largely involves exploring travel reduction strategies that could reduce travel demand and improve the roadway operating conditions without the major capital investment of new roadways. Travel reduction may be in terms of daily or peak period occurrences. TDM strategies may be critically important in areas of environmental or historical significance where constraints present a limit to adding roadway capacity. There are many different actions available to the region for reducing travel demand. However, they must be reviewed carefully to determine if they are a cost-effective means to reaching the ultimate goal. Different actions may also conflict with each other in reducing demand. Other actions may require certain roadway improvements in addition to the TDM action. It is generally recognized that there are limits to TDM effectiveness. TDM may also tend to compliment or supplement other transportation investments. Travel reduction has many specific purposes including:

- reducing the need for new transportation facilities
- reducing the travel costs to remaining motorists
- reducing energy consumption and air pollutants, and
- reducing the potential for conflicts or accidents

This study represents an evaluation and development of a comprehensive approach to managing travel within Burlington. It will not serve as the end all of planning in the study area but is intended to further the process. With the high density growth that has already occurred and which is anticipated, there is a high probability of successful programming with respect to TDM within the town.
b. study process

The primary objective of this study was to develop an approach to managing and reducing travel demand within the project area through travel demand management (TDM). It was one element making up the Town's transportation master plan study effort. The roadway alternatives were discussed in Technical Report No. 2.

The TDM study process involved a review of current transportation services and activities currently taking place in the area, an inventory of major generators, a survey of major local employers, a review and research of the Transportation Management Association (TMA) practice in the area, an estimate of future travel conditions under potential growth conditions, and an evaluation of potential TDM alternatives. There were certain areas where data was collected to form a baseline of information. Contact with the regional transportation agencies and the local services occurred during the study as well. The approach taken in this effort can be applied for evaluating TDM potential in the other regions.

This report describes the findings of the inventories and the results of the analysis. The current TMA/TDM practice in the Burlington area as well as the Massachusetts experience in general is presented. Traffic flow condition in the region under present as well as future (Year 2010) without the TDM application beyond the present levels is documented. As will be shown later in this document, the need for TDM application will be critically important for this area in order to achieve economic success and at the same time relieve the congestion on the local and regional highway system. Ultimately, a Recommended TDM Plan has been outlined for the Town of Burlington. An important aspect of the plan is to set up a monitoring and feedback system that can be used to evaluate strategies and refine or make changes before a crisis occurs.

c. potential effects of economic growth

When studying traffic impacts as a result of economic growth, there is much to be learned from the past and history of our country's largest cities. Using Boston as an example, one begins to see the direct relationship between a comprehensive transportation system and economic growth. However, over the past few decades the City of Boston's main arteries into and out of the city have become so congested that these roadways operate at or near level of service "F" for a good portion of the day. Roadway problems like these combined with lower rents in modern, high-tech office building along Routes 128, 93 and 495 have persuaded many large companies to leave the City and locate in the suburbs. Burlington is a perfect example of a community that has benefitted from a good regional roadway system that has built up over the years and where companies relocated into town and enhance the tax base. A problem associated with that pattern is that the suburban roadways were bit typically designed to accommodate large volumes of traffic. Unlike large cities, most suburban communities do not have the transit systems in place to move workers into and out of town and therefore must rely more heavily on the existing roadway networks. This can become a large problem. If Burlington is to continue to be an economic hub of the region in the future as its been in the past, and not impose substantial hardship on its residents, it must set up a comprehensive plan. The comprehensive plan must focus on the management of travel as much if not more than the physical roadway condition as there will be an ultimate limit to
constructing new roadway facilities.

congestion points

The Town has determined that under buildout conditions, another 3.3 million square feet of commercial and industrial development will occur and an additional 780 dwelling units will be constructed. In addition, all existing vacant properties and ongoing or planned developments in the area will also be filled and operational. To completely understand the impacts of full buildout on Burlington, a process of forecasting long range traffic volumes as a result of the new developments was completed. This process was fully described in Technical Report No. 1. Assuming similar travel patterns as currently occur, the estimated new traffic generated under zoning buildout and vacant infill is expected to be more than 64,000 additional vehicle trips per day. In the peak hours, there would be an additional 7,200 vehicle trips added to the roadway system.

Given the existing volume on Burlington’s major roadways including Middlesex Turnpike, Cambridge Street, and Winn Street, and combining it with the projected 64,000 additional trips per day, a substantial increase in delay and congestion will be experienced on the Town’s roadway network. By the year 2013 volume along Cambridge Street could be exceeding 40,000 vehicles per day. The same holds true along sections of Middlesex Turnpike, with Winn Street is not far behind. As the congestion along these routes intensifies, drivers will seek alternative routes, diverting onto local neighborhood roadways, even though they may represent longer travel distances.

constraints

A major factor in the influence of TDM is the increasingly difficult environment to construct new roadways or substantially enhance or rebuild existing ones. The economics of roadway construction can be substantial, particularly when property must be acquired. In addition, the environmental issues that have become more stringent over the past 15 to 20 years serve to significantly delay certain roadway improvements while designed to protect important resources.

This is not so different in Burlington. Issues have surfaced in the past with both Middlesex Turnpike and Winn Street regarding roadway widening and the potential negative impacts. Burlington is at the mercy of its primary roadways, particularly Route 128 and Route 3.

Consequently, TDM as well as TSM have become more important tools to enhance travel, minimize negative effects on surroundings and further protect resources. The federal ISTEA legislation further gives the encouragement of TDM actions with eligible funding and relationships to the Clean Air Act of 1990. At the same time, it has been shown to date that TDM requires significant effort and commitment on everyone’s part including the general traveling public. Even with these commitments, the relative effect of TDM on travel reduction or environmental improvements has been limited. Many of the TDM strategies are designed to change an individual’s travel behavior which is a complex issue. Yet it is an important concept to pursue as it is likely to become more important as well as effective in the future. One of the objectives of this
task is to start to identify programs which will help reduce congestion and delay on area roadways, and help reduce the amount of cut-through traffic on residential roadways, making them safer for Burlington residents.

need for travel demand management (tdm)

Eventually, there will be a limit placed on roadway reconstruction to accommodate travel to and within Burlington. It is therefore essential to incorporate TDM as well as TSM strategies and principals into the transportation planning process now. It will be important to set a foundation for future emphasis on TDM. TDM programs can benefit an individual company’s situation (i.e. reduce parking requirements), benefit a major activity center or Town as a whole. Companies like Hewlett Packard (HP), Lahey Clinic and M/A-Com could serve as starting points or examples of company implemented TDM measures, which could be implemented at other employers within town, helping offset the commuter hour and/or reducing the number of vehicles on the roadway through convenient public transportation, carpooling and vanpooling. The North Suburban Transportation Management Association (TMA) is also vehicle for the private sector to participate in TDM programs in the area.

d. organization of the report

This report is organized into several sections. First, current TDM/TSM experience is discussed. This includes presenting the various actions and strategies available and their potential effectiveness. In addition, the transportation management association in the region is described as well as the existing transportation services currently available in the Town. The next major section of the report discusses the potential application and evaluation of TDM strategies for the Town. The travel survey conducted as part of this task is presented in that section. The last section of the report presents the recommended TDM plan element.
**current TMA/TDM experience**

**a. potential tdm alternatives**

The growth that is highly possible in the region over the next 20 years has the potential to cause severe congestion, virtually stopping traffic movement in several key locations as motorists attempt to access the regional highway system. Consequently the pressure on the local road system will substantially increase as motorists utilize alternative routes. While roadway and capacity improvements will likely be necessary, some of the analysis clearly indicates that simply constructing more roadway capacity is not sufficient to meet the demands that could exist. In addition, with the environmental and socio-economic constraints that exist within the area, there will be a physical limit as to the level of highway construction that can be implemented.

To this end, TDM has become evermore critical in the movement of people between homes, workplace, recreational and shopping locations. For a suburban area to remain economically vibrant, areawide TDM programs will become necessary. As a result, this study focuses on the types of TDM strategies that are available and should be considered for implementation. The different actions and strategies can also be categorized by

- increasing capacity, and
- reducing demand

Table 1 shows a general listing of the potential TDM strategies considered and evaluated during this study.

**table 1**

<table>
<thead>
<tr>
<th>Potential TDM Strategies</th>
</tr>
</thead>
<tbody>
<tr>
<td>• staggered work hours</td>
</tr>
<tr>
<td>• residential parking permits</td>
</tr>
<tr>
<td>• park and ride system along transit routes</td>
</tr>
<tr>
<td>• fringe park and ride system</td>
</tr>
<tr>
<td>• employer based ridesharing</td>
</tr>
<tr>
<td>• midday shopper shuttles</td>
</tr>
<tr>
<td>• bicycle route system</td>
</tr>
<tr>
<td>• employer sponsored transit subsidies</td>
</tr>
<tr>
<td>• transit/pedestrian friendly site planning</td>
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<tr>
<td>• expanded transit service</td>
</tr>
<tr>
<td>• flexible work hours</td>
</tr>
<tr>
<td>• neighborhood traffic barriers</td>
</tr>
<tr>
<td>• peak hour on-street parking bans</td>
</tr>
<tr>
<td>• institution of parking fees</td>
</tr>
<tr>
<td>• shuttle connections to terminals</td>
</tr>
<tr>
<td>• transportation centers</td>
</tr>
<tr>
<td>• bicycle storage facilities</td>
</tr>
<tr>
<td>• guaranteed ride home</td>
</tr>
<tr>
<td>• priority treatment for HOVs</td>
</tr>
<tr>
<td>• site planning w/personal services</td>
</tr>
</tbody>
</table>

Some of the actions listed in Table 1 are actually transportation system management (TSM) or traffic engineering solutions which do have an effect on managing demand and are sometimes required in concert with TDM strategies.
b. experience in tdm effectiveness

As indicated earlier in the report, an increasingly important part of dealing with the transportation system is the consideration of Transportation Demand Management (TDM). The philosophy of TDM has been with us since the 1970's when the two energy crises occurred and the 1977 Clean Air Act Amendment was passed. However, TDM's particular importance is much more emphasized today with the passing of the 1990 Clean Air Act and the 1991 ISTEA bill. The new federal legislation provides several unique opportunities to weave TDM strategies into the overall solution to the problems faced in a transportation corridor, Route 128 and specifically Burlington not being an exception.

TSM planning has been more formally recognized somewhat longer than the TDM focus and importantly, can be readily evaluated in quantifiable terms. For example, improved signal timing can be measured through the reduction is travel time and delay data. Computer programs that utilize the delay models can be used to estimate the effect of intersection improvements prior to implementation and the analyst can be reasonably assured that the actual effect will be close to the estimated. Years of study has resulted in this ability. TDM strategies, on the other hand, have not been the focus of as much study. In addition, TDM tends to relate to personal human behavior more than a physical change in the system and consequently, has been more difficult to model and quantify. However, the work over the past five years or so has begun to provide insight on TDM measures and their respective effectiveness. While there is general agreement among the professional community that optimal evaluation tools and study results are not available at the present time to help guide the planners and decision makers, ongoing research has in fact provided some key results which will be discussed further.

TDM planning involves exploring single occupant vehicle (SOV) travel reduction strategies that could reduce travel demand and improve the roadway operating conditions without the major capital investment of new roadways. TDM strategies will become critically important in areas of environmental or historical significance where constraints present a limit to adding roadway capacity. There are many different actions available to a region for reducing travel demand. However, they must be reviewed carefully to determine if they offer a cost-effective means to reaching the ultimate goal. The research that has taken place has indicated that:

- the ability to fully evaluate the effect that TDM actions will have on travel is difficult at best as has been well documented. Analysis tools and procedures need to be refined. The results from recent studies are either not conclusive or are flawed in terms of statistical findings;

- TDM alone will not generally solve the congestion or safety problems. Some of the more extensive TDM actions implemented on an areawide basis in a suburban working environment can reduce peak hour travel by 10% to 15%;

- success in TDM will be significantly limited without an incentives program;

- midday travel in the large suburban activity centers has been found to be much larger than once thought and it is important to have guaranteed ride home programs,
midday shuttles and on-site services within these centers;

- the program must be a comprehensive system management approach tying together roadway infrastructure, TSM, TDM, land use planning, etc to bring a successful access plan to an area;

- there is a question of sustainability with respect to TDM actions such as ridesharing with the more successful ridesharing programs involve personal coordinators to manage the program; and

- the need exists for employer commitments to the program or its success will be limited, particularly for the large employers. However, programs must also include the smaller employers as together they may represent a large portion of the areawide employment.

Table 2 summarizes some of the more common TDM actions and the impacts identified through ongoing testing and research. This task examines the potential tasks for the most applicable strategies to implement as part of the Burlington master plan.
### SUMMARY OF TDM/TSM STRATEGIES AND POTENTIAL EFFECTIVENESS

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Objective</th>
<th>Actions</th>
<th>Effect on Trip Reduction</th>
<th>Effect on Efficiency</th>
<th>Cost</th>
<th>Difficulty of Implementation</th>
</tr>
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<td>increase riders</td>
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<tr>
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<td>provide priority</td>
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**Notes:**
- "e" : enhances effectiveness of other actions
- "-" : not directly applicable
<table>
<thead>
<tr>
<th>Strategy</th>
<th>Objective</th>
<th>Actions</th>
<th>Effect on Trip Reduction</th>
<th>Effect on Efficiency</th>
<th>Cost</th>
<th>Difficulty of Implementation</th>
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</tr>
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</table>

Notes:
- o: none or little
- +: moderate
- ++: high
- e: enhances effectiveness of other actions
- -: not directly applicable
c. **Existing Transportation Management Association**

One of the useful tools that have come into being is the transportation management association (TMA). In general, TMA's are defined as private, non-profit organizations that are formed to facilitate private sector involvement in addressing transportation issues. They tend to focus on particular geographic areas. Some have public representation either as ex-officio or advisory members or in some situations, more formal membership positions. They remain flexible to deal with any issue that the membership feels needs to be addressed.

There are now more than 140 TMA's operating across the country. In many jurisdictions, the TMA's have become recognized as partners in solving the local and regional transportation problems. As will be briefly discussed below, they are involved in a range of activities in an attempt to better manage the system and the demand for travel. While each TMA tailors its programs, historically they have done the following:

- represent their membership as part of the public process
- plan and operate demand management programs for their members
- provide demand management services for members
- monitor traffic conditions for members
- and increasingly serve as a clearinghouse on local or regional issues

The success of the TMA rests in the bottom-line results in terms of implementing actions and resolving issues and concerns. Typically the members, both private and public, work together in addressing these issues. Some of the services provided include providing an advocacy for the private sector in shaping the transportation services and facilities in an area, establishing local transportation policies, working on mitigating transportation problems and impacts created by land development, providing transportation services such as transit service or rideshare matching, and managing the parking system serving an area. Most importantly is that the TMA's remain flexible yet focused on the overall goal of reducing traffic congestion in its area and improving travel for its members.

Over the past several years, the *North Suburban TMA* has been formed and is continue to develop. It operates out of the North Suburban Chamber of Commerce, serving thirteen (13) communities. These include the following:

- Bedford
- Billerica
- Burlington
- Carlisle
- Concord
- Lexington
- Lincoln
- North Reading
- Reading
- Stoneham
- Wakefield
- Wilmington
- Woburn

The services currently provided by the North Suburban TMA include providing a ridematching database, employer "commute management" programs tailored for an individual member's needs or characteristics, training and support to on-site transportation managers, and an information...
source on schedules of information and ongoing roadway construction projects that could effect
the commute. The TMA was also instrumental in gaining an operating grant to implement transit
service between Burlington and the Mishawum Rail Station and Logan Express. The Railink
service began in early 1994.

The TMA was originally formed in recognition that the North Suburban region was heavily
congested with still room for significant growth. The North Suburban TMA currently is organized
under the auspices of the North Suburban Chamber of Commerce but functions as a separate
entity with separate operating budgets and organization structure. Current membership in the
North Suburban TMA includes 10 to 12 major employers in the region including the Lahey Clinic
in Burlington, the MITRE Corp. in Bedford, Hanscom Air Base in Bedford, Finard & Co. in
Burlington and American Landmark in Burlington. One must be a member in the Chamber of
Commerce to be a member in the TMA. The TMA has a Board of Directors and an Executive
Director. The Board is currently made up of nine (9) members, with six (6) from the private sector,
two (2) from the public sector and the Chamber being represented as well. The North Suburban
TMA has also been set up to work with an advisory board made up for the most part of the major
State and regional transportation and planning agencies. The Board sets the TMA agenda and
policy and identifies the transportation issues that must be addressed.

The North Suburban TMA has developed a mission statement with goals. The Mission Statement
is as follows:

"...to be an action oriented association organized to provide leadership in
using the combined resources of the public and private sectors to maximize
access to, and optimize mobility within, the area served by the TMA."

Current activities of the North Suburban TMA have been to try and build membership, coordinate
with the Route 128 Council TMA to the south and work with the initial members in developing
TDM plans for them to implement. The most active plans currently being developed relate to the
Lahey Clinic and the Hanscom Air Base. Each program has been specifically developed for the
particular member. Both the Lahey Clinic and Hanscom are experiencing problems related to
growth and the inability to park everyone in close, convenient locations. This is a problem
common to many major employers in the area. The proposed programs for these two members
generally consist of the following actions:

- promoting vanpools
- offering a guaranteed ride home program
- designating preferential parking spaces for vanpools and carpools
- expanding and promoting use of the Burlington B-Line (local transit service)
- promoting the use of public transit in general
- installing various databases for traffic information hotline reports and ridematching
- hiring and training an on-site transportation coordinator.

The North Suburban TMA has been involved on the Master Plan Committee providing input and
assistance throughout the plan development effort.
d. existing tdm/study area services

As part of the evaluating TDM potential for the Town and area, an investigation of current travel patterns, TDM activity and a review of Town regulations was conducted. The following sections present the findings of the effort.

Independent company actions

During the employee transportation survey, which is discussed in detail in section three of this report, interviews were also conducted with human resource managers of three of the five companies surveyed. The goal of the survey was to determine what, if any, programs or incentives individual companies within the town offered to their employees. The results showed a good effort on behalf of the companies, with most commenting that they wish they could do more.

Hewlett-Packard (HP) is probably the best example of an informal company action which has a large impact on the amount of HP employees using the roadway during the peak periods. HP has implemented a "Free Breakfast" program for all employees who start work before 7:45 AM. This means that any employee who shows up for work before 7:45 AM, before the peak morning travel period, is given a free breakfast. Our discussions indicated that over 80% of their employees take advantage of this program at least 2 times per week. Realizing that there are two peak travel periods over the course of a day, HP also offers free aerobics/weight training classes starting at 5:00 PM and continuing until 7:00 PM. Again, this helps reduce the number of HP employees on the roadway during the afternoon peak period. Since both programs are offered to employees free of charge, a large portion of the employees, more than 50%, use both programs. Hewlett-Packard has found that by offering incentives to its employees, it not only makes the employees happy, but feels it also makes them more productive, resulting in a situation where the benefits far out way the cost.

MA/COM, another company trying to reduce the congestion on the roadways, has developed a somewhat different approach. They determined that a large majority of their employees come from and travel to the north. There were a sufficient enough number, that they started running a shuttle bus between Lowell, MA and their offices, located off of Middlesex Turnpike in Burlington. The company picks up the majority of the cost with the employees paying only $2 to $3 each week. Sources within MA/COM said ridership on the shuttle is approximately 20-25 passengers (each way) per day. Before the regional economic slowdown in the late 1980's, a larger shuttle type vehicle was used and ridership was closer to 50-60 passengers (each way) per day. MA/COM finds that the shuttle offers a good convenient alternative to its employees, and the employees enjoyed the regular structured hours and the relief from attempting to travel Route 3 everyday by personal vehicle.

In addition to these activities, other institutions such as the Lahey Clinic are working with the TMA in instituting programs such as remote parking and ridesharing.
town regulations

The Zoning Bylaws for the Town of Burlington, dated May 1993, makes only one reference to TDM which appears on page 7-1. It relates to Article VII - Parking and Loading Regulations, subsection 7.1.0.1 which states:

"The purpose of this Article is to require the minimum amount of parking spaces needed to adequately serve all land uses and properties through the accomplishment of the following objectives.

7.1.0.1.1 To prevent the creation of surplus amounts of parking spaces which contribute to additional Single Occupancy Vehicle (SOV) trips being generated, resulting in traffic congestion and traffic service level deterioration on roadways;

7.1.0.1.2 To encourage use of Transportation Systems Management (TSM) and Transportation Demand Management (TDM) strategies, and to provide a basis for the development of Transportation Management Plans (TMP) to reduce new Single Occupancy Vehicle (SOV) trips within the Town, particularly during peak hour periods;

7.1.0.1.3 To increase use of public transportation opportunities and High Occupancy Vehicle (HOV) such as buses, carpools, and vans;... etc."

This Article essentially attempts to minimize the amount of parking needed, assuming that if more parking were available, more vehicles would come, resulting in traffic congestion and level of service deterioration. By allowing only a minimum amount of parking to adequately serve the properties, other opportunities need to be explored if the site demand increases. Hence, TDM and public transportation become a primary alternative in solving these problems.

Other points worth mentioning is Article 5.1.10 Floor Area Ratio Incentive, which says that the maximum floor area ratio may be increased from .15 to a maximum of .25 through a 20% reduction of the estimated Institute of Transportation Engineers (ITE) forecasts. A similar requirement exists for Article VII, Section 7.4.0 Special Permit for Increasing The Maximum Parking Space Requirements for Specific Non-Residential and Non-Educational Uses, which states that the maximum parking requirements may be increased by more than 10% if a 20% reduction in trip generation during both the am and pm peak hours can be achieved.

Lastly, Article VII Section 12.1.0 which deals with zoning requirements and submissions to the planning board states that applications for a planning development rezoning or an application for a planning development special permit requires that the applicant submit a concept plan which includes a traffic report which must contain; traffic counts (both ATR and turning movement), an inventory of the roadway, estimated trip generation, estimated distribution, level of service, estimated parking and peak accumulation and proposed mitigation.

Two examples of imposing these regulations include the Lahey Clinic and General Cinema. For example, the General Cinema, was required to run a shuttle bus circulator between the Burlington Mall and the Cinema which is on the opposite side of Middlesex Turnpike from the Mall.
existing public transportation system

A major element of a TDM program is the public transportation system. The study area is served by several different public and non-profit transit agencies. As part of this study, alternative transportation systems and services available in the study area were identified. The largest is the Massachusetts Bay Transportation Authority (MBTA). In general, the study area is served by:

- fixed route bus
- commuter rail
- express bus service
- regional vanpooling service, and
- taxis

In addition, demand-responsive service, primarily related to the elderly and/or handicapped citizens also serves the area. As will be shown on the next several pages, the majority of transit service is oriented radially between Boston and the study area as opposed to within the study area. Figure 1 illustrates the existing public transportation system graphically. A detailed discussion of the public transit system in the Town is included in the Technical report No. 1 and is not repeated here.

- mbta bus routes

There are several bus routes that serve Burlington. These include routes 352, 353, and 354. These essentially connect Burlington with downtown Boston. The bus routes serve Middlesex Turnpike, Route 3A, Burlington Mall Road and Crosby Drive.

- mbta commuter rail

The Mishawum Station is located within the Town of Woburn off Mishawum Road. The station is on the Lowell commuter rail line. Parking at the station currently numbers approximately 500 spaces, 11 of which are designated for handicap use. Observations indicate that approximately 50 percent of the spaces are full. Train service includes 6 peak period trains during the weekday. Weekend service is also provided on a more limited basis. Similar to the bus service, most of the rail line's use is by patrons with a Boston or Cambridge destination. Reverse commuting patterns are very low in numbers.

- burlington b-line

The Town of Burlington operates a local bus service called the Burlington B-Line. The B-Line serves various local streets in Burlington on either of six operating routes. At the present time there are three buses in operation, all three of which are wheelchair accessible and all are 22 feet in length. All three buses can accommodate 19 passengers each. The Burlington B-Line is currently limited to weekday service with typical weekday operations being from 8:00 AM to 6:30 PM. The People Mover would like to provide bus services for Lahey Clinic (earlier hours) and also Mishawum Station in Woburn, but funding is not available.

- logan express

Massport is currently operating a Logan Express service between Woburn and Logan Airport.
existing transit system

transportation master plan
burlington, massachusetts

not to scale

figure 1
The express presently operates from the Mishawum Commuter Rail Station.

While on the surface it appears as if Burlington is well served by transit, several potential areas of concern relate to the services as follows:

- much of the service is radially oriented to Boston and not to the high activity centers within the study area,
- there are no facilities available along any of the bus routes for people to park and ride,
- there are few reasons or incentives for a commuter to utilize these services.

**major activity centers**

The study area is presently highly developed, although there is much potential for further growth. Figure 2 illustrates the existing land use areas and major activity centers within Burlington. Existing and future centers of activity include:

- Burlington Mall
- Lahey Clinic
- Burlington Mall Road Area
- Town Center
- Wheeler Road Corridor
- Middlesex Turnpike Area

While an accurate count of employees working in this area is not available, total existing employment in the community is approximately 31,500 employees as of the most recently available data from Metropolitan Area Planning Council (MAPC) of which approximately 3,700 are town residents.

**other alternative modes**

As discussed in the first technical report for the transportation master plan study, the existing facilities for pedestrians and bicyclists are limited at best. There were areas of sidewalk continuities as well some streets without sidewalks. While there is a bicycle group working to advance the first bike path in Town, there is little else in terms of encouraging bicycle travel. These areas are important if the reduction of single occupant vehicles is to occur. In certain areas, the provision of pedestrian or bicycle facilities may not effect peak demand but could offer alternatives to midday travel which is also important in terms of a retail area and having a positive effect on the environment. Bicycle facilities also support recreational opportunities for the residents in addition to possible encouraging less SOVs at least during the good weather period of the northeast region.
summary of key land uses and major generators

transportation master plan
burlington, massachusetts

NOTE: Reference Numbers Pertain to List In Table A of the Appendix
evaluation of TDM strategies

a. evaluating tdm actions/procedures

TDM programs for employers, developers and the residential population are designed to shift employees out of single occupant vehicles and into alternative modes, such as carpools, vanpools, transit, bicycling and walking. Many of the TDM programs developed to date are geared to the work commute trip. Some programs also encourage employees to travel outside of the peak traffic periods. All of these types of programs help to:

- Reduce the need for new major roadway facilities,
- Reduce the travel costs to remaining motorists,
- Reduce energy consumption and air pollutants, and
- Reduce the potential for conflict or accidents.

If the employee is shifted from a solo commuting vehicle to one of the commuting alternative modes, the peak-hour vehicle trips on the highway and local street network will be reduced and affect traffic conditions in a positive manner.

Research has shown there are limited or no estimating techniques available for evaluating many of the TDM strategies. Most evaluations rely on limited amounts of empirical data collected in other locations. Many of the TDM studies have been before/after studies and not the development of techniques to forecast an impact. However, when evaluating or estimating the effectiveness of TDM actions and procedures, it is important to know the following information:

- how much the commute-alternative participation rate increased because of a particular program;
- how many vehicle trips were eliminated because of the participation rate increase; and
- what percentage of all trips on a roadway the eliminated vehicle trips represent.

In conducting before/after studies, one can measure how much the participation rate has changed as a result of a particular program can be accomplished by comparing before and after employee survey results or observing driveway volumes. Estimating the vehicle trip reductions and effects of vehicle trip reductions on traffic conditions is more involved. It includes measuring traffic flows during the peak periods and assessing changes in vehicle occupancy, vehicle types and the number of vehicles.

Estimating the reduction of vehicles as a result of the employees who continue to work the same hours but switch to an alternative mode is somewhat more complicated. First, it requires knowing what modes are available to employees and the ridership associated with each. Then, over a period of time, the before and after ridership data for each mode should be compared. Calculating the reduction involves knowing the increases and then determining how many of those users shifted from SOVs. Depending on the services available, employees could switch to several different modes. Some employees may also use alternative modes less than five days each week.
To determine the effects of vehicle trip reductions on traffic conditions, existing traffic volumes on the roadways in question must be known. If traffic volumes are close to capacity, as the major roadways in Burlington are, then even a small percent reduction in vehicles could have a significantly positive effect on traffic conditions. This is because travel delay increases rapidly as volumes approach and then exceed street capacity. To estimate the trip reductions, comparing the before roadway traffic volumes with the traffic volumes after a particular program has been implemented, will provide an indication of the change in roadway volume.

All this said, it is also generally recognized at the present time, that TDM alone will not generally solve the congestion or safety problems for the Town of Burlington, particularly in the near future. Some of the more extensive TDM actions implemented on an areawide basis, however, appear to be able to reduce peak hour travel by 10 to 15%. With the right mix of TDM alternatives and TSM strategies, a TDM/TSM program at individual employment sites can be very effective, reducing vehicle trips by as much as 30 to 40% under optimal conditions.

b. tdm potential

Actions listed in Table 2 were reviewed for applicability. Commonly used programs and services considered for TDM include:

- vanpools;
- guaranteed ride home program;
- designating preferential parking spaces for vanpools and carpools;
- provision of and expansion of public transit;
- creating transit and pedestrian friendly environments;
- installing various databases for traffic information hotline reports and ridematching; and
- hiring and training an on-site transportation coordinator.

Programs similar to these are presently being used at Lahey Clinic. Discussed earlier in this report were innovation programs implemented at HP and MA/COM. These is one indication of potential for TDM in the area.

The Burlington area is currently served by:

- fixed route bus
- commuter rail (in nearby Woburn)
- express bus service to Boston
- regional vanpooling service, and
- taxis

While these services exist, they are not all geared to Burlington travel as one can see the Boston orientation. There would appear to be some potential of TDM success due to the general lack of certain service alternatives at the present time. Another indication for TDM effectiveness is the current pattern of commuting to Burlington work places. Table 3 summarize the manner in which...
people who currently work in Burlington commute to work.

**Table 3**

**summary of work commute by mode and residency**

<table>
<thead>
<tr>
<th>mode</th>
<th>Burlington residents</th>
<th>non-residents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Car - Drive alone</td>
<td>88%</td>
<td>88%</td>
</tr>
<tr>
<td>In carpools</td>
<td>8%</td>
<td>10%</td>
</tr>
<tr>
<td>Use public transportation</td>
<td>2%</td>
<td>1.5%</td>
</tr>
<tr>
<td>Use other means</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Walked or work at home</td>
<td>2%</td>
<td>0.5%</td>
</tr>
</tbody>
</table>

1 - residents who also work in Burlington

From these, one can see that opportunity clearly exists to increasing the use of transit and other modes in an effort to reduce SOVs. In addition, observations of driveway volumes have been conducted by MSI to identify current vehicle occupancy rates of commuters (VORs). If average occupancy levels were observed to be greater than 1.25 persons per vehicle, then the potential for additional ridesharing would appear limited. However, observations have indicated VORs between 1.08 and 1.12. Consequently, the potential exists for increasing ridesharing and possible greater use of transit for non-residents. With nearly 30,000 non-resident people presently working in Burlington, even a relatively small percentage change can have significant effects on travel.

**c. employee transportation survey**

As part of this task, an employee travel survey was conducted. The purpose of the employee transportation characteristics survey was to identify the type and extent of current trip-making characteristics of major employers within Burlington. This would ideally also indicate areas of potential TDM strategies to pursue. For the purpose of this survey, a major employer was classified as a company with over 100 employees working within Burlington. There were five companies that met the criteria and agreed to participate in the study. They were:

- Hewlett-Packard
- MA/COM
- Baybank Middlesex
- Raytheon Service
- Nixdorf Computer

The survey consisted of seventeen (17) questions. Figure 3 illustrates the survey.

Four companies responded to the survey in sufficient time for analysis. As shown in Table 4, the survey had an overall response rate of 39% of the employees for companies that responded to the survey. This is considered a very good response for the nature of the survey. Shown below is the response rate by company.
Baybank Middlesex had the highest response rate at 63%, followed by Hewlett-Packard at 41%, Raytheon at 34% and M/A Com at 25%. Highlights of the surveys are discussed in the following paragraphs. Frequency tables of survey response are included in the Appendix.

The information obtained from a survey of this nature helps describe travel patterns of employees in terms of who is going where, with whom, at what time, by which mode and route, and for what purpose. It also provides insight on the potential for TDM effectiveness; the types of services that people would like to see within their buildings or complex; and, suggestions for improving local and regional transit system.

The category of occupation responding to the survey varied with the professional/technical employees make up 41% of the respondents. The administrative support category made up 28%, the executive/managerial staff 18%, and the remaining 13% was spread out between retail/sales, laborers and machine operators. Of all the employees surveyed, only 3% worked less than 40 hours per week, and 40% of the respondents said they work over 40 hours per week. The majority of people start work at 8:00 AM and leave work at 5:00 PM. With over 92% of the respondents driving alone to work during the peak period, congestion on the roadway becomes more and more clear. Companies like Hewlett-Packard and M/A Com have realized this and have initiated programs that encourage reducing peak period trip making. These incentives benefit all parties involved: it benefits the public, employees and the companies.

Findings from the survey showed a relatively high proportion of employees residing north of Burlington along the Route 3 and Route 93 corridors. Of the 797 surveys received, 694 live within Massachusetts, 100 live within New Hampshire and 3 within Rhode Island. Consequently, close to 13% of all the employees surveyed are coming from New Hampshire. This combined with the high number of residences from Billerica, Chelmsford, Lowell and Tewksbury, a high percentage of people (27%) of the Burlington employees are living in the north area. This translates into several thousand people overall.

With 27% of the employees working within Burlington coming from the north area, there is a large amount of people that through the right programs could potentially be removed from the roadways and put into an efficient transit system. M/ACom recognized this and has been running a shuttle system to the north, although the system is limited to M/ACom.
The Town of Burlington is conducting a survey to measure the type and extent of trip-making characteristics of major employers. The survey will help describe the travel patterns of employees in terms of who is going where, with whom, at what time, by which mode and route, and for what purpose.

We appreciate your taking time to complete this survey. It is our hope that the information gained from this survey today will make for a better commute for you tomorrow.

1.) What is your occupation?
   - Executive/Managerial
   - Professional/Technical
   - Retail/Sales
   - Administrative Support
   - Handler/Cleaner/Mover
   - Laborer
   - Machine Operator
   - Other

2.) Approximately how many hours per week do you typically work?
   - 20 Hours
   - 30 Hours
   - 40 Hours
   - Over 40 Hours

3.) What are your official work hours? (Fill in time and circle AM or PM)
   - Start Time
   - Leave Time

4.) How do you normally travel to work?
   - Walk
   - Bicycle
   - Motorcycle
   - Drive Alone - Car
   - Taxi
   - Drive with others - Car
   - Local Bus
   - Express Bus
   - Vanpool
   - Other (Specify)

5.) For transit riders and ride-sharers, do you have a private vehicle available to you to commute to work in?
   - Yes
   - No

6.) From where do you commute?
   City/Town —— State —— ZIP

7.) Approximately how many miles do you travel from home to work? __ Round-trip miles

8.) How long does it usually take you to travel from home to work? __ Minutes

9.) What PRIMARY ROUTES do you use to travel to work? (Please Check all that apply):
   - Route 3 from the north
   - Route 3 from the south
   - Route 128
   - Middlesex Turnpike
   - Route 495
   - Mass Pike
   - Route 93
   - Winn Street
   - Other (specify) __

10.) In general, how many times per week do you leave the premises during the period from 11:00 AM to 2:00 PM for errands or lunch?
    - 0
    - 1
    - 2
    - 3
    - 4
    - 5 or more

11.) If you arrived by vehicle TODAY, how many people, including yourself, were in the vehicle. For example, if you drove alone, check "1" below:
    - 1
    - 2
    - 3
    - Other (How Many?) __

12.) What would encourage you to share a ride or take transit to work?
    - Help finding people to ride with
    - Guaranteed ride home (In case of emergencies, illness)
    - More flexible hours
    - More fixed hours
    - Employer sponsored time off, prizes, drawings, and contests
    - Subsidy for vanpools
    - Being able to share a ride just 1-3 days a week
    - Preferred Parking
    - Mid-day shuttle to shopping area
    - Increased transit operating hours
    - None of the above
    - Other (specify) __

                     figure 3 - page 22
employees only. All companies surveyed indicated that they would be interested in participating and even help finance a shuttle system similar to what M/ACom is providing. If the Town were able to meet with these companies and give them direction, a large amount of single occupancy vehicles could be reduced to a few buses.

If a program like this were to be successful, then some type of incentive or services would have to be offered to its users to address issues of individuals needs to conduct personal business either during the midday breaks from work or combined with travel to or from the workplace. Another major finding from the survey was that more than 70% of the workers surveyed that they leave the premises of the workplace during the midday to run errands and personal business. The issue of the need for people to be able to get to their vehicle in an emergency must also be addressed.

Programs like a guaranteed ride home or a midday shuttle begin to address this need. The midday shuttle becomes very important as over 70% of the survey respondents indicated that they leave the premises at least once if not more during the period from 11:00 AM to 2:00 PM for errands or lunch. These same people will continue to drive alone to work if a convenience alternative is not offered to them for completing their errands.

A method to accomplish this with or without a midday shuttle is to offer the services that the employees are looking for within their own complex. These service range from a place to buy stamps or get cash (ATM), to a convenience store, day care or deli/restaurant. Another service that could be offered very easily is a dry cleaner. Some dry cleaner businesses are presently offering drop off and pick up service at major office buildings. This is a service for employees that is easy to provide, costs nothing to employers, and reduces vehicle trips.

Other highlights from the survey were:

- low transit use currently occurs as either transit services are not provided between communities or are not convenient,
- there would be an interest in some form of express bus travel for long distance travelers,
- there was indication of some interest in ridesharing
- providing various personal services within or in close proximity to a person workplace would reduce the need for either driving to and from work or adding o the midday travel in the area.

If TDM programs are expected to be successful, they have to be setup so that its easy for people to get to and utilize. For example, the number one reason people said they commute alone by automobile is because public transportation is unavailable or inconvenient to where they live. Assuming that public transportation could be made available to where its presently unavailable and is needed the most, the problem of inconvenience will still existing. Today there is a problem with transit systems being inconvenient to its users. Whether its operating hours and schedules or the larger problem of "I live here, the transit system originates there" need to be addressed.
TDM options for Burlington

Taking into consideration the research findings, the conditions of existing services and facilities, the transportation goals and objectives, and the survey findings, a listing of alternative TDM strategies for Burlington was developed. These were generally reviewed with the Master Plan Committee and certain actions were then further considered as part of the recommended transportation master plan. These alternative actions are described below and include regulatory actions, employer based alternatives, public transit, parking and actions for improving pedestrian and bicycle facilities.

a. land use regulatory options

Burlington has a fairly comprehensive project review process and has over the years, successfully obtained needed infrastructure improvements to accommodate growth as a result of the process. However, these were reviewed as part of the master plan study and relative to the TDM program, modifications to the regulations may be desirable to enhance the management of the local transportation system.

local approval process

- the process for subdivision approval by the Planning Board and special permit by the Board of Appeals should be consistent,
- a traffic access study should be required where the project’s peak hour trips exceed fifty vehicles,
- access for all project’s must be reviewed in terms of sight distance, driveway/roadway spacing and geometric design,
- site plan review should be instituted in the Town to ensure that access guidelines are consistently applied.

transportation management district (TMD)

A method to manage the growth and access throughout the Town is to create a management district. The establishment of this district would retain the underlying regulations in each district, but add new standards that are specific to the study area. This approach is comparable to overlay zoning for other purposes or for protection of other resources. It recognizes that the area under consideration has special problems and opportunities in addition to the characteristics that make the underlying zoning appropriate. The management district could establish additional regulations not included in the underlying zoning (for example, curb cut spacing, bonus densities, etc.); establish additional development opportunities not permitted in similarly-zoned areas elsewhere in the Town; serve as the mechanism to linking individual parcels in the district together, and probably most importantly, provide the mechanism to finance the implementation and operations of transportation improvements. The final boundary of the management district would have to be established but would tend to be within the major commercial and office development zones. Items that could be defined in detail within the Transportation Management
District include:

- limitation on high traffic generators
- setback requirements
- maintenance of landscaped front yards
- limited number of access points
- spacing of driveways/intersections
- define development bonuses/joint access requirements
- participation in transportation improvements and services
- requirement to join local transportation management association

An example of the TMD development in Montgomery County Maryland is included in the Appendix for informational purposes.

**Traffic impact and access study**

The Town currently requires a traffic study for any project that come before them for approval. More detailed guidelines for the preparation and submission of a Traffic Impact Access Study should be included in the special permit and site plan review regulations. In addition, there should be incorporated into the process an early meeting between the applicant and Town staff to review the key issues and scope of study prior to conducting the analysis. Also, the proposed mitigation plan must include a TDM element. At a minimum, traffic studies should be considered under a number of conditions including:

- a major development generating at least 25 peak hour vehicle trips,
- its proximity to high accident area,
- questionable sight distances exists,
- it is in or abuts a sensitive area,
- request for access on a high speed roadway, and
- a major change in land use is proposed from what is currently zoned.

The following summarizes guidelines for conducting a Traffic Impact Study based on various sources including the Site Impact Traffic Evaluation Handbook¹ and a Summary of Recommended Practice² by ITE and procedures required by the State Transportation Department.

- Establish the study area for the project through discussions with local officials. Consideration should be given to expected travel paths.

- Collect data including turning movement counts at all study area intersections during peak traffic hours (and/or the site generation peak hour if appropriate), accident research for the past three years at all study area intersections, stopping sight distance measurements, and vehicle travel speeds.

- **Existing Conditions Analysis** - Develop adjustment factors from data available from State and regional planning agencies in order to estimate average and peak season

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peak hour traffic conditions. Perform Level of Service (LOS) calculations on each location using the methods as set forth in the 1985 Highway Capacity Manual.  

Analyze the accident, sight distance, and travel speed data to identify locations with existing safety problems.

- **No-Build Analysis** - For comparison purposes, assess future conditions without the proposed project. Future conditions should reflect at a minimum of a five year period beyond current conditions. Other periods may be appropriate to study as well depending on type and schedule of development. Estimate the future background growth rate for traffic from data available from State, regional planning and local planning agencies and factor the existing traffic data appropriately. In addition, site specific developments which are located within or will have an impact upon the project study area should be added directly to the existing traffic data. Calculate the Levels of Service and compare them to the results of the existing conditions analysis.

- **Site Traffic Forecasts** - Calculate the daily and peak hour totals of traffic generated by the project according either based on local observations of similar uses, using the ITE Trip Generation Handbook, or some combination thereof. Local observations will require prior approval by the local planning and/or engineering department. In addition, the expected distribution pattern of entering and exiting site traffic should be provided.

- **Build Analysis** - Add all site related traffic to the No-Build traffic and calculate the study area intersections Levels of Service. Compare the results to the Existing and No-Build Conditions results. Deficiencies in terms of adverse impact should be identified.

- **Mitigation of Impacts** - Develop a mitigative plan to address all locations which are adversely impacted by the site traffic and indicate the expected LOS as a result of these improvements and estimated construction costs. This might include the addition of turn lanes, signal timing changes, major roadway improvements, or actions to limit or reduce peak hour traffic. Mitigative measures should also be proposed for deficient locations that were studied and not substantially impacted by the project. The mitigation plan must include TDM and may relate to implementing actions from the transportation master plan.

- **Document the study findings and proposed mitigative actions in an organized, detail report for review by local officials.**

Other regulatory options would require participation in the North Suburban TMA, require participation in supporting the local transit service, and requiring each development or owner to develop their own TDM plan specific to their needs. In addition, the site review should consider design and layout aspects that would make the site transit friendly as well as pedestrian friendly. Services (i.e. print shop, cafeteria, bank) provided in one building may be used by employees located in another building more readily if it is convenient to walk. This may require having building sited closer together, parking designed to service more than one building in the campus type settings.

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b. public transit services

A number of potential transit improvements were identified during the course of the analysis. These are shown in Table 5.

<table>
<thead>
<tr>
<th>Table 5</th>
<th>List of potential public transportation alternatives</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>modify existing routes</td>
</tr>
<tr>
<td></td>
<td>modify start/end times</td>
</tr>
<tr>
<td></td>
<td>improve connections between services</td>
</tr>
<tr>
<td></td>
<td>institute a midday shuttle in Mall Road area</td>
</tr>
<tr>
<td></td>
<td>express service from remote areas</td>
</tr>
<tr>
<td></td>
<td>change vehicle type for local service</td>
</tr>
<tr>
<td></td>
<td>provide shelters at key locations</td>
</tr>
<tr>
<td></td>
<td>provide parking for resident commuters</td>
</tr>
</tbody>
</table>

Of these actions, some of the more promising for encouraging shifts from the single occupant vehicles appear to be the provision of remote express service from the North, provision of a location or travel center where different transit services could be coordinated and patrons could make connections between services and the midday shuttle in the business areas. For local service to encourage resident commuters, then the service must start earlier (i.e. 7 AM) and end later (i.e. 7 or 8PM). The route must also be more direct. Typical planning standards suggest that a bus route should take no longer than 20% the time it takes one to drive - park - walk to the destination. Currently, the route structure of the B-Line is very circuitous and results in excessive trip times from the north area of Town to the business/mall area of the community i the south. One solution would be to develop more direct routes for the peak commute time periods only and during the off-peak revert back to the current structure.

Parking was identified during the public participation process by residents who commute to work to the South (i.e. Boston, Cambridge area) and use transit. Locations for small, secure parking areas near bus routes for these residents should be considered. With a small travel center to coordinate the services, some parking could be incorporated as well.

Amenities to encourage public transit use and minimize its negative aspects on the system would include providing shelters along routes at major loading areas, providing bus turnouts along major routes at the stops and providing bike storage facilities at the stops. Pedestrian safety should also be considered at the stops.
c. employer sponsored programs

Employer sponsored programs will tend to focus on encouraging ridesharing for its employees, encouraging and being flexible in work schedules in an effort to reduce peak hour travel, supporting the TDM efforts of the Town including the bus service, and developing their projects to be TDM friendly. The benefit that employers or developers may realize will be less parking requirements as well as improved mobility within the transportation system. The services provided also provide benefits to employees which may make it somewhat easier to recruit employees. Support for the midday shuttle and the guaranteed ride home are important to reducing vehicle travel which in turn will reduce the pressure or need for excessive parking. In addition, through participation with the North Suburban TMA, other programs such as advance traveler information systems for the employees of the building or complex could be developed. Finally, as the pedestrian and bicycle systems are developed within the community, the employers and developers have an opportunity to enhance their use by providing secure storage areas, shower facilities and physical connections to the Town system of walks, routes and paths.

d. parking

Parking is an important aspect of travel management. For example, in areas where severe congestion exists, imposing parking restrictions and providing effective transit service has been used to manage traffic flow and the operations of the transportation system. Many growth areas, particularly central business districts have developed fringe type parking systems to reduce the number of vehicles on the local roadway system during peak hours.

Individual facilities can also experience excessive vehicle demand conditions resulting in the need for more parking. A local example is the Lahey Clinic which continues to experience increases in patient service. With limited alternatives to travel, their parking facilities have been overtaxed for some time. They have been attempting various techniques such as remote parking and ridesharing emphasis as a way to resolve their on-site parking dilemma as well as reduce the vehicle demands on the roadway system adjacent to the Clinic.

At the same time, Burlington is a suburb and the growth that occurred in the past centered around the private vehicle. While transit service exists, it is not focused at transporting commuters to work in the town whether a resident or non-resident.

Through this study, there were a number of parking issues or needs identified including:

- resident demands taking transit to the south (i.e. Boston)
- non-resident employees working in Burlington and residing >20 miles away,
- local demands of the businesses and the related local congestion
- regional demands with destinations other than Burlington

In terms of affecting local traffic flow and congestion levels, the demands created by the businesses is a major factor. One will not, however, tend to alter the demands created by the patron or shopper of the business (Burlington Mall visitor). Rather, any change in managing
Parking will have to be directed towards the employee population. One option is to develop a fringe parking system in close proximity to the highway system and operate shuttle buses to the major business area. The businesses could financially assist the development of the parking areas and the operations of the shuttle while being required to construct less on-site parking. Development bonuses may also be an incentive for this strategy.

Another strategy directed to providing alternative travel means to employees residing more than 20 miles away would be remote park and ride system with express bus to the Burlington work areas. The travel survey conducted as part of this study found approximately 27% of the surveyed employees residing to the north and the potential for this service.

The regional parking demands are those potentially created by employees currently commuting to the south (i.e. Boston and Cambridge) and would use an alternative service if parking were to be provided. The regional planning agency identified a location for regional park and ride at the interchange of Route 3 and 128. At the present time, this is not even in the planning phases. Envisioned, however, is a major parking facility with bus service to the south. While positive from a regional perspective at reducing corridor volumes (Route 93), legitimate concern over access and its impact on the Burlington roadway system exists. These would have to be examined in the planning stages of any such facility.

From a more positive viewpoint, the Town of Burlington may be able to capitalize from such a facility if part of the parking area could be designated for the local fringe parking. Again, access to the facility would have to be reviewed and a local shuttle between the parking lot and the local work places would have to be developed.

**e. Pedestrians/Bicycle Facilities**

The most noticeable need in terms of pedestrians and bicycle travel is the need for developing a system of continuous facilities whether it is sidewalks or bicycle routes and paths. Inventories of sidewalks along the study’s roadways indicated several locations where gaps in the system exist. Along certain roadways, sidewalks are simply non-existent. Actions to improve the conditions would be to close the gaps, and provide sidewalks (one or two sides) along all major roadways in the community. A listing of the roadways, inventory results and locations of needed improvements are included in the Appendix. Sidewalks should be at least 5 to 6 feet wide. In areas of higher pedestrian volumes or area including street furniture along the sidewalk, then it will need to be wider.

In areas of high traffic volumes or high travel speeds, crosswalks should be highly visible using the “ladder” type design with reflective thermoplastic material.

A potential priority system for addressing the sidewalk deficiencies in Burlington is presented in Table 6.
Table 6
Priority of the construction of new sidewalks

<table>
<thead>
<tr>
<th>Gaps within one half mile</th>
<th>Roadway classification</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Arterial</td>
</tr>
<tr>
<td>Schools</td>
<td>1</td>
</tr>
<tr>
<td>Churches</td>
<td>1</td>
</tr>
<tr>
<td>Parks/recreation areas</td>
<td>2</td>
</tr>
<tr>
<td>Shopping</td>
<td>3</td>
</tr>
</tbody>
</table>

*Priority ratings range from 1 for the highest and 5 for the lowest.

The above priority plan will assist in scheduling the construction of new sidewalks as funds become available, while the following recommended guidelines provide some general design specification and standards to be followed during construction. While the inventory conducted for this report does not take into account the condition and availability of sidewalks along every street, the priority evaluation and guidelines may be applied to any sidewalk system to determine the extent of need and the recommended design.

The recommended guidelines for the replacement and installation of sidewalks were developed with the aid of two research publications. Table 7 provides a set of guidelines that can be followed when new sidewalks are to be constructed or existing sidewalks are to be replaced. The information in the table may be used to determine where sidewalks should be provided based on the roadway classification and whether or not the sidewalk is being considered along an existing or new road.

To supplement the information in the table the following set of standards has been developed to assist in the decision making process and provide some general design guidelines to be followed during construction.

1) Any local street within two blocks of a school site that would be on a walking route to school should have a sidewalk on at least one side.

2) Sidewalks may be omitted on one side of new streets where that side clearly cannot be developed and where there are no existing or anticipated uses that would generate pedestrian trips on that side.

3) Where there are service roads, the sidewalk adjacent to the main road may be eliminated and replaced by a sidewalk adjacent to the service road on the side away from the main road.

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### Table 7

**Recommended Guidelines for Sidewalk Installation**

<table>
<thead>
<tr>
<th>Land-Use/Roadway Classification</th>
<th>New Urban and Suburban Streets</th>
<th>Existing Urban and Suburban Streets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commercial &amp; Industrial/All Streets</td>
<td>Both Sides</td>
<td>Both Sides. Every effort should be made to add sidewalks where they do not exist and complete missing links.</td>
</tr>
<tr>
<td>Residential/Major Arterials</td>
<td>Both Sides</td>
<td>Same as above.</td>
</tr>
<tr>
<td>Residential/Collectors</td>
<td>Both Sides</td>
<td>Multi-family - both sides. Single family dwellings - prefer both sides, required at least one side.</td>
</tr>
<tr>
<td>Residential/Local Streets More Than 4 Units/Acre</td>
<td>Both Sides</td>
<td>Prefer both sides, required at least one side.</td>
</tr>
<tr>
<td>1 to 4 Units Per Acre</td>
<td>Prefer both sides; required at least one side.</td>
<td>One side preferred</td>
</tr>
<tr>
<td>Less Than 1 Unit Per Acre</td>
<td>One side preferred, shoulder both sides required.</td>
<td>At least 4 foot shoulder on both sides required.</td>
</tr>
</tbody>
</table>

Source: Transportation Research Board, NCHRP 139, Pedestrian and Traffic-Control Measures

4) All new sidewalks should be at least five feet wide and must comply with “American with Disability Act” access requirements/standards.

5) Where the right-of-way exists, there should be a buffer of at least three feet between the edge of roadway and the edge of the sidewalk.

6) Granite curbs are desired to provide a barrier between motor vehicles and pedestrians when the edge of the sidewalk is within ten feet of the traveled way.

Bicycle plans have been underway in the Town by a relatively small group of enthusiasts. However, at this time, there are virtually no bicycle facilities or emphasis on bicycle travel in the community. Alternatives for improving this include designating bicycle routes, bicycle paths, bicycle storage facilities in key locations (i.e. employment centers, town buildings, transit stops), and disseminating the information to the community through mapping and signage.

The actual design of a bicycle path or route is a relatively simple engineering task. The keys to a
successful facility are associated with the connections that are available and the appropriate treatment at the interfaces with streets, driveways and other facilities. The following figure and photographs illustrate examples of “bicycle friendly” design aspects. These treatments should be considered in developing any route system or separate bicycle path. A separate path is typically 8 to 10 feet wide and also include graded shoulders of an additional foot or two.

As part of this study task, a proposed bicycle route system was developed for both recreational as well as commute type travel. Figure 5 illustrates this potential system.
Existing

Bicycle Friendly

Existing

Bicycle Friendly

bicycle friendly roadway layouts

transportation master plan
burlington, massachusetts

not to scale

figure 4
Examples of Bicycle Path Treatments
Examples of Bicycle Path Treatments
LEGEND

- ——— Potential Commuter Route
- ——— Potential Recreational Route
- ——— Existing Route
- ——— Proposed Connection

potential bicycle routes

transportation master plan
burlington, massachusetts

not to scale

Figure 5
conclusions

The previous pages have outlined TDM and its principles and potential effectiveness. Possible strategies for the Town of Burlington were also presented and discussed. These will be further considered in the development of the recommended plan.

It cannot be stressed enough that for TDM to be successful, the commitments from all parties, both public and private, is required. In addition, the effect of the TDM strategy or strategies will not generally be felt right away and may take years to reach the full potential. It is important that the TDM programs strive for sustaining the effort. However, it is an increasingly important part of any transportation plan and should be viewed in that manner.

The alternative TDM actions that were discussed in this report will be further evaluated through committee discussions, public review and in concert with all the various strategies and actions. Ultimately, a number of the TDM strategies will be selected for inclusion in the recommended plan based on the potential to reduce single occupant vehicle travel and their ability to help meet the Town's transportation goals and objectives. For those selected, further studies may be necessary to design and estimate costs, secure funding and implement.
part 7 technical appendices
appendix

- reference tables
- bus transit schedules and routings
- new traffic volume counts
- list of source references
map and figure references
reference tables

- figure 6
- figure 12
### TABLE A
LISTING OF SCHOOLS, CHURCHES AND RECREATION AREAS

The following is a listing of public buildings, grounds and institutional facilities shown on Figure 6.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Wildwood School</td>
</tr>
<tr>
<td>2</td>
<td>St. Malachy's Church</td>
</tr>
<tr>
<td>3</td>
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**SUMMARY OF SOURCES**
**EXISTING LEVEL OF SERVICE**
(See Figure 12)

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**AM PEAK HOUR IS 7:45 TO 8:45**
- Volume: North: 861
- Volume: South: 560
- Combined: 1401
- Directional Split: North: 61%, South: 39%
- Peak Hour Factor: North: 0.95, South: 0.93, Combined: 0.96

**PM PEAK HOUR IS 5:00 TO 6:00**
- Volume: North: 603
- Volume: South: 772
- Combined: 1375
- Directional Split: North: 44%, South: 56%
- Peak Hour Factor: North: 0.30, South: 0.92, Combined: 0.92
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**TOTALS:** 15819 16204 32023

**AM PEAK HOUR IS 7:15 TO 8:15**

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- **Date:** Tuesday 10/12/93
- **Correction Factor:** 1.00
- **Operator:** PGL

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**Totals:**
- South: 1,137
- North: 1,086
- Combined: 2,223

### AM Peak Hour
- **Time:** 7:15 to 3:15
- **Volume:**
  - South: 1,139
  - North: 538
  - Combined: 1,677
- **Directional Split:**
  - South: 71%
  - North: 29%
- **Peak Hour Factor:** 0.97

### PM Peak Hour
- **Time:** 5:00 to 6:00
- **Volume:**
  - South: 787
  - North: 1,191
  - Combined: 1,978
- **Directional Split:**
  - South: 60%
  - North: 60%
- **Peak Hour Factor:** 0.96
| HOUR BEGINS | WEST | | | | EAST | | | | | COMBINED | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AM | | | | | | | | | | | | | | |
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| 1 | 1 | 1 | 1 | 0 | 3 | 3 | 1 | 1 | 2 | 7 | 10 | | |
| 2 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 2 | | |
| 3 | 0 | 0 | 0 | 2 | 2 | 0 | 0 | 0 | 1 | 1 | 3 | | |
| 4 | 2 | 2 | 2 | 1 | 7 | 0 | 1 | 0 | 1 | 2 | 9 | | |
| 5 | 3 | 6 | 4 | 10 | 23 | 0 | 2 | 1 | 1 | 4 | 27 | | |
| 6 | 13 | 22 | 26 | 23 | 99 | 1 | 4 | 5 | 18 | 28 | 117 | | |
| 7 | 50 | 57 | 48 | 48 | 203 | 10 | 22 | 26 | 19 | 77 | 390 | | |
| 8 | 67 | 59 | 34 | 44 | 204 | 10 | 17 | 16 | 15 | 58 | 362 | | |
| 9 | 34 | 21 | 16 | 24 | 95 | 16 | 12 | 21 | 14 | 61 | 156 | | |
| 10 | 20 | 20 | 28 | 15 | 83 | 24 | 12 | 13 | 17 | 56 | 149 | | |
| 11 | 17 | 21 | 21 | 21 | 80 | 15 | 27 | 27 | 25 | 94 | 174 | | |
| PM | | | | | | | | | | | | | | |
| 12 | 24 | 21 | 16 | 25 | 36 | 28 | 27 | 23 | 23 | 166 | 192 | | |
| 1 | 20 | 16 | 20 | 29 | 85 | 30 | 20 | 19 | 28 | 97 | 182 | | |
| 2 | 25 | 27 | 30 | 25 | 107 | 35 | 23 | 29 | 27 | 114 | 221 | | |
| 3 | 15 | 27 | 18 | 35 | 95 | 25 | 25 | 33 | 55 | 138 | 233 | | |
| 4 | 12 | 27 | 24 | 26 | 59 | 44 | 40 | 42 | 44 | 170 | 259 | | |
| 5 | 33 | 22 | 26 | 33 | 114 | 50 | 51 | 50 | 68 | 199 | 313 | | |
| 6 | 20 | 30 | 27 | 4 | 85 | 60 | 37 | 45 | 142 | 227 | | |
| 7 | * | * | * | * | * | * | * | * | * | * | * | | |
| 8 | * | * | * | * | * | * | * | * | * | * | * | | |
| 9 | * | * | * | * | * | * | * | * | * | * | * | | |
| 10 | * | * | * | * | * | * | * | * | * | * | * | | |
| 11 | * | * | * | * | * | * | * | * | * | * | * | | |

**TOTALS** 1657 1384 2841

**AM PEAK HOURS IS 7:15 TO 8:15**

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**PM PEAK HOURS IS 5:15 TO 6:15**

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<tr>
<td>DIRECTIONAL SPLIT</td>
<td>34%</td>
<td>66%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PEAK HOUR FACTOR</td>
<td>0.83</td>
<td>0.87</td>
<td>0.90</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
bus transit schedules and routings

B-Line Routes 1-6
MBTA 350, 352, 353/354
Railink
B Line 1 & 4
Winnmere-All Malls (Red Line)

**WEEKDAYS**

**ROUTE 1**

<table>
<thead>
<tr>
<th>Leave Center School</th>
<th>Leave Middlesex Mall</th>
<th>Leave Tower Records</th>
<th>Leave Burlington Mall</th>
</tr>
</thead>
<tbody>
<tr>
<td>9:00AM</td>
<td>9:10AM</td>
<td>9:15AM</td>
<td>9:20AM</td>
</tr>
<tr>
<td>10:00</td>
<td>10:10</td>
<td>10:15</td>
<td>10:20</td>
</tr>
<tr>
<td>11:00</td>
<td>11:10</td>
<td>11:15</td>
<td>11:20</td>
</tr>
<tr>
<td>12:00PM</td>
<td>12:10PM</td>
<td>12:15PM</td>
<td>12:20PM</td>
</tr>
<tr>
<td>a 2:00</td>
<td>2:10</td>
<td>2:15</td>
<td>2:20</td>
</tr>
<tr>
<td>b 3:00</td>
<td>3:10</td>
<td>3:15</td>
<td>3:20</td>
</tr>
<tr>
<td>4:00</td>
<td>4:10</td>
<td>4:15</td>
<td>4:20</td>
</tr>
<tr>
<td>5:00</td>
<td>5:10</td>
<td>5:15</td>
<td>5:20</td>
</tr>
<tr>
<td>6:00</td>
<td>6:10</td>
<td>6:15</td>
<td>6:20</td>
</tr>
<tr>
<td>Lahey Clinic on request</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**ROUTE 4**

<table>
<thead>
<tr>
<th>Leave Center School</th>
<th>Leave Mill St.</th>
<th>Leave Wyman St.</th>
<th>Leave Peach Orchard Rd.</th>
</tr>
</thead>
<tbody>
<tr>
<td>8:00AM</td>
<td>8:05AM</td>
<td>8:10AM</td>
<td>8:15AM</td>
</tr>
<tr>
<td>8:30</td>
<td>8:35</td>
<td>8:40</td>
<td>8:45</td>
</tr>
<tr>
<td>9:30</td>
<td>9:35</td>
<td>9:40</td>
<td>9:45</td>
</tr>
<tr>
<td>10:30</td>
<td>10:35</td>
<td>10:40</td>
<td>10:45</td>
</tr>
<tr>
<td>11:30</td>
<td>11:35</td>
<td>11:40</td>
<td>11:45</td>
</tr>
<tr>
<td>12:30PM</td>
<td>12:35PM</td>
<td>12:40PM</td>
<td>12:45PM</td>
</tr>
<tr>
<td>a 2:05PM and 2:25PM</td>
<td></td>
<td>2:40</td>
<td>2:45</td>
</tr>
<tr>
<td>b 3:25PM</td>
<td></td>
<td>3:40</td>
<td>3:45</td>
</tr>
<tr>
<td>c 1:45PM</td>
<td></td>
<td>4:00</td>
<td>4:05</td>
</tr>
<tr>
<td>d 2:05PM</td>
<td></td>
<td>4:30</td>
<td>4:35</td>
</tr>
<tr>
<td>e 3:25PM</td>
<td></td>
<td>5:00</td>
<td>5:05</td>
</tr>
</tbody>
</table>

To hail bus: Stand on side of road bus travels. Wave at it and driver will pick you up.

**1: Center School-All Malls**
via Middlesex Turnpike

**4: Center School-Winnmere**
via Winn St.

1993 Schedule
Service operates Monday through Friday only
For Assistance Call 270-1965

---

**Fares:**
- Under 6: 15c
- Students: 60c
- Adults: 75c
- Seniors: 35c
- Transfers: 10c

**Exact Change Required**
B Line 2 & 5
Fox Hill-Lahey Clinic and Malls (Green Line)

WEEKDAYS
ROUTE 2

<table>
<thead>
<tr>
<th>Leave Center School</th>
<th>Leave Wilmington Drive</th>
<th>Leave Westwood St.</th>
<th>Leave Toner Dr.</th>
</tr>
</thead>
<tbody>
<tr>
<td>8:00AM</td>
<td>8:05AM</td>
<td>8:15AM</td>
<td>8:20AM</td>
</tr>
<tr>
<td>9:00</td>
<td>9:05</td>
<td>9:15</td>
<td>9:20</td>
</tr>
<tr>
<td>10:00</td>
<td>10:05</td>
<td>10:15</td>
<td>10:20</td>
</tr>
<tr>
<td>11:00</td>
<td>11:05</td>
<td>11:15</td>
<td>11:20</td>
</tr>
<tr>
<td>12:00PM</td>
<td>12:05PM</td>
<td>12:15PM</td>
<td>12:20PM</td>
</tr>
<tr>
<td>1:00</td>
<td>1:05</td>
<td>1:15</td>
<td>1:20</td>
</tr>
<tr>
<td>2:00</td>
<td>2:05</td>
<td>2:15</td>
<td>2:20</td>
</tr>
<tr>
<td>3:00</td>
<td>3:05</td>
<td>3:15</td>
<td>3:20</td>
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<tr>
<td>4:00</td>
<td>4:05</td>
<td>4:15</td>
<td>4:20</td>
</tr>
<tr>
<td>5:00</td>
<td>5:05</td>
<td>5:15</td>
<td>5:20</td>
</tr>
<tr>
<td>6:00</td>
<td>6:05</td>
<td>6:15</td>
<td>6:20</td>
</tr>
</tbody>
</table>

WEEKDAYS
ROUTE 5

<table>
<thead>
<tr>
<th>Leave Center School</th>
<th>Leave Lahey Clinic</th>
<th>Leave Burlington Mall</th>
<th>Leave Middlesex Mall</th>
</tr>
</thead>
<tbody>
<tr>
<td>9:00</td>
<td>9:05</td>
<td>9:15</td>
<td>9:20</td>
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<tr>
<td>10:00</td>
<td>10:05</td>
<td>10:15</td>
<td>10:20</td>
</tr>
<tr>
<td>11:00</td>
<td>11:05</td>
<td>11:15</td>
<td>11:20</td>
</tr>
<tr>
<td>12:00PM</td>
<td>12:05PM</td>
<td>12:15PM</td>
<td>12:20PM</td>
</tr>
<tr>
<td>1:00</td>
<td>1:05</td>
<td>1:15</td>
<td>1:20</td>
</tr>
<tr>
<td>2:00</td>
<td>2:05</td>
<td>2:15</td>
<td>2:20</td>
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<tr>
<td>3:00</td>
<td>3:05</td>
<td>3:15</td>
<td>3:20</td>
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<tr>
<td>4:00</td>
<td>4:05</td>
<td>4:15</td>
<td>4:20</td>
</tr>
<tr>
<td>5:00</td>
<td>5:05</td>
<td>5:15</td>
<td>5:20</td>
</tr>
<tr>
<td>6:00</td>
<td>6:05</td>
<td>6:15</td>
<td>6:20</td>
</tr>
</tbody>
</table>

To hall bus: Stand on side of road bus travels.
Wave at it and driver will pick you up.

1993 Schedule
Service operates Monday through Friday only
For Assistance Call 270-1965

Fares: Under 6 15¢
       Students 60¢
       Adults 75¢
       Seniors 35¢
       Transfers 10¢

Exact Change Required
**B Line 3 & 6**

**Francis Wyman-Terrace Hall (Blue Line)**

**3: Center School-Bedford Line**
via Francis Wyman Rd.

**6: Center School-Burlington Mall**
via Terrace Hall Ave.

---

### WEEKDAYS

<table>
<thead>
<tr>
<th>ROUTE 3 (Francis Wyman-Terrace Hall)</th>
<th>ROUTE 6 (Center School-Burlington Mall)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Leave</strong></td>
<td><strong>Leave</strong></td>
</tr>
<tr>
<td>8:00AM</td>
<td>8:05AM</td>
</tr>
<tr>
<td>9:00</td>
<td>9:05</td>
</tr>
<tr>
<td>10:00</td>
<td>10:05</td>
</tr>
<tr>
<td>11:00</td>
<td>11:05</td>
</tr>
<tr>
<td>12:00PM</td>
<td>12:05PM</td>
</tr>
<tr>
<td>1:00</td>
<td>1:05</td>
</tr>
<tr>
<td>2:00</td>
<td>2:05</td>
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<tr>
<td>3:00</td>
<td>3:05</td>
</tr>
<tr>
<td>4:00</td>
<td>4:05</td>
</tr>
<tr>
<td>5:00</td>
<td>5:05</td>
</tr>
<tr>
<td>6:00</td>
<td>6:05</td>
</tr>
</tbody>
</table>

---

To hall bus: Stand on side of road bus travels.
Wave at it and driver will pick you up.

**Fall 1993**
September 11, 1993 - December 31, 1993

---

For Assistance Call 270-1965

---

**Burlington Bus**

**THE B LINE**

Fall 1993
September 11, 1993 - December 31, 1993

---

**Fares:**
- Under 6: 15¢
- Students: 60¢
- Adults: 75¢
- Seniors: 35¢
- Transfers: 10¢

Exact Change Required

---

**This service is funded by the town of Burlington and the METRO and is being operated by Joseph's Limousine Service Inc. under contract to the town of Burlington.**

---

**1993 Schedule**
Service operates Monday through Friday only
Shuttle service is now provided Monday through Friday from the Mishawum commuter rail station in Woburn to Burlington businesses.

The shuttle completes a major circle serving many Burlington businesses, as well as providing transportation for residents of Burlington to the rail station.

Schedule:
- AM (Starting at Mishawum):
  * 6:15, 7:15, 8:15  Morning buses pull into Lahey and NEEP upon request.
- PM (Starting at Mall Rd. & Cambridge St.):
  * 3:30 (for 4:30 train)
  * 4:30 (for 5:30 train)
  * 5:30 (for 6:30 train)

Burlington Residents Schedule:
- AM (Pick up at St. Margaret's):
  * ~6:50 (for 7:13 Boston train)
  * ~7:50 (for 8:13 Boston train)
- PM (Drop off at St. Margaret's):
  * ~5:15 (for 5:07 Boston train)
  * ~6:30 (for 6:12 Boston train)

Schedule may vary slightly due to traffic conditions and weather.

Sponsored by the North Suburban Transportation Management Association (an affiliate of the North Suburban Chamber of Commerce) in cooperation with the U.S. Dept. of Transportation, the Massachusetts Highway Department, the Town of Burlington, and the City of Woburn, as well as private donations from Fnerd & Company, Lahey Clinic, American Landmark, Hewlett Packard, and Spaulding Investment.
sidewalk inventories
<table>
<thead>
<tr>
<th>Roadway</th>
<th>From</th>
<th>To</th>
<th>Sidewalks Exist</th>
<th>Gap in Available Sidewalks (ft.)</th>
<th>Approximate Cost To Fill Gaps</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cambridge Street</td>
<td>Lincoln Knoll Lane</td>
<td>Wall Street</td>
<td>East Side</td>
<td>Gaps East-400'</td>
<td>$10,000</td>
</tr>
<tr>
<td></td>
<td>Wall Street</td>
<td>Mail Road</td>
<td>Both Sides</td>
<td>Gaps East-600', Gaps West-1200'</td>
<td>$45,000</td>
</tr>
<tr>
<td></td>
<td>Mall Road</td>
<td>Arlington Road</td>
<td>Both Sides</td>
<td>Gaps East-100'</td>
<td>$2,500</td>
</tr>
<tr>
<td></td>
<td>Arlington Road</td>
<td>Anna Road</td>
<td>Both Sides</td>
<td>Gaps East-200', Gaps West-1500'</td>
<td>$42,500</td>
</tr>
<tr>
<td></td>
<td>Anna Road</td>
<td>Bedford Street</td>
<td>Both Sides</td>
<td>Gaps West-300'</td>
<td>$7,500</td>
</tr>
<tr>
<td></td>
<td>Bedford Street</td>
<td>Winn Street</td>
<td>Both Sides</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Winn Street</td>
<td>Skilton Lane</td>
<td>Both Sides</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Skilton Lane</td>
<td>Wilmington Road</td>
<td>Both Sides</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Wilmington Road</td>
<td>Francis Wyman Road</td>
<td>Both Sides</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Francis Wyman Road</td>
<td>Billerica Townline</td>
<td>Both Sides</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Middlesex Turnpike</td>
<td>Adams Street</td>
<td>Wheeler Road</td>
<td>East Side</td>
<td>Gaps West-100'</td>
<td>$2,500</td>
</tr>
<tr>
<td></td>
<td>Wheeler Road</td>
<td>South Avenue</td>
<td>West Side</td>
<td>Gaps West-750'</td>
<td>$18,750</td>
</tr>
<tr>
<td></td>
<td>South Avenue</td>
<td>Lexington Street</td>
<td>None</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lexington Street</td>
<td>Third Avenue</td>
<td>None</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Third Avenue</td>
<td>Terrace Hall Avenue</td>
<td>None</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Terrace Hall Avenue</td>
<td>&quot;A&quot; Street</td>
<td>East Side</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>&quot;A&quot; Street</td>
<td>Bedford Street</td>
<td>East Side</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mountain Road</td>
<td>Glen Avenue</td>
<td>Both Sides</td>
<td>Large Gaps (~600')</td>
<td>$15,000</td>
</tr>
<tr>
<td></td>
<td>Glen Avenue</td>
<td>Route 128 Ramps</td>
<td>Both Sides</td>
<td>Large Gaps (~800')</td>
<td>$20,000</td>
</tr>
<tr>
<td></td>
<td>Route 128 Ramps</td>
<td>Johnson Road</td>
<td>Both Sides</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Johnson Road</td>
<td>Peach Orchard Road</td>
<td>East Side</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Peach Orchard Road</td>
<td>Locust Street</td>
<td>Both Sides</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Locust Street</td>
<td>Mill Street</td>
<td>East Side</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mill Street</td>
<td>Winn Street</td>
<td>East Side</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bedford Street</td>
<td>Middlesex Turnpike</td>
<td>South Side</td>
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<td></td>
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<tr>
<td></td>
<td>Humboldt Avenue</td>
<td>Terrace Hall Road</td>
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<td></td>
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<tr>
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<td>Cambridge Street</td>
<td>North Side</td>
<td></td>
<td></td>
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<td></td>
<td>Cambridge Street</td>
<td>Center Street</td>
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<tr>
<td></td>
<td>Terrace Hall Avenue</td>
<td>Middlesex Turnpike</td>
<td>Washington Avenue</td>
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</tr>
</tbody>
</table>
## Burlington Transportation Master Plan

### Inventory of Available Sidewalks

**Date:** 5/18/94

<table>
<thead>
<tr>
<th>Roadway</th>
<th>From</th>
<th>To</th>
<th>Sidewalks Exist</th>
<th>Gap in Available Sidewalks (ft.)</th>
<th>Approximate Cost To Fill Gaps</th>
</tr>
</thead>
<tbody>
<tr>
<td>Washington Avenue</td>
<td>Hilltop Drive</td>
<td>None</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hilltop Drive</td>
<td>Bedford Street</td>
<td>None</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lexington Street</td>
<td>Middlesex Turnpike</td>
<td>Mall Road</td>
<td>Both Sides</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mall Road</td>
<td>South Bedford Street</td>
<td>Stonybrook Road</td>
<td>Both Sides</td>
<td></td>
<td></td>
</tr>
<tr>
<td>South Bedford Street</td>
<td>Stonybrook Road</td>
<td>Spruce Hill Road</td>
<td>East Side</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stonybrook Road</td>
<td>Spruce Hill Road</td>
<td>McGinnis Drive</td>
<td>East Side</td>
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<td></td>
</tr>
<tr>
<td>Country Road</td>
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<tr>
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<td>Foster Road</td>
<td>West Side</td>
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<td>East Side</td>
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<tr>
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<td>Cambridge Street</td>
<td>Wilmington Townline</td>
<td>North Side</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Center Street</td>
<td>Cambridge Street</td>
<td>Bedford Street</td>
<td>North Side</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bedford Street</td>
<td>Winn Street</td>
<td>North Side</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skilton Lane</td>
<td>Cambridge Street</td>
<td>Grant Avenue</td>
<td>None</td>
<td>Gaps South ~400'</td>
<td>$10,000</td>
</tr>
<tr>
<td>Grant Avenue</td>
<td>Patriot Road</td>
<td>Mill Street</td>
<td>South Side</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patriot Road</td>
<td>Mill Street</td>
<td>None</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fox Hill Road</td>
<td>Skilton Lane</td>
<td>Fox Hill School</td>
<td>North Side</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mill Street</td>
<td>Winn Street</td>
<td>Locust Street</td>
<td>None</td>
<td></td>
<td></td>
</tr>
<tr>
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<td>Toner Drive</td>
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<tr>
<td>Toner Drive</td>
<td>Wilmington Townline</td>
<td>None</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Chandler Road</td>
<td>Locust Street</td>
<td>Drake Road</td>
<td>South</td>
<td>Gaps South ~400'</td>
<td>$10,000</td>
</tr>
<tr>
<td>Locust Street</td>
<td>Winn Street</td>
<td>Sparhawk Drive</td>
<td>None</td>
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</tr>
</tbody>
</table>
**Burlington Transportation Master Plan**

<table>
<thead>
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<td>East Side</td>
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**Notes:**

1) The approximate cost of filling gaps is based on a unit cost of $25 per linear foot of concrete sidewalk 5 feet wide and 3 inches thick.

2) The unit cost of $25 per linear foot does not take into account unusual circumstances such as, the need for retaining walls, land takings etc....
travel survey frequency tables
BURLINGTON MASTER PLAN
EMPLOYEE TRANSPORTATION SURVEY

The Town of Burlington is conducting a survey to measure the type and extent of trip-making characteristics of major employers. The survey will help describe the travel patterns of employees in terms of who is going where, with whom, at what time, by which mode and route, and for what purpose.

We appreciate your taking time to complete this survey. It is our hope that the information gained from this survey today will make for a better commute for you tomorrow.

1.) What is your occupation?
   - 18% Executive/Managerial
   - 41% Professional/Technical
   - 3% Retail/Sales
   - 28% Administrative Support
   - 0% Handler/Cleaner/Mover
   - 3% Laborer
   - 1% Machine Operator
   - Other

2.) Approximately how many hours per week do you typically work?
   - 2% 20 Hours
   - 1% 30 Hours
   - 57% 40 Hours
   - 40% Over 40 Hours

3.) What are your official work hours? (Fill in time and circle AM or PM)
   - 8:00 AM or PM
   - 5:00 AM or PM

4.) How do you normally travel to work?
   - 0% Walk
   - 0% Bicycle
   - 0.25% Local Bus
   - 0.5% Motorcycle
   - 0.5% Express Bus
   - 92% Drive Alone - Car
   - 0.5% Vanpool
   - 0% Taxi
   - 0.25% Other (Specify) MaCom Bus/Other

5.) For transit riders and ride-sharers, do you have a private vehicle available to you to commute to work in?
   - 63% Yes
   - 37% No

6.) From where do you commute?
   - City/Town: Billerica
   - #1-answer: State MA
   - ZIP: 01862

7.) Approximately how many miles do you travel from home to work?
   - #1 answer: Round-trip miles

8.) How long does it usually take for you to travel from home to work?
   - #1 answer: Minutes

9.) What PRIMARY ROUTES do you use to travel to work? (Please Check all that apply):
   - 12% Route 3 from the north
   - 13% Route 3A
   - 3% Route 3 from the south
   - 2% Mass Pike
   - 37% Route 128
   - 11% Route 3A
   - 9% Middlesex Turnpike
   - 2% Winn Street
   - 3% Route 495
   - 8% Other (specify)

10.) In general, how many times per week do you leave the premises during the period from 11:00 AM to 2:00 PM for errands or lunch?
    - 29% 0
    - 24% 1
    - 16% 2
    - 15% 3
    - 7% 4
    - 10% 5 or more

11.) If you arrived by vehicle TODAY, how many people, including yourself, were in the vehicle. For example, if you drove alone, check "1" below:
    - 92% 1
    - 6% 2
    - 1% 3
    - 1% Other (How Many?)

12.) What would encourage you to share a ride or take transit to work?
    - 12% Help finding people to ride with
    - Guaranteed ride home (In case of emergencies, illness)
    - 2% More flexible hours
    - 5% Employer sponsored time off
    - 3% Subsidy for vanpools
    - 3% Increased transit operating hours
    - 29% None of the above
    - 6% Other (specify)
    - Transit to NH, Northern MA/A Park and Ride for LRT
    - Transit hours extended to 8PM or later
    - Monorail along LRT
    - Guaranteed No Claim for passengers / Ability to pickup child at day care
13.) Please numerically RANK, in order of importance, the TOP THREE reasons you commute alone by automobile.

1. Public transportation is unavailable
2. Public transportation is too expensive
3. Public transportation takes too much time
4. I need my car for personal uses before and after work.
5. I need my car for personal uses at lunch time.
6. Irregular work schedule
7. I don't have anyone to ride with
8. My residence is inconvenient to public transportation
9. Public transportation is inconvenient to my workplace

___ Other (specify) __________________________

14.) Is public transportation available from your home (within a reasonable distance)?

23% Yes 61% No 16% Don’t Know

If YES, what service (Please Circle):

7% Town of Burlington Bus Service (B-Line)
33% MBTA Commuter Rail
53% MBTA Bus

15.) Transit Riders: What is your estimated round-trip cost to and from work? Please include all transit fares and parking charges, if any. (Fill in Amount).

$3.00 per day
$50.00 per month

16.) If any of the following programs were introduced within your workplace or building that included incentives to participate, would you participate in or use them?

A carpool/vanpool program? 33% Yes 67% No
A shuttle or bus service from Mishawum commuter rail station in Woburn? 5% Yes 95% No
Improved MBTA or local bus transportation? 19% Yes 81% No
A park & ride facility with express bus? 28% Yes 72% No
A mid-day shuttle to area shopping and restaurants? 16% Yes 84% No
A shared-ride taxi service? 7% Yes 93% No

17.) Are there any services, that if provided within your workplace or building, such as dry cleaning, convenience store, bank ATM or a deli/restaurant, would reduce your need to leave the building?

30% Yes 70% No

If yes, please describe.

ATM = 30%, Convenience Store = 19%, Drug Store = 7%
Day Care = 6%, Deli/Restaurant = 16%, Dry Cleaning = 10%
Gym/Health Club = 3%, Post Office = 9%

Again, the Town of Burlington would like to thank you for taking the time to complete this survey. Your responses, and others like yours, will help us plan for a better commute today and in the years to come.
Question #3

Starting Time
8:00 AM 55%
8:30 AM 23%

Finish Time
5:00 PM 37%
4:30 PM 33%

General rest occurred during 7-9
General rest occurred during 3-6

Question #6

Billerica is Greatest Origin = 45 Workers
Woburn is next at = 36 Workers
Nashua next at = 30 Workers
Burlington is in the middle at 25 Workers

Question #7

Number one answer was 40 miles round-trip
Next was 50 Miles.
Answers ranged from 1 Mile to 160 Miles.

Question #8

Number one answer was 30 minutes
Next was 45 minutes
Answers ranged from 2 Minutes to 3 Hours
If a carpool/vanpool program were introduced would you participate?

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TDM example - Montgomery County, MD
COUNTY COUNCIL FOR MONTGOMERY COUNTY, MARYLAND

By: Council President at the Request of the County Executive

AN EMERGENCY ACT TO:

(a) provide for transportation system management in the Silver Spring Central Business District to achieve certain objectives;
(b) establish an advisory committee for certain purposes;
(c) require developers to execute traffic mitigation agreements under certain circumstances;
(d) require certain employers and property owners to submit traffic mitigation plans under certain circumstances;
(e) monitor the effect of traffic mitigation plans and certain other transportation system management measures;
(f) allow the use of parking fees for partial funding of transportation system management;
(g) provide for the enforcement of this article, including the establishment of certain penalties;
(h) provide for an annual survey and an annual report;
(i) authorize the adoption of regulations; and
(j) provide generally for transportation system management.

By adding to
Montgomery County Code
Chapter 42A, Ridesharing,
Sections 42A-10 through 42A-20

By amending
Montgomery County Code
Chapter 60, Silver Spring, Bethesda, Wheaton and Montgomery Hills Parking Lot Districts, Section 60-16
Sec. 1. Chapter 42A is amended as follows:

CHAPTER 42A
RIDESHARING and TRANSPORTATION MANAGEMENT

ARTICLE I
RIDESHARING
***

ARTICLE II
TRANSPORTATION SYSTEM MANAGEMENT

42A-10. Application.

This article applies in the Silver Spring Central Business District as defined in Section 59-C-6.12(c).

42A-11 Definitions.

In this article, unless the context indicates otherwise:

(a) Alternative work hours program means any system for shifting the workday of an employee so that the workday starts or ends outside of the peak period, including:

(1) Compressed work weeks;

(2) staggered work hours involving a shift in the set work hours of all employees at the workplace; or

(3) flexible work hours involving individually determined work hours within guidelines established by the employer.

(b) Annual Growth Policy means the most recently adopted Annual Growth Policy under Section 33A-13.

(c) Carpool means a motor vehicle occupied by 2 or more
employees travelling together.

(d) **Commute** means a home-to-work or work-to-home trip.

(e) **Department** means the Montgomery County Department of Transportation.

(f) **Director** means the Director of the Montgomery County Department of Transportation.

(g) **District** means a transportation management district established in the Silver Spring Central Business District as defined in Section 59-C-6.12(c).

(h) **Employee** means any person hired by an employer, including part-time and seasonal workers.

(i) **Employer** means any public or private employer, including the County, having a permanent place of business in the district. The maximum number of employees on the largest shift determines the size of the employer. Employer does not include: (1) contractors with no permanent place of business in the district, (2) other businesses with no permanent workplace or location, or (3) government agencies not required by law to follow County regulations.

(j) **Peak period** means the hours from 7:00 a.m. to 9:00 a.m. and 4:00 p.m. to 7:00 p.m. during work days.

(k) **Planning board** means the Montgomery County Planning Board or the Maryland-National Capital Park and Planning Commission.

(l) **Single-occupancy vehicle** means a motor vehicle occupied by one employee for commuting purposes, excluding two-wheeled vehicles.
Transportation system management means any method of reducing demand for road capacity during the peak period, including alternative work hours programs, car-pools, vanpools, subsidized transit passes, preferential parking, and peak period parking charges.

Vanpool means a van occupied by at least 8 employees travelling together.

Workplace means the place of employment, base of operation, or predominant location of an employee.


(a) The district is experiencing significant new economic activity and interest in further revitalization.

(b) Limited transportation infrastructure in the district and vicinity and related traffic congestion, pedestrian access, and safety concerns are primary constraining factors in objectives.

(c) Transportation system management is undertaken in conjunction with adequate transportation facility review, planned capital improvement projects, and parking and traffic control measures to provide sufficient transportation capacity to achieve County land use objectives and further permit economic development in the district.

(d) Transportation system management will reduce the demand for road capacity and promote traffic safety and pedestrian access in the district and vicinity.
Transportation system management will also help reduce vehicular emissions, energy consumption, and noise levels. The resulting improved traffic levels of service, air quality, and ambient noise levels will contribute to making the district and vicinity an attractive and convenient place to live, work, visit, and do business.

Transportation system management will equitably allocate responsibility for reducing single-occupancy vehicle trips among government, developers, employers, non-residential property owners and the public.

The establishment of transportation system management in the district in accordance with this article substantially advances these important governmental objectives. Adoption of this article is in the best interests of the public health, safety and general welfare, both within the district and the County.

42A-13. Creation; Purpose; Authority of the department and planning board

Transportation system management is established in the district to foster coordinated and comprehensive transportation system management by government, new developers, property owners and employers in order to:

1. increase transportation capacity;
2. reduce existing and future levels of traffic congestion;
3. reduce air and noise pollution; and
4. promote traffic safety and pedestrian access.

Transportation system management in the district must be implemented in a manner consistent with the commuting goals specified in the Annual Growth Policy.
(c) (1) The department may take action necessary to achieve transportation system management in the district in accordance with this article and other applicable law, including:

(A) constrained parking;

(B) monitoring and assessment of changing traffic patterns and pedestrian access and safety in the district and vicinity;

(C) establishment of traffic and parking control measures in the district and vicinity;

(D) provision of approved transportation related capital projects in the district and vicinity;

(E) promotion, development, and implementation of transit and ridesharing incentive programs;

(F) promotion of regional cooperation between the County and other governmental agencies; and

(G) establishment of cooperative County and private sector programs to increase ridesharing and transit usage.

(2) The department and the planning board may, in accordance with this article and other applicable law, impose reasonable transportation system management measures as conditions on development.


(a) Creation.

The district must have a Silver Spring Transportation System Management Advisory Committee. The members of the advisory committee are appointed by the County Executive and confirmed by the County Council.
(b) **Composition.**

(1) The advisory committee has 12 voting members and 4 non-voting members. The County Executive should appoint the voting members so that:

(A) three members are nominated by the Silver Spring Chamber of Commerce;

(B) three members are nominated by the Silver Spring Advisory Board of which:
   (i) one is a resident of the district;
   (ii) one is a resident within the North and Western Silver Spring Sector Plan areas; and
   (iii) one is a resident of the southern portion of the Kemp Mill-Four Corners or the Silver Spring East master plan area; or the Montgomery County portion of the Takoma Park planning area.

(C) three members are employers of fewer than 50 employees in the district; and

(D) three members are employers of 50 or more employees in the district.

(2) The following are non-voting members of the advisory committee:

(A) The directors or their designees of the department; and
   (i) Silver Spring Center.

(B) A representative of the planning board.
(c) A representative of the Montgomery County Police Department.

(c) Nominations.

(1) Prior to deciding who shall be recommended to the County Executive for membership on the advisory committee, the Silver Spring Advisory Board must solicit nominations, by letter, from the presidents of each civic association in the district and the Silver Spring and Takoma Park policy area as well as from the Mayor and City Council of Takoma Park.

(2) The County Executive may reject individuals nominated to serve on an advisory committee and request additional nominations.

(d) Term.

(1) Advisory committee members serve for a period of 3 years beginning July 1. However, when the advisory committee is first formed:

(A) the period between appointment and the next July 1 is not counted as part of a committee member's term; and

(B) the County Executive may designate up to six members to serve for only 2 years.

(2) The County Executive may reappoint committee members.

(e) Duties.

(1) The advisory committee may advise the County government on all aspects of programs, management, and finances relating to the implementation of transportation system management in the district and vicinity.
(2) The advisory committee:

(A) proposes guidelines for traffic mitigation plans;

(B) monitors the implementation of the traffic mitigation plans;

(C) evaluates progress in attaining the commuting goals specified in the Annual Growth Policy;

(D) recommends government, private or joint actions necessary to facilitate attainment of the commuting goals specified in the Annual Growth Policy;

(E) advises the director on parking policies, including the parking rate structures for garages in the district funded under Section 60-16;

(F) reviews traffic patterns and control measures in the district and vicinity, including any relevant issues relating to neighborhood parking and pedestrian access and safety.

(G) submits comments and recommendations on the director's annual report required under Section 42A-18 by December 1 of each year, starting December 1, 1988.

(f) Compensation.

(1) The County does not compensate members of the advisory committee for their services.

(2) Committee members are exempt from Chapter 19A.(Ethics)

(g) Advisory Category.

The advisory committee is in the advisory category established in Section 2-143.
Traffic Mitigation Plans.

(a) Upon determining that an employer may be subject to this article, the director must notify the employee, by letter, that the employer must submit a traffic mitigation plan meeting the requirements of this section.

(b) An employer who employs 25 or more employees in the district at any time within one year preceding the date of notice under subsection (a) must submit a traffic mitigation plan to the director. The traffic mitigation plan should be consistent with the commuting goals specified in the Annual Growth Policy. A traffic mitigation plan may include use of an alternate work hours program, carpools, vanpools, subsidized transit passes, preferential parking, and peak period parking charges or other transportation system management measures.

(c) The director must establish a schedule for initial submission of traffic mitigation plans by employers.

(d) Each employer must submit its traffic mitigation plan within 45 days after receiving notice under subsection (a).

(e) The director may extend an employer's time to file a traffic mitigation plan for good cause.

(f) (1) The director may require that the owner of a non-residential building in the district submit a traffic mitigation plan if:

(A) the director determines that a plan under this subsection can best achieve the purpose of this article because of the owner's control of parking or common space or for other similar reasons, and
(8) notice is provided to the owner of the building as required in subsection (a).

(2) As designated in the notice, the plan may cover all or some of the employers in the building. A plan required to be submitted under this subsection may be in addition to that required under this section of an individual employer.

(3) Upon receipt of the notice required under this section, an owner must submit a traffic mitigation plan that meets the requirements applicable to an employer.

(g) The director, in consultation with the advisory committee, must provide guidance in the preparation of traffic mitigation plans.

(h) The director must:

(1) determine if each proposed plan meets the requirements of this section; and

(2) participate with the employer in revising a plan that does not meet the requirements.

(i) (1) An employer required to submit a traffic mitigation plan may submit a consolidated plan with other employers in the same building or complex of buildings. A consolidated plan must be designed so that the consolidated actions would satisfy the requirements of this section measured on an overall basis for all employers covered by the plan.
(2) An owner may submit a traffic mitigation plan on behalf of one or more employers in a building to satisfy the requirements imposed on the employers under this section measured on an overall basis for all employers covered by the plan.

(j) The director may require an employer to resubmit a plan that is not consistent with the commuting goals specified in the Annual Growth Policy. The director may not require an employer to submit a plan that meets the requirements of this section more than once every 2 years.

42A-16. Traffic Mitigation Agreement.

(a) (1) Any proposed subdivision or optional method development in the district must be subject to a traffic mitigation agreement if the planning board determines, under criteria and standards adopted by the County Council relating to the adequacy of public transportation facilities, that additional transportation facilities or traffic alleviation measures are necessary for approval.

(2) A traffic mitigation agreement must specify those transportation system management measures that will be undertaken by the applicant or other responsible party. The transportation system management measures must be reasonably calculated to ensure that public transportation facilities will be adequate to serve the proposed development by meeting the commuting goals specified in the Annual Growth Policy.
(b) A traffic mitigation agreement may include:
   (1) the required appointment of a transportation coordinator;
   (2) limitations on parking spaces;
   (3) peak period parking charges;
   (4) preferential parking requirements for carpools and vanpools;
   (5) provision of transit or vanpool subsidies for employees
   (6) financial or other participation in the construction or operation of related on or off-site transportation facilities or systems; or
   (7) other transportation system management measures.

(c) A traffic mitigation agreement must be:
   (1) executed by the applicant, the department and the planning board; and
   (2) made an express condition of any approval for subdivision under Chapter 50 or optional method development under Chapter 59, Division 59-D-2, as appropriate.

(d) A traffic mitigation agreement is subject to all additional review and approval requirements of Chapter 50 (Subdivision Regulations) and Chapter 59, Division 59-D-2 (Project Plan for Optional Method of Development, CBD Zones), as applicable.

(e) A traffic mitigation agreement may:
   (1) require adequate financial security assurances, including bonds, letters of credit, or similar guarantees;
(2) be made binding on future tenants; and
(3) provide for liquidated damages, specific performance, or other remedies, as appropriate.

(f) The department is the agency designated to enforce the contractual terms of a traffic mitigation agreement. This may not be interpreted, however, to limit the planning board's authority to revoke or otherwise enforce, in accordance with law, any approvals granted for subdivision under Chapter 50 or optional method development under Chapter 59, Division 59-0-2, in the event of non-compliance with a traffic mitigation agreement.

42A-17, Annual Survey

(a) The director, after consulting the advisory committee, must establish a schedule for annual commuter surveys.

(b) The director, after consulting the advisory committee, must prepare an employer commute survey form that generates information:

(1) to establish an accurate data base of employee commute patterns;
(2) to monitor progress toward the attainment of the commuting goals specified in the Annual Growth Policy.

(c) The director must mail the annual survey forms to all employers under the schedule the director establishes. Each notified employer must submit a completed survey to the director within 45 days after receiving the form.

(a) By September 1 of each year, starting September 1, 1988, the director must submit to the advisory committee and planning board an annual report on transportation system management in the district. The report must include:

1. Employee commute patterns by employer in the district;
2. Auto occupancy rates by employer in the district;
3. Level of service measurements for each intersection in the district and selected critical intersections outside of the district;
4. Parking supply and demand in the district;
5. Status of road or intersection improvements, signal automation, and other traffic modifications in the district and vicinity;
6. Transit utilization and availability in the district, and
7. Carpooling and vanpooling efforts in the district.

(b) By January 1 of each year, starting January 1, 1989, the County Executive must forward the annual report to the County Council. The County Executive must note any disagreement between the director and the advisory committee.

(c) If the commuting goals specified in the Annual Growth Policy are not met by September 1, 1990, the director must recommend to the County Executive corrective action, which may include mandatory mitigation measures for the district.

The County Executive may adopt regulations under method (2) to implement this article.


The department enforces this article. Any employer who fails within 30 days after a second notice to submit a traffic mitigation plan or to provide source data is guilty of Class C violation. An owner who fails within 30 days after a second notice to submit a traffic mitigation plan is guilty of a Class C violation. Any party to a traffic mitigation agreement under Section 42A-16 who fails within 30 days after notice to comply with the agreement is guilty of a Class A violation.

Sec. 2. Section 60-16 is amended as follows:

60-16. Purpose of parking lot funds; loans to county, etc.

***

(c) (1) Notwithstanding the limitations in subsections (a) or (b) or any other provisions of this chapter, the County Council may transfer revenue from parking fees:

(A) to the fund of any urban district from which the fees are collected as limited by section 68A-4(a)(2)(B);

(B) to fund activities of the Department of Transportation to implement transportation system management under section 42A-13. Parking fee revenue transferred to fund activities in a Transportation System Management District may not exceed parking fees collected in that Transportation System Management District.
(2) In this subsection, "parking fee" means revenue from parking meters, parking permits, or any other user charge for parking.

Sec. 3. Coverage.

Section 42A-16 of Section 1 of this act applies to all applications for subdivision or optional method development in the district approved on or after the effective date of this act.

Sec. 4. Emergency Effective Date.

The Council declares that an emergency exists and that this legislation is necessary for the immediate protection of the public health and safety. This act takes effect on the date on which it becomes law.
intersection concept plans
Conceptual Improvement Plan Option A
Bedford Street at Terrace Hall Avenue

Transportation Master Plan
Burlington, Massachusetts

MCDONOUGH & SCULLY, INC. Framingham, Massachusetts

SCALE: 1" = 40'
Conceptual Improvement Plan Option B
Bedford Street at Terrace Hall Avenue

Transportation Master Plan
Burlington, Massachusetts

McDonough & Scully, Inc. Framingham, Massachusetts

Scale: 1" = 40'
Upgrade Traffic Signal Control

Remove Existing Island

Modify Corner and Existing Island to Provide Tighter Terrace Hall Avenue Approach

LEGEND

Existing

Proposed

Post Signal

Pedestrian

Conceputal Improvement Plan
Middlesex Turnpike at Terrace Hall Ave.

Transportation Master Plan
Burlington, Massachusetts

SCALE: 1" = 40'

FIGURE
MIDDLESEX TURNPIKE

Define Curbing, Sidewalks & Crosswalks

Proposed R.O.W.

Add Right-Turn Lane

Proposed Sidewalk

Bedford Street (Route 62)

Install New Traffic Signal With Pedestrian Controls

Bank

LEGEND

Existing

- Post

\[\rightarrow\] Signal

\[\rightarrow\] Pedestrian

Proposed

- Post

\[\rightarrow\] Signal

\[\rightarrow\] Pedestrian

Conceptual Improvement Plan Option A Bedford Street at Middlesex Turnpike

Transportation Master Plan Burlington, Massachusetts

MCDONOUGH & SCULLY, INC. Framingham, Massachusetts

SCALE : 1" = 40'

FIGURE
Conceptual Improvement Plan Option B
Bedford Street at Middlesex Turnpike

Transportation Master Plan
Burlington, Massachusetts

MCDONOUGH & SCULLY, INC.  Framingham, Massachusetts

SCALE : 1" = 40'

FIGURE
Conceptual Improvement Plan Option C
Bedford Street at Middlesex Turnpike

Transportation Master Plan
Burlington, Massachusetts

MCDONOUGH & SCULLY, INC. Framingham, Massachusetts

SCALE: 1" = 40'

FIGURE
Simonds Park

Provide New Lane Striping and High Visibility Crosswalks

CAMBRIDGE STREET

Install New Traffic Signal With Mast Arms

Town Common

BEDFORD STREET

Museum

Proposed R.O.W.

LEGEND

Existing

Proposed

Post
Signal

Pedestrian

Conceptual Improvement Plan Option A
Bedford Street at Cambridge Street

Transportation Master Plan
Burlington, Massachusetts

MCDONOUGH & SCULLY, INC. Framingham, Massachusetts

SCALE : 1" = 40'
Provide Exclusive Right-Turn-Only Lane

Simonds Park

Provide New Lane Striping and High Visibility Crosswalks

Install New Traffic Signal With Mast Arms

Town Common

Proposed R.O.W.

Proposed R.O.W.

Proposed R.O.W.

Proposed R.O.W.

Musewn

LEGEND

Existing

Proposed

Post

Signal

Pedestrian

Conceptual Improvement Plan Option B
Bedford Street at Cambridge Street

Transportation Master Plan
Burlington, Massachusetts

MCDONOUGH & SCULLY, INC. Framingham, Massachusetts
MILL STREET

Align Locust Street Approach

Modify Private Driveway

MILL STREET

LOCUST STREET

Conceptual Improvement Plan
Mill Street at Locust Street

Transportation Master Plan
Burlington, Massachusetts

MCDONOUGH & SCULLY, INC. Framingham, Massachusetts

SCALE: 1" = 40'

NORTH

FIGURE
Conceptual Improvement Plan Option A
Peach Orchard Road at Winter Street

Transportation Master Plan
Burlington, Massachusetts

MCDONOUGH & SCULLY, INC. Framingham, Massachusetts
Conceptual Improvement Plan Option B
Peach Orchard Road at Winter Street

Transportation Master Plan
Burlington, Massachusetts

MCDONOUGH & SCULLY, INC. Framingham, Massachusetts
Conceptual Improvement Plan Option A
Bedford Street at Francis Wyman Road

Transportation Master Plan
Burlington, Massachusetts

MCDONOUGH & SCULLY, INC. Framingham, Massachusetts

SCALE: 1" = 40'
Conceptual Improvement Plan Option B
Bedford Street at Francis Wyman Road

Transportation Master Plan
Burlington, Massachusetts

SCALE: 1" = 40'

FIGURE
Conceptual Improvement Plan Option C
Bedford Street at Francis Wyman Road

Transportation Master Plan
Burlington, Massachusetts

MCDONOUGH & SCULLY, INC. Framingham, Massachusetts
town center/cambridge street concept plans
Conceptual Improvement Plan
Town Center
Long Range Option B

SCALE 1" = 100'
Conceptual Improvement Plan
Town Center
Long Range Option C

SCALE 1" = 150'