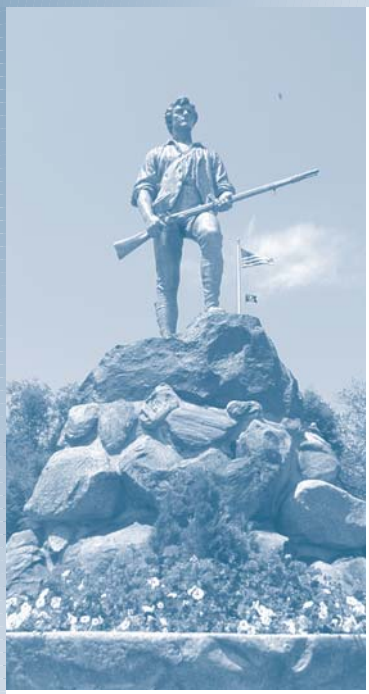
MAGIC Subregional Area Study
Phase II Report



Produced by the Central Transportation Planning Staff for the Boston Metropolitan Planning Organization

MAGIC Subregional Area Study

Phase II Report

Author
Mary P. McShane
with
Clinton Bench
Stanley Genthner
Scott A. Peterson
Paul Reim
Alicia Wilson

Cover Design
Kate Parker

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Central Transportation Planning Staff
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Final Report – May 2004

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INTRODUCTION

This report presents results of Phase II of the MAGIC Subregional Area Study, originated at the request of the MAGIC subregion of the Boston metropolitan area.[1] Phase II consisted of four work tasks, selected after consultation with the MAGIC Committee, and with town planners and engineers within each of the MAGIC towns during Phase I of the Study. This process is described in detail in the MAGIC Phase I report, published in February 2002.[2]

The present report is organized into four sections, corresponding to the four tasks undertaken in Phase II:

Section 1 of the report addresses the principal task of the study, investigating the potential for remote or satellite parking near existing MAGIC-area commuter rail stations. This task included license-plate surveys to determine the towns of origin of travelers currently using the commuter rail stations. In addition, an inventory of private parking facilities in the vicinity of each station was undertaken. Observations were made of parking usage and surplus parking capacity at these sites during weekdays, to determine if any of these sites have potential for use as satellite commuter rail parking. This section also includes discussions about the types of shuttle services which might be required for any promising sites located beyond a reasonable walking radius of about one-quarter mile.

Section 2 presents a brief summary of the principal issues associated with shuttle services connecting remote parking lots with commuter rail stations. This material is covered in slightly more detail in Section 1, and the recent *Suburban Transit Opportunities Study*[3] provides a broader and more comprehensive treatment of the issues related to shuttle services connecting train stations with other land uses. No specific shuttle services are evaluated in Section 2. If communities are successful in identifying promising satellite parking lots, such evaluation can be taken up at a later date.

Section 3 summarizes the results of the third task, designed to be an abbreviated update of a feasibility study for a trail on an unused rail right-of-way in Concord and Sudbury. The original study was performed jointly by CTPS, the Metropolitan Area Planning Council (MAPC), and the Northern Middlesex Area Commission, in 1987. The current effort was

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[1] MAGIC stands for Minuteman Advisory Group on Interlocal Coordination. The MAGIC subregion includes the following Massachusetts towns: Acton, Bedford, Bolton, Boxborough, Carlisle, Concord, Hudson, Lexington, Lincoln, Littleton, Maynard, and Stow.

[2] *MAGIC Subregional Area Study, Phase I Report: Current Conditions and Proposed Additional Studies*, McShane, Mary, et al., Central Transportation Planning Staff, February 14, 2002. The tasks included in Phase II represent a subset of the items identified as "recommended" in Table 5-1 of the Phase I report. The investigation of the potential for satellite commuter rail parking was requested by the MAGIC committee in lieu of a study of more traditional park-and-ride lots, the element originally included in Table 5-1.

[3] Santa Maria, Steven, et al., *Suburban Transit Opportunities Study*, January 2004.

limited to the assembing of current data on traffic volumes and vehicle crash data obtained from several sources.

Section 4 is a brief letter-report transmitting the results of limited traffic signal warrant analyses for two intersections in Lexington to that town's traffic engineer.

* * *

The results and findings of the four Phase II tasks were developed as individual memoranda and circulated to the task proponents for early review. Now that they are completed, they are assembled and documented in this report, which is a companion to the Phase I report. Additional study items were proposed as worthy of investigation during Phase I; some of these may be advanced as CTPS work scopes in the future, as funding and timetables permit.

Potential for Shared Parking at Satellite Locations to Serve MAGIC-Area Commuter Rail Stations

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1. INTRODUCTION

This report summarizes investigations made as part of the MAGIC Phase II Study into the opportunities available for shared use of existing parking in the vicinity of five MAGIC-area commuter rail stations where the parking at the station itself is regularly filled to capacity. There is considerable interest among MAGIC representatives in opportunities for such shared use, either of parking areas within walking distance of a train station or of parking areas that would need to be connected by a shuttle service to the nearest station. The present report explores potential opportunities for the shared use of both of these categories of satellite parking area.

Efforts were undertaken to identify vacant or underutilized existing parking areas, within range of MAGIC commuter rail stations, which might be candidates for joint parking use, and to develop profiles of the usage characteristics of the ones that are currently active. The best candidates for satellite commuter rail parking will be properties located within one-quarter mile of a train station, because this distance is typically selected as the maximum distance people will be willing to walk to access commuter rail services. These sites are considered "best" because they would not require commuters to make an additional vehicle transfer before reaching the train station. Such transfers are considered by commuters to be onerous: previous CTPS studies have identified the penalty associated with such transfers as equivalent to up to 15 extra minutes of in-vehicle journey time.[1] Therefore, the potential for good usage of a satellite lot connected to the train station by a feeder shuttle is almost certainly less than is the potential usage of a site within walking distance, assumed to be about one-quarter mile as a maximum. This study did, however, identify potential parking sites located up to, or just beyond, a distance of one mile from a commuter rail station.

The following chapter of this report reviews previous experiences with satellite parking and other forms of nontraditional access to commuter rail stations, both in the Boston region and elsewhere. Chapter 3 presents an inventory of potential satellite parking sites for the use of MAGIC committee members and town officials who may wish to approach site owners at suitable locations to discuss the possibilities for joint parking use. Chapter 4 gives the results of field surveys of the usage characteristics of those sites that are currently active. Chapter 5 presents this study's conclusions regarding each commuter rail station's potential for having its parking supply supplemented by a satellite facility, and Chapter 6 gives the overall conclusions of the study. Appendix A presents the results of a literature review on shared parking that was conducted as part of this study. Appendix B reports on the license plate surveys performed for this study at the MAGIC-area commuter rail stations.

[1] Central Transportation Planning Staff, *Transfer Penalties in Urban Mode Choice Modeling*, Prepared for the Federal Transit Administration, January 1997.

2. PREVIOUS EXPERIENCE

One of the arrangements under consideration in this study—supplementary commuter rail parking in a lot which is shared with a compatible land use, connected to the train station by a feeder bus or van service—is not found as yet in the Boston area, to our knowledge. *Variants* of this type of service do exist, as do examples of commuter rail stations being served by supplementary parking within walking distance. Examples of such existing arrangements include the follows:

- The Town of Concord has been successful in identifying several property owners near the Concord Station who are willing to share parking space with rail commuters. One of these is an active commercial property (Crosby's Market). These lots are located within an easy walk of the train platform and do not require connecting shuttle services. The lots were observed to be heavily used.

- In a number of communities (Framingham, Acton, and others), formal *or* informal arrangements exist under which commuters are allowed to park during the daytime in church lots, movie theater lots, shopping center lots, or similar parking lots at which they can connect directly with bus service or with carpool/vanpool partners. The services to which these commuters transfer typically deliver them at or close to their final destination, so that the only transfer required is between the traveler's car and a single transit vehicle.

- Some travelers do use existing, traditional feeder bus services to access commuter rail, although the numbers of these riders are small. There is little or no data on the mode of access to bus for these travelers.

- A satellite parking lot exists at the Martha's Vineyard ferry terminal at Woods Hole, for overflow parking by summer visitors. This parking lot is connected to the ferry terminal by a shuttle bus and—since many of the arriving recreational travelers bring their bicycles—by a bikeway. There is no alternative to the ferry as a public mode of travel to Martha's Vineyard, however, so travelers' willingness to use this lot and shuttle bus is not a good gauge of how many would be willing to access commuter rail in that way.

None of these examples is a direct analog for a satellite parking area connected to a train station by a feeder shuttle; consequently, no directly applicable data exists, to our knowledge. However, two previous survey initiatives, are worth describing. The first has considerable applicability to the concept of satellite parking within walking distance of a train station and also can shed some light indirectly on satellite parking connected to the station by a shuttle. The second was administered to users of a shuttle connecting to a train station from a town center, but no parking area was provided on the town center end.

First, surveys of existing MassHighway park-and-ride lot patrons and observations of lot usage, done by CTPS in 1998, yielded information about the characteristics which influence people to drive to park-and-ride lots and switch modes for trips (primarily work trips) to the

Boston core and elsewhere. The most important factors reported by survey respondents were travel time and convenience. It took respondents, on average, 13 minutes to reach the lot, and an additional 51 minutes on average to travel from the lot to the destination point in Boston, Cambridge, or elsewhere. The most important components of "convenience" were defined as "closeness (of lot) to home," "existence of bus service to Boston," and "closeness (of lot) to highway."

The second set of surveys was conducted on the Maynard Shuttle, a service which operated between Maynard Center and the South Acton train station, a distance of almost two miles. That service was discontinued in July 2003, because ridership was judged to be too low (10 to12 passengers per day in 5 trips). Before it ended, shuttle riders were surveyed to elicit information about them and about the characteristics of the shuttle service that attracted them to use it. The key results of the survey may be summarized as follows:

- The 8 survey forms returned represented two-thirds of the 12 travelers who rode the shuttle on the date when the survey was conducted.
- All of the respondents were traveling from home to work.
- Five of the respondents were people who walked from their homes to the shuttle stop in Maynard, 2 were dropped off at the stop, and 1 person drove and parked at the stop.
- Five of the respondents reported that they used the shuttle 4 or 5 days per week; the other 3 respondents used it less frequently.
- Three of the respondents reported that an auto was available for the trip; the other 5 reported no auto available.

It is noteworthy that a good part of the shuttle's ridership was people who were within walking distance of the stop in Maynard. At the same time the shuttle surveys were undertaken, CTPS also conducted license plate surveys at the five MAGIC-area commuter rail stations (the license plate surveys are documented in Appendix B). A total of 56 Maynard license plates were recorded for parked vehicles at four stations, with the highest number recorded at West Concord (47).[2] In addition, 10 dropoff patrons were observed arriving in vehicles with Maynard license plates, 7 of these at South Acton.

The results of both survey initiatives suggest that new alternatives to expanded commuter rail parking will need to offer commuters high levels of both convenience and reliability in order to be successful.

Other urban areas around the country have also grappled with the difficulties of providing access to train stations, as discussed in the recent CTPS *Suburban Transit Opportunities Study*.[3] The most successful of these efforts involve shuttles connecting a transit station with an employer site, partially or totally funded by the employer. Numerous successful services of this kind run in different urban areas all over the country, including metropolitan Boston.

[2] The other stations used by Maynard parkers were South Acton (7), Concord (3) and Lincoln (5).
[3] Santa Maria, Steven, et al., *Suburban Transit Opportunities Study*, CTPS, January 2004.

The experience with successful feeder services to suburban commuter rail stations on the *residence* end is much sparser. However, a few such services exist, including the following:

- DART On-Call service, Dallas, Texas – This is a demand-responsive service which uses vans to service small[4] areas in the vicinity of a local rail station or transit center during the entire day (5:00 A.M. to 8:00 P.M.). Riders can travel anywhere within the service area at off-peak times, but are restricted to the transit station during peak commuter hours. Also, the service times are restricted so that each van must be at the rail station or transit center twice an hour, at specified meet times during the morning and evening peak commuter periods. Customers contact a van directly via the driver's cell phone to arrange pick-ups and drop-offs; this eliminates the need for a paid dispatcher. Riders pay $2.25 per trip; there are discounts for seniors, as well as monthly pass purchase options. Riders can call to make a reservation up to one hour before the planned trip.

- Maplewood, New Jersey jitney service – This service was started to provide an alternative to parking expansion at an existing commuter rail station. It has proven to be the most durable and popular of the jitney services which have been proposed or implemented over the past few years. This was a town-initiated effort, originally using the town-owned Senior Transportation bus; but with success it has expanded, additional vehicles being provided by grants through New Jersey Transit. Following upon the creation of the jitney service in 1997, the town also revitalized the old railroad station, and in cooperation with local retail businesses and services initiated a "concierge" service at the station, further enhancing the attractiveness of the jitney service.

- Interest in using jitneys for train station access has now expanded to other New Jersey municipalities, as well as to Chappaqua and Central Islip, New York. The Central Islip jitney provides door-to-door service from home to the local Long Island Railroad station for a $4.00 per day (round-trip) fare.

The literature review in **Appendix A** provides additional information about the general concept of "shared parking" as it is interpreted by many local areas around the country—a slightly different interpretation from the one discussed in this report, because it focuses on the transit agency as the parking provider, and the private developer as the "sharer" of a limited public resource (parking). This concept is different from the main focus of this report, although it may be worth exploring as new development properties become active adjacent to transit stations in the Boston region (for example, near the Littleton/Route 495 station). Several relevant examples are mentioned in Appendix A. No studies were found documenting experiences with shared use of privately owned parking lots as satellite parking for commuter rail.

Based on what has worked in other urban areas, successful nontraditional commuter rail access alternatives seem to have the following characteristics:

[4] Typically 6 to 9 square miles, with 15,000-25,000 residential population

- *Operation on the local level.* The initiators of the most successful services of this kind are typically the local communities themselves, acting through town managers or volunteer bodies created especially for this purpose. Ideally, a local service committee or board would make the policies for the service, evaluate service options, routes, and needs, coordinate fund-raising and the involvement of local retailers and other businesses, oversee contract fulfillment, and perform other functions. A TMA would serve this function for a shuttle service to employer sites; a local citizens' group or committee would be the best group to facilitate development of shuttle or jitney-type services bringing riders to train stations from residential communities. The services are less costly to create if the towns themselves own the vehicles[5] and need to raise only the operating costs.

  Massachusetts towns such as Lexington and Burlington have demonstrated such local involvement in the creation of local bus services such as L'Express and the Burlington B-Line. Concord, too, had a local bus committee which focused its efforts on the Concord Free Bus that used to provide limited service in that town.[6] Other towns which do not have train stations of their own, but which contribute riders who use other towns' filled-to-capacity parking lots,[7] might consider creating commuter committees charged with developing subscription bus services providing access to the particular train station used by most of their residents.

- *Strong local support and commitment.* Participation and support by citizens as well as by local businesses and town interests appear to be the key factor in the success of these services. This involves recognition of the value of the service even by citizens who are not themselves riders, and willingness to provide the financial support necessary to keep the service running, and keep improving it, while ridership builds.

- *Station location convenient for patrons*. The most successful commuter rail feeder services operate to and from train stations which are located within business or activity areas. In such areas, arriving early for a scheduled train departure would allow people to shop, buy coffee and a newspaper, or even run errands or use a "concierge" service such as that provided at Maplewood. Among the MAGIC-area towns, Concord and Lincoln have train stations which best fit that description. The Concord stations, in particular, are surrounded by retail businesses which might be interested in exploring the potential to provide such services to rail commuters.

- *Service area limited to a fairly narrow radius around the station—ideally no more than a mile.* It is essential that such feeder services be reliable in arriving at the train stations on time and in being coordinated with train schedules; consequently, the one-way trip time rarely can exceed 10 or 15 minutes. If the service is a

[5] Frequently purchased with grants made through the regional transit agency
[6] It is believed that this committee is no longer in existence.
[7] For example, in this area, Sudbury, Stow, and Boxborough

shuttle serving a single remote lot, the lot should be within a one-way trip time not exceeding 15 minutes.

- *Commuter willingness to pay premium fares for premium services.* The services which tend to be successful are tailored to the needs of individual commuters or small groups of people—they are not really "mass transit" in the traditional sense. The vehicles used are small; they do not stay on a fixed route but can deviate as needed. Amenities such as coffee service might even be provided. Essentially, such services would represent a step between traditional taxi services and traditional bus services. Such personalized services are expensive to provide; but there may be a niche market of people willing to pay $3 to $4 or more per day for such service in the relatively affluent communities of the MAGIC area. Operation of such service on a monthly subscription basis would allow some level of planning and would eliminate the need for daily cash transactions on the vehicle.

- *Potential for combining with other services*. One efficient way of providing local feeder service to a train station may be to use a town-owned vehicle, or set of vehicles, for different purposes at different times of the day. The Dallas service, mentioned above, is used primarily for commuter feeder service during the morning and evening peak-periods, and for senior-citizen and paratransit-type service during the remainder of the day. Bedford, Massachusetts also has a local bus service which mainly serves seniors but which also serves trips to the Burlington Mall and the Lahey Clinic (service is limited to noncommuting hours).

Other factors favoring the success of such services are discussed at length in the *Suburban Transit Opportunities* report, referenced above.

3. INVENTORY OF PARKING LOTS

Criteria Used in the Inventory

A search was undertaken to identify churches, shopping centers, and other selected land uses within (or just beyond) a radius of one mile from each of the five MAGIC-area commuter rail stations.[8] The nature of these land uses is that they tend both to have large parking lots associated with them, and to have peak activity and parking demand periods that do not coincide with the business day, which is the time of peak demand for commuter parking. Thus, for example, schools and office parks do not qualify, because their primary hours of parking demand overlap with the hours when commuter rail parking would be needed. Our charge was to investigate the characteristics of the identified lots, with the understanding that any approach to the owners for actual discussions of such use would be left to others.

The *ideal site* would have the following characteristics:

- Located within one-quarter mile of the train station
- Located on an arterial street, with high visibility from the street, not in the middle of a residential neighborhood
- Having a large parking lot—100 or more spaces
- Representing an activity which generates most of its traffic at night and/or on weekends, with not more than 50 percent parking occupancy on typical weekdays in the daytime
- Owners willing to consider allowing shared daytime parking use by commuters

Information Collected

Table 1 is a listing of the churches identified within the communities of interest, while Table 2 is a listing of shopping centers and other retail areas. Table 2 also lists miscellaneous nonretail uses (such as country clubs, selected office buildings, parkland, and public land) which could represent plausible sites for shared parking. Figures 1 through 4 show the five MAGIC-area train stations and environs, also identifying church, synagogue, retail and nonretail sites within or just beyond a radius of one mile from the nearest station. Each of these locations was visited to determine its potential suitability as a satellite parking lot, primarily in terms of its size and whether it appeared to have excess capacity. This information is given in the tables. The usage characteristics of selected sites were of each location were later examined in more detail, as described in Chapter 4.

Types of Parking Lot

The most obvious potential location for shared-use parking would be a retail site close to the train station. Most such sites, however, tend to have parking capacity which the site owners consider just adequate to their own needs during the daytime. These include small local-area retail clusters, typically having a convenience store such as White Hen Pantry or Store 24 as

[8] Lincoln, Concord, West Concord, South Acton and Littleton/Route 495.

their "anchor," often located together with such businesses as a pharmacy (such as CVS or Brooks), a small-scale fast-food vendor such as Dunkin Donuts or Subway, a small bank branch, a liquor store, a video store or a gas station—generally not more than three or four storefronts in all. These small plazas are quite busy during the business day, and tend to have a small amount of high-turnover parking. The most typical example is the Acton Hardware Plaza on Main Street in Acton. These small plaza areas generally do *not* have a supermarket.

Shopping areas with supermarkets are usually larger, with larger parking areas; the greatest density of parking activity for most of the day is in front of the supermarket itself. Typically, such a shopping center will have at least eight or nine active stores, including a larger bank branch, a non-fast-food restaurant, a larger hardware store and pharmacy, and a selection of uses which would tend to draw patronage from a larger distance than the immediate neighborhood: clothing stores, kitchen gadgetry stores, stationery stores. That is, they offer more general merchandise than does a small local plaza, but are not at the level of a regional mall. They are located on arterial streets, but still serve essentially local patrons.

In the area close to the train stations in question, the most typical examples of shopping areas with supermarkets are probably the Roches shopping plaza and the Powder Mill Plaza in Acton, the Crosby's Market plaza in Concord, and the Shaw's plaza in Stow. The Roches plaza used to contain an Ames department store, which has been replaced by a TJ Maxx store (opened in late September 2003). Powder Mill Plaza contains a Stop & Shop supermarket and a Dress Barn store. Crosby's Market in Concord, near the Concord train station, has a very large undivided parking lot shared among numerous plaza tenants (Crosby's Market itself, a large CVS pharmacy, a large hardware store, and numerous specialty businesses). Crosby's Market has designated a small area at the far end of its lot for use by commuter rail parkers, and several commuter buses also stop there. Shopping plazas with supermarkets may be more receptive to the idea of shared parking use than other activities, because returning commuters who wish to shop and then drive straight home, instead of making a second trip to another shopping location, may be more likely to do so at such shopping plazas.

Church and synagogue facilities offer another possible opportunity for shared parking use. This option is most promising in the case of facilities that do *not* offer day-care or school-related activities, which are daytime users of parking. The churches identified as closest to the Littleton, South Acton, Concord and Lincoln stations tend to have little or no parking of their own. There are some large lots, however, most notably St. Anne's Catholic Church in Littleton, and Congregation Beth Elohim in Acton. Other, smaller lots exist at St. Anne's Episcopal Church in Lincoln, the Christian Science Church in Concord Center, and Mount Calvary in Acton. Most of these are beyond a one-mile distance from the station. Church and synagogue facilities *typically* have little parking demand during the daytime, but they may *occasionally* need all the parking they have available, for special events.

In addition to these, there are other site types that could be considered as candidates for shared parking, and which are included in this study's inventory. Among these are country clubs and golf courses, uninhabited or pre-buildout office buildings, and the headquarters of

fraternal organizations, such as the Elks, Knights of Columbus, Sons of Italy, Ancient Order of Hibernians, and other such groups.

Two other categories of privately-owned properties which in theory represent good potential sites for satellite parking deserve mention, even though no candidates exist within range of the MAGIC-area train stations: "big-box" retail stores, and movie theaters. Big-box retailers include Best Buy, Target, Home Depot, and similar stores, which serve a larger regional market area. It is estimated that they draw their customer base from as much as 15 miles away, and they are usually located as close as possible to the interchanges of major limited-access highways. Such stores, if they existed in the area, might be promising candidates for shared parking use, because the parking lots at such stores tend to be very large, to accommodate very high demand during holiday and weekend shopping periods; while there is comparatively little demand, or need for large quantities of parking, during traditional working hours on weekdays. Unfortunately, there are no bona fide big-box retail stores within range of any of the five commuter rail stations.

Movie theaters are sometimes willing to allow shared use of their parking during the day on weekdays, since they, like big-box retail stores, have their primary periods of activity at night and on weekends. The multiplex cinema at the Natick Mall allows the remote portion of its parking lot to be used for commuter parking in conjunction with direct commuter bus service to Boston; the theater requires the commuter parkers to vacate the lot by 6:00 P.M. This limitation deters some potential users from using that lot, because their arrival time back at the lot is hard to predict. No movie theaters are located within a mile of any of the five MAGIC-area stations in any case, so this does not appear to be an option here at present.

TABLE 1
Inventory of Churches and Synagogues
(by Town)

Church	Address	Town	Proximity to Station	Size of Parking	Excess Capacity?
Acton Congregational Church	12 Concord Rd	Acton	❍		
Acton Korean Church/Faith Evangelical Church	54 Hosmer St	Acton	❍		
Christian Science Society	267 Central St	Acton	❍		
Church of the Good Shepherd	164 Newtown Rd	Acton	❍		
Congregation Beth Elohim	10 Hennessey Dr	Acton	◗	●	May have excess capacity
Mt Calvary Lutheran Church	472 Massa-chusetts Ave	Acton	❍	◗	Little excess capacity
Nashoba Valley Church	468 Great Rd	Acton	❍		
South Acton Congregational Church	35 School St	Acton	●	❍	No parking
St Elizabeth of Hungary Church	89 Arlington St	Acton	❍		
St Matthew's United Methodist	435 Central St	Acton	❍	◗	
West Acton Baptist Church	592 Massa-chusetts Ave	Acton	❍	❍	
United Church of Christ Congregational/Boxborough Church	723 Massa-chusetts Ave	Boxborough	❍	❍	
Acton Friends Meeting	1276 Main St	Concord	◗	❍	
First Church of Christ, Scientist	199 Sudbury Rd	Concord	◗	◗	Little excess capacity
First Parish in Concord	20 Lexington Rd	Concord	◗	❍	
Kerem Shalom	659 Elm St	Concord	◗	◗	May have excess capacity
New Life Community Church	40 Stow St	Concord	❍		
Our Lady Help of Christians	1404 Main St	Concord	◗	❍	
Redeemer Presbyterian Church	191 Sudbury Rd	Concord	●	❍	
St Bernard's Parish	70 Monument Sq	Concord	◗	❍	

Table 1 (Cont'd)

Trinitarian Congregational Church	54 Walden St	Concord	◗	❍	
Trinity Episcopal Church	81 Elm St	Concord	◗	❍	
West Concord Union Church	1317 Main St	Concord	◗	❍	
United Church of Christ/Congregational Church	5 Still River Rd	Harvard	❍		
First Parish in Lincoln	14 Bedford Rd	Lincoln	❍	❍	
Masonic Temple	187 Lincoln Rd	Lincoln	◗	❍	No excess capacity
St Anne's Episcopal Church	147 Concord Rd	Lincoln	◗	◗	May have excess capacity
St Joseph Catholic Church	142 Lincoln Rd	Lincoln	●	❍	No excess capacity
Abundant Life Assembly/Seeds o' Faith	212 Harwood Ave	Littleton	**n/a**		
Church of Jesus Christ of LDS	616 Great Rd	Littleton	❍	◗	
Congregational Church/Stork Support	330 King St	Littleton	❍	◗	
First Baptist Church, Littleton	461 King St	Littleton	❍	❍	
First Church Unitarian	19 Foster St	Littleton	❍	❍	
Seeds O'Faith Church	225 Great Rd	Littleton	**n/a**		
St Anne's Catholic Church	75 King St	Littleton	❍	●	Has excess capacity
Assembly Church of God	179 Main St	Maynard	**n/a**		
First Bible Baptist Church	62 Waltham St	Maynard	❍		
Holy Annunciation Orthodox Church	15 Prospect St	Maynard	❍		
Mission Evangelical Congregational Church	19 Walnut St	Maynard	❍		
New Hope Fellowship	54 Main St	Maynard	❍		
St Bridget's Church	1 Percival St	Maynard	❍		
St George's Episcopal Church	62 Summer St	Maynard	❍		
St Stephen's Knanaya Church	182 Main St	Maynard	❍		
Union Congregational Church	80 Main St	Maynard	❍		
United Methodist Church	2 Summer St	Maynard	❍		
First Parish Church of Stow & Acton	Great Rd	Stow	❍		
St Isidore's Church	429 Great Rd	Stow	❍		
Union Church of Stow	317 Great Rd	Stow	❍		

Table 1 (Cont'd)

Congregation Beth El School	105 Hudson Rd	Sudbury	❍		
Congregation Bnai Torah	225 Boston Post Rd	Sudbury	❍		
First Baptist Church of Sudbury	162 Landham Rd	Sudbury	❍		
First Parish in Sudbury	Sudbury Center	Sudbury	❍		
Memorial Congregational Church	26 Concord Rd	Sudbury	❍		
Presbyterian Church in Sudbury	330 Concord Rd	Sudbury	❍		
St John's Evangelical Lutheran Church	16 Great Rd	Sudbury	❍		
St Elizabeth's Episcopal Church	1 Morse Rd	Sudbury	❍		
Church of the Holy Spirit	169 Rice Rd	Wayland	❍		
Community United Methodist Church	5 Damon St	Wayland	❍		
First Parish in Wayland	50 Cochituate Rd	Wayland	❍		
Islamic Center of Boston	126 Boston Post Rd	Wayland	❍		
Peace Lutheran Church	107 Concord Rd	Wayland	❍		
St Ann's Church	124 Cochituate Rd	Wayland	❍		
Temple Shir Tikva	141 Boston Post Rd	Wayland	❍		
Trinitarian Congregational Church	53 Cochituate Rd	Wayland	❍		
Wellesley Park Assembly of God	6 Loker St	Wayland	❍		

SYMBOLOGY

Proximity		**Size**		**Excess Capacity?**	
●	Within ¼ mile	●	Large lot (100+ spaces est.)	**Some/no excess**	Included in survey; observations as noted
◗	Within 1 mile	◗	Moderate-size lot (50 to 100 spaces est.)		Disqualified because of distance or size
❍	Beyond 1 mile	❍	Small lot (fewer than 50 spaces) or no reserved parking		
			Not visited—disqualified by distance		

TABLE 2
Inventory of Shopping Centers and Other Uses

Site	Address	Town	Use	Proximity to Station	Size of Parking	Excess Capacity?
Acton Bowl-a-drome & Arcade	257 Main St	Acton	Sports (bowling)	◗	❍	
Acton Hardware Shopping Center	210 Main St	Acton	Hardware retailer & other businesses	◗	◗	Little excess capacity
Roches/TJ Maxx Shopping Center	385 Massachusetts Ave	Acton	Department store/ supermarket	❍	◗	No excess capacity
Assabet Sand & Gravel Co	16 Knox Trail	Acton	Sand & gravel	❍	◗	
KMart/ McDonald's	252 Main St	Acton	Department stores	◗	●	May have excess capacity
Liberty Tree Farm Inc	24 Liberty St	Acton	Riding academy	◗	❍	
Main St Shopping Center	305 Main St	Acton	Hardware and other retail	❍	◗	
Wedgewood Realty	20 Main St	Acton	Office building	◗	◗	May have excess capacity
Stop & Shop/ Dress Barn	100 Powdermill Rd	Acton	Food markets/ convenience	❍	●	No excess capacity
West Acton Market	586 Massachusetts Ave	Acton	Food markets/ convenience	❍	❍	
Victory Supermarkets	22 Fitchburg Rd	Ayer	Food markets/ convenience	❍		
Apple Country Markets	629 Massachusetts Ave	Boxborough	Food markets/ convenience	❍		
300 Baker Ave	300 Baker Ave	Concord	Office	●	●	May have excess capacity
Valley Sports	2320 Main St	Concord	Sports club	❍	●	
Beharrell St Post Office	35 Beharrell St	Concord	Post office and other businesses	●	◗	No excess capacity
Concord Country Club	246 Old Road to 9 Acre Corner	Concord	Clubs/fraternal organizations	◗	◗	No excess capacity

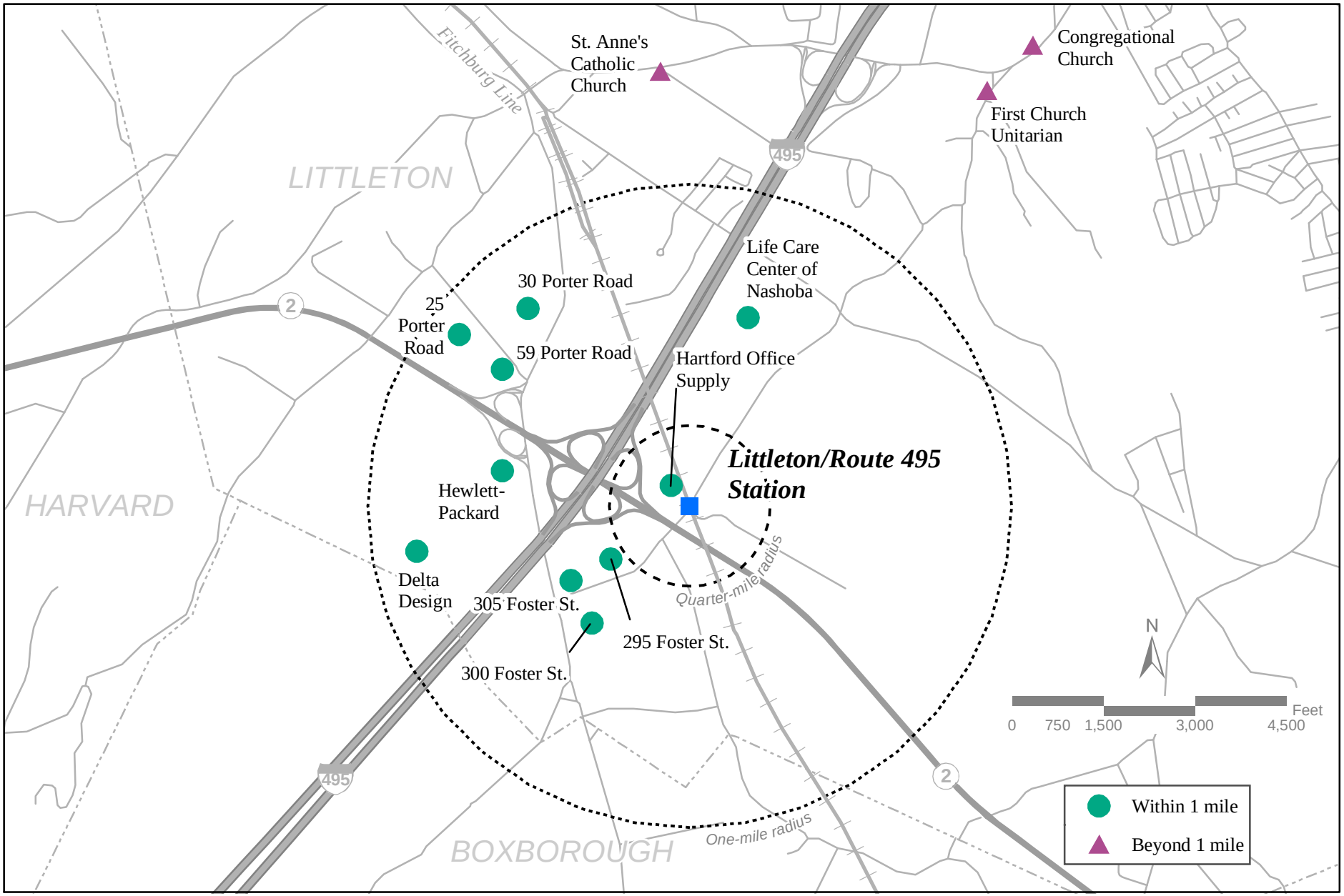
Table 2 (Cont'd)

Concord Crossing	10 Concord Crossing	Concord	Restaurants	●	●	Has excess capacity
Concord Package Store et al.	73 Thoreau St	Concord	Liquors and other retail	●	◗	No excess capacity
Crosby's Market	211 Sudbury Rd	Concord	Food markets/ convenience	●	●	Already used for satellite parking
Elks Lodge	221 Baker Ave	Concord	Clubs/fraternal organizations	◗	●	Has excess daytime capacity
Retail/town parking	28 Walden St	Concord	Public parking lot	◗	◗	No excess capacity
West Concord Plaza	Commonwealth Ave	Concord	Food markets/ convenience	●	◗	Little excess capacity
West Concord Market	24 Commonwealth Ave	Concord	Food markets/ convenience	●	❍	
Depot Square retail	145 Lincoln Rd	Lincoln	Post office and other businesses	●	●	May have excess capacity
Drumlin Farm	South Great Road	Lincoln	Wildlife sanctuary/ nature education center	◗	◗	No excess capacity
Donelan's Supermarkets Inc	236 Great Rd	Littleton	Food markets/ convenience	❍	●	
Life Care Center of Nashoba	191 Foster St	Littleton	Nursing/convalescent home	◗	❍	No excess capacity
Hartford Office Supply	265 Foster St	Littleton	Office/manufacturing	●	◗	Little or no excess capacity
Office bldgs	295, 300 and 305 Foster St	Littleton	Office buildings	◗	●	All may have excess capacity
Hewlett-Packard	153 Taylor St	Littleton	Office building	◗	●	Has excess capacity
Elks Lodge	34 Powder Mill Rd	Maynard	Clubs/fraternal organizations	❍	●	Has excess capacity
Maynard Country Club	50 Brown St	Maynard	Clubs/fraternal organizations	❍	◗	No excess capacity
Powder Mill Plaza	76 Powder Mill Rd	Maynard	Food markets/ convenience	❍	●	No excess capacity

Table 2 (Cont'd)

Shaw's Supermarket	155 Great Rd	Stow	Food markets/ convenience	❍	●	
Shaw's Supermarket	509 Boston Post Rd	Sudbury	Food markets/ convenience	❍	●	
Weston Market	284 North Ave	Weston	Food markets/ convenience	❍		

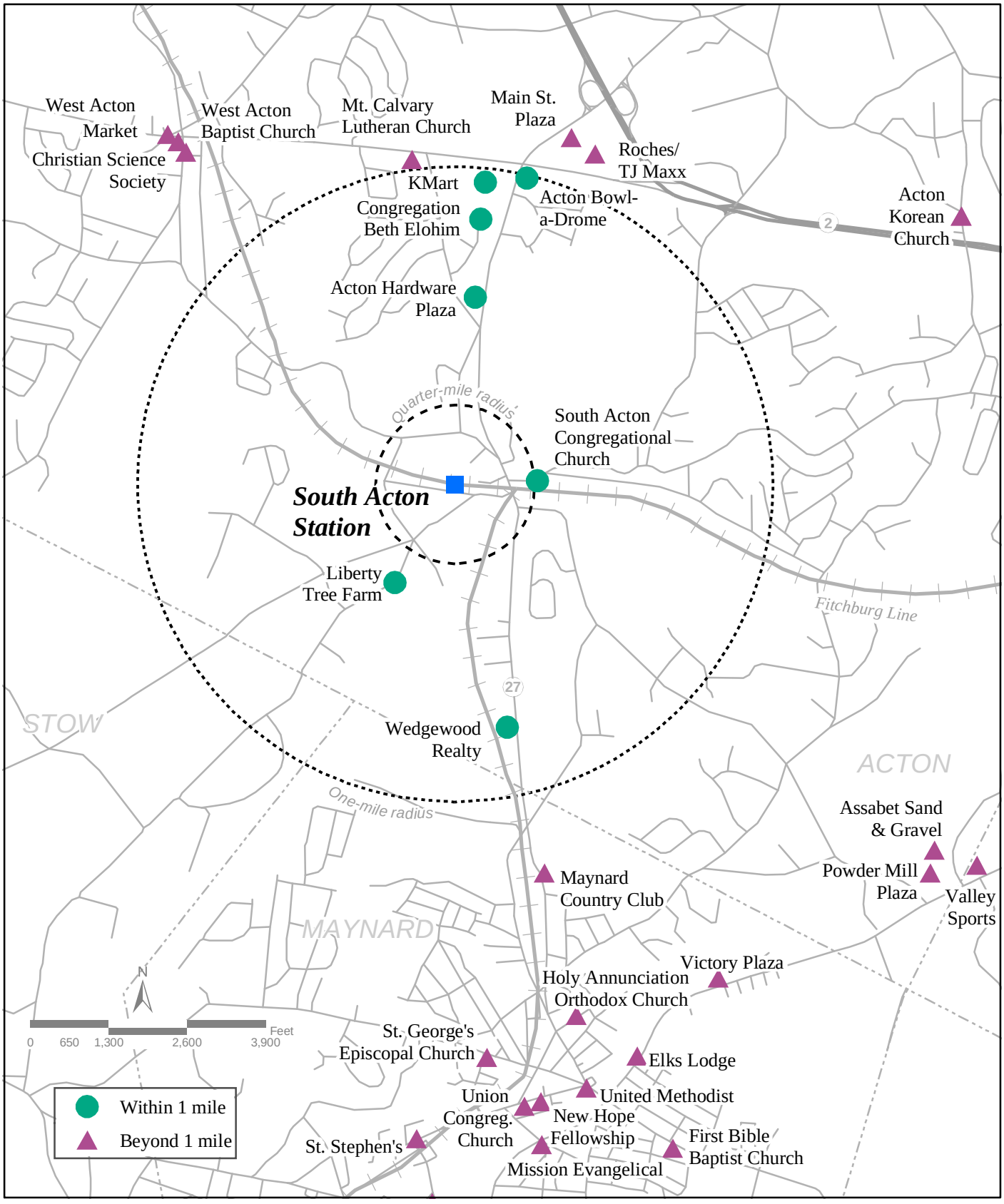
SYMBOLOGY					
Proximity		**Size**		**Excess Capacity?**	
●	Within ¼ mile	●	Large lot (100+ spaces est.)	**Some/no excess**	Included in survey; observations as noted
◗	Within 1 mile	◗	Moderate-size lot (50 to 100 spaces est.)		Disqualified because of distance or size
❍	Beyond 1 mile	❍	Small lot (fewer than 50 spaces) or no reserved parking		
			Not visited—disqualified by distance		



CTPS
MAGIC
Subregional Area Study

Figure 1

Potential Sites for Shared Parking Near Littleton/Route 495 Station

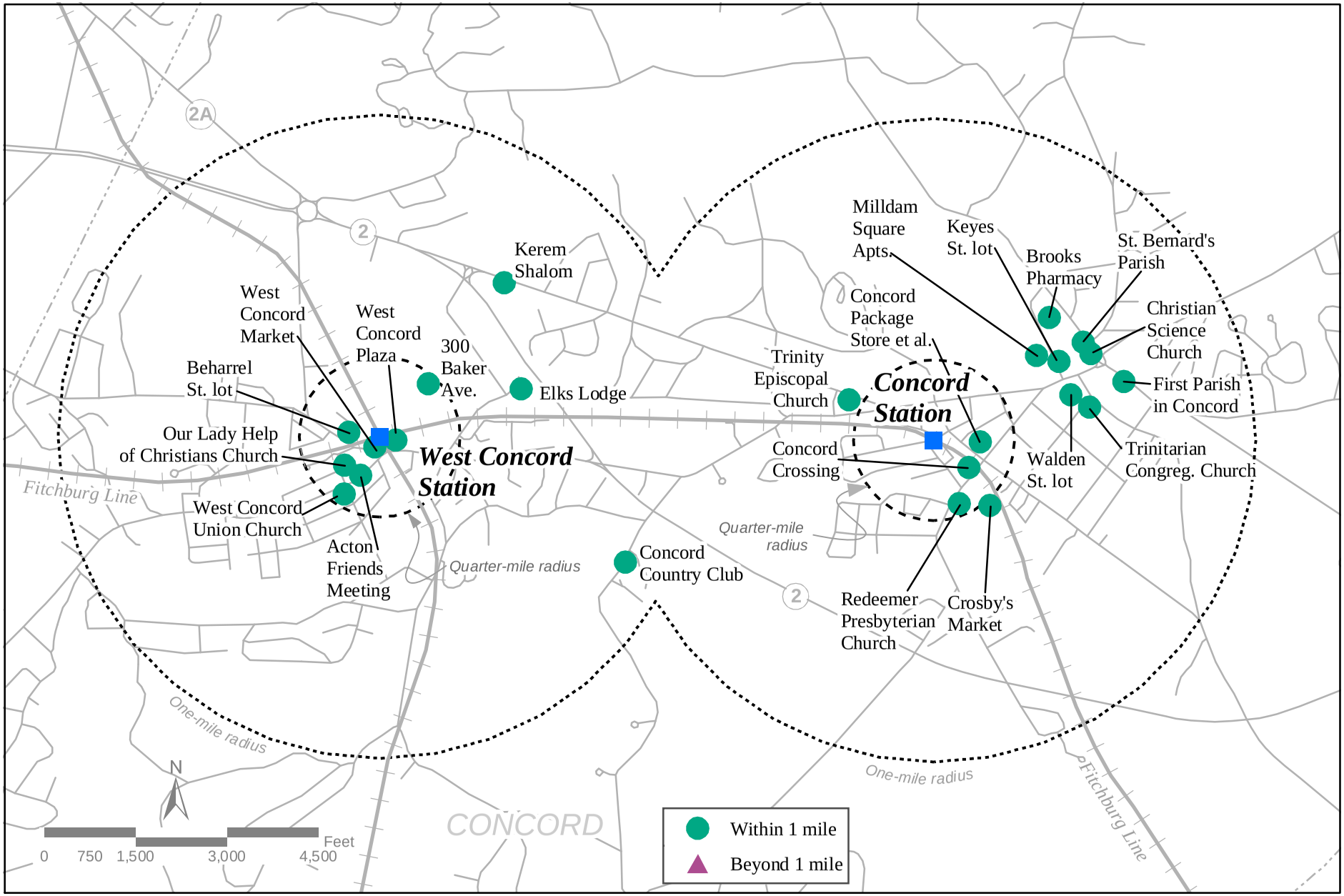


CTPS

MAGIC
Subregional Area Study

Figure 2

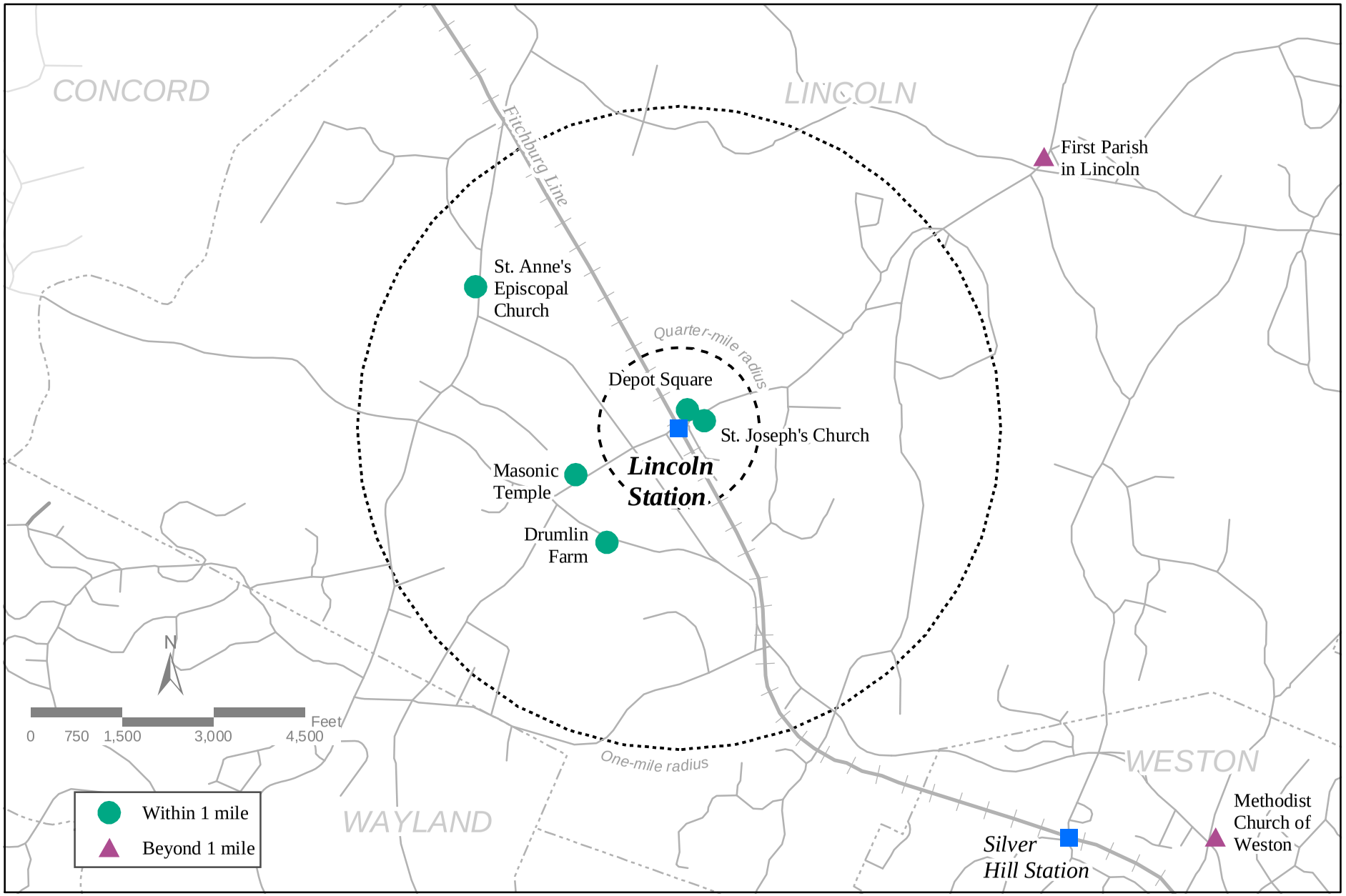
Potential Sites for Shared Parking Near South Acton Station



C T P S
MAGIC
Subregional
Area Study

Figure 3

Potential Sites for Shared Parking Near Concord Stations



CTPS
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Subregional
Area Study

Figure 4

Potential Sites for Shared Parking Near Lincoln Station

4. PARKING OCCUPANCY OBSERVATIONS AT POTENTIAL LOTS

The purpose of the parking occupancy observations was to identify the parking usage characteristics of different facility types during the daytime, when shared use by commuters might be desirable. The observations were made at the sites in the study area that were judged to be the most likely candidates for use as satellite lots.

Because all of the sites examined within range of the train stations are privately-owned, observations of parking use during the day were made from the street or during brief drive-throughs. For the same reason, in this report's presentation of the findings from the observations, the identities of specific sites are not disclosed: the sites are grouped into several land use types, and averages are calculated for those types.

The occupancy observations were performed during five weekdays during September and October 2003, beginning at around 7:00 A.M. Data were recorded every one to two hours until 5:00 to 6:00 P.M. at most of the observed sites. It should be noted that data were collected over a period of one to two days per site, and are not intended to represent maximum, minimum, or even average parking demand at any particular location. For example, data at country clubs and recreational sites were collected on good-weather days, when people were able to enjoy the activities at these sites. Bad weather will reduce the level of activity at these sites, and therefore the likely demand for parking. However, the data do provide an idea of how activity levels and parking demand are likely to vary over the course of a single ordinary (good-weather) day. The results are discussed below for different types of sites:

Retail Sites

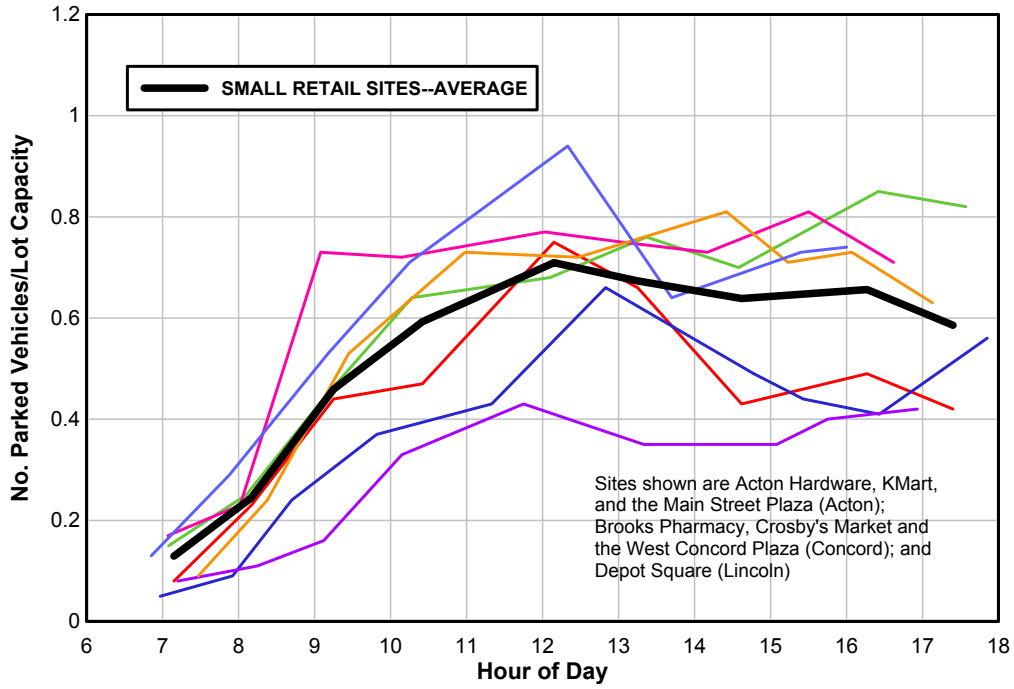
Figure 5 shows the accumulation of parking at seven of the nine retail plazas at which data were collected. The dark black line represents the average accumulation of parking at these similar sites. At almost all these sites, parking lots filled to about 70 percent of capacity or more during the busiest part of the day, the early afternoon period of 12:00 noon to 1:30 P.M. Parking demand remained high throughout the afternoon, and tapered off close to 5:00 P.M. It may rise again after 5:00 P.M. as a result of people returning from work stopping off to shop before going home.

No significant difference was observed, in terms of parking accumulation, at sites with and without supermarkets. The rise in parking demand toward the post-12:00 noon peak may begin a little earlier at the sites which have supermarkets; but this effect was not consistently observed. Only two of the sites shown on this graph have supermarkets: the Crosby's Market plaza and Depot Square. Two other sites with supermarkets were surveyed, but are not shown in Figure 5: these are the Roches/TJ Maxx Plaza and Powder Mill Plaza in Acton. These two are the largest retail sites in the study area, with the largest parking lots. The parking lots at both these sites were filled to over 90 percent of capacity during the midday period of peak demand.[9]

[9] Note: Visits to the Roches/TJMaxx site included observations both before and after the recent opening of the TJMaxx store.

Based on the combined characteristics of distance, parking lot size, and daytime parking occupancy, the Crosby's Market lot is the retail site with the best chance for success as satellite commuter parking. The Crosby's lot already has a section of about 60 spaces, located close to the street, which the owner allows to be used for commuter parking by train passengers. In addition, West Concord Plaza and Concord Crossing certainly meet the distance criterion, and they also have excess parking capacity during the daytime. The Acton Hardware, Kmart, and Roches/TJ Maxx sites are within a mile of the South Acton train stations; Acton Hardware and Kmart both have small amounts of surplus parking that might be available, but the Roches/TJ Maxx site has no spare parking capacity to offer commuters. The Depot Square parking lot in Lincoln also has a small amount of surplus parking. That lot is signed as off-limits to commuters, however, and is patrolled by security personnel; this has been the case at least since Lincoln began charging out-of-towners to park in its commuter lot.

FIGURE 5
Parking Occupancy as Percent of Capacity
MAGIC-Area Small Retail Sites, September-October 2003

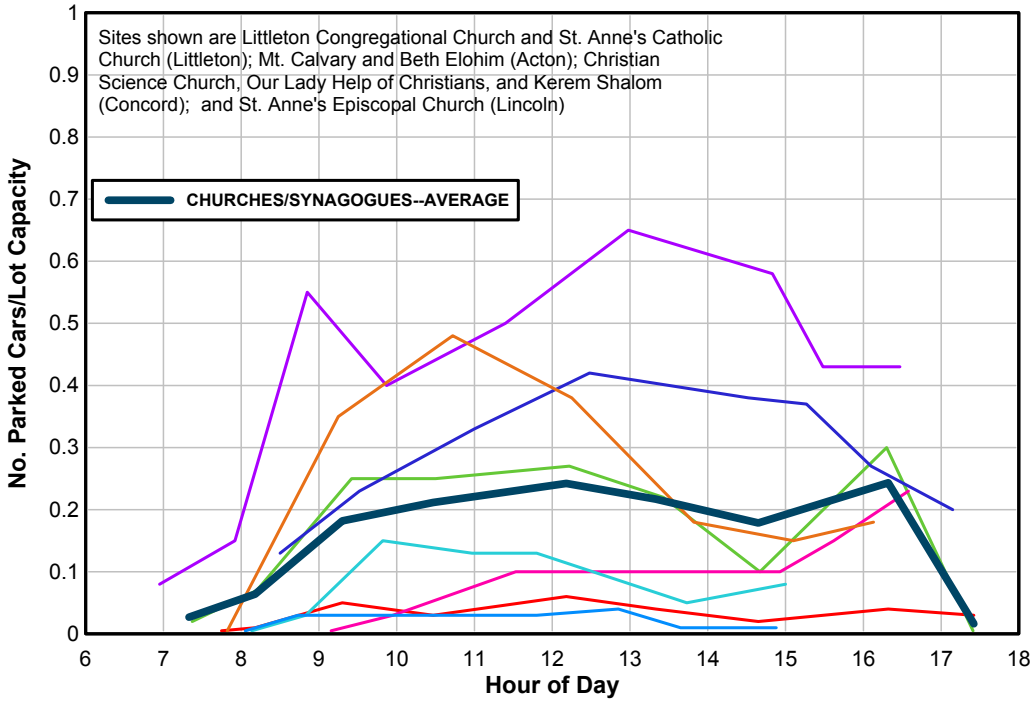


Church/Synagogue Sites

Figure 6 illustrates the parking occupancy characteristics of the church or synagogue facilities visited during the parking survey. Many of the churches and synagogues in the MAGIC area do have attached off-street parking, but some do not: St. Joseph's Church in Lincoln, the South Acton Congregational Church, the West Acton Baptist Church, and the First Unitarian Church in Littleton do not appear to have their own dedicated parking lots, but either use on-street parking or share parking lots with other uses. For example, the

Unitarian church in Littleton appears to use parking in the police/fire department lot across the street for Sunday services. Those which do have dedicated parking lots may be divided into those which have attached day-care centers, nursery schools, or other such daytime activities involving children, and those which do not appear to have such activities (at least not on a daily basis).

FIGURE 6
Parking Occupancy as Percent of Capacity
MAGIC-Area Church/Synagogue Sites, September-October 2003



Churches and synagogues which sponsor child-related activities do tend to use parking during weekdays, particularly during the late morning and early afternoon hours. Such use can represent as much as 60 percent of parking capacity at small lots (lots with 20 to 40 spaces). The use of church and synagogue property for day-care centers, play groups, educational groups, scout groups and other uses is the principal cause of variation in parking accumulation over the day across the different church sites represented in Figure 6. The usual observed number of parked cars at these locations during peak weekday hours was about 15 to 25 parked cars, which in most cases represented between one-half and one-quarter of the available lot's capacity.

Several of the church/synagogue parking lots in the MAGIC area are much larger than typical, notably those of Congregation Beth Elohim in Acton and St. Anne's Catholic Church in Littleton. The former site is located in a residential area on a secluded driveway and is not visible from the street. The latter site is more than a mile from the Littleton train station. No churches were identified in Concord or Lincoln having large parking capacities and located close enough to the nearest train station to make it reasonable to consider them.

Existing Town Parking Lots

Concord Center has several large parking lots available for use by people doing business in the town center. Littleton has a small public parking lot adjacent to the Police and Fire Stations. Parking activity at these lots was also observed to determine daily patterns of usage.

Two of the Concord lots are on Keyes Road, in back of the Tourist Information Center, and a third is located in back of the shops on the south side of Main Street, adjacent to the Postal facility and accessible via a narrow driveway from Walden Street. These three lots fill to 80-90 percent of parking capacity by 11:00 A.M., and remain full for the greater part of the day. There are no charges for parking in any of these lots, which serve as local business parking supplementing the metered on-street spaces on Main and Walden Streets. The Walden Street lot takes a little longer to fill up, possibly because its access and signing are limited, and drivers cannot see from the street whether or not they are likely to find a space there before they commit themselves to entering.

The Littleton lot is much smaller, having fewer than 15 spaces. It serves more limited uses, but all but two or three of its spaces were filled by mid-morning. There is no large general-purpose lot in Littleton that we could identify. The Donelan's Supermarket site and the former movie theater directly across Great Road from it are private sites with parking lots which are fairly large; and the Town's office buildings on Shattuck Street also have a large parking area. The Donelan's site and the Town office lot are located 2.3 and 1.9 miles, respectively, from the Littleton train station.[10]

Industrial/Office Sites

Industrial and office sites were not a primary focus of concern of this study, because their hours of peak parking demand coincide with the hours when commuter parking is most desired. However, we did note the existence, in the vicinity of train stations, of several large office properties that appear to be less than fully occupied at present. The most notable examples include the following:

Acton: The Wedgewood Realty Trust property on Route 27 in South Acton is just within one mile from the train station. It was identified as appearing to have surplus parking capacity, possibly available to share with commuters.

Littleton: Several office buildings along Foster Street south of Route 2 appear to be only partially occupied, and the Grubb property on the southeast corner of the Foster Street/Taylor Road intersection appears to be almost vacant. In addition, one of two buildings on the Hewlett Packard site on Taylor Road appears to be vacant at present. All of these facilities have parking that is largely or entirely unused during the work day.

Concord: The property at 300 Baker Avenue is another large office site which appears to be only partly occupied, with large areas of parking which are unused throughout the work-day.

[10] Distances "as the crow flies"; distances via local roads are slightly longer.

Particularly attractive is the isolated lot at the southern end of the site, in back of the buildings. If a pedestrian walkway existed between this lot and the train station platform, it would represent an easily walkable distance.

These sites were generally observed from the street during drive-by tours, so parking accumulation data is not available for them. But at least some considerable portion of their parking appears to be unused during the day. This disuse may be a temporary condition attributable to the sluggish economy and the slowdown in the development market within recent years. Once business activity picks up, the owners of these sites may intend to add new tenants and to expand activity on the sites. Hence it is not clear if the sites could be considered as long-term options for shared parking. But they may be available at least on a temporary basis.

Recreational Sites

The sites visited in this category included the country clubs in Maynard and Concord, the Elks Lodges in Maynard and Concord, and Drumlin Farm, the Audubon Society property in Lincoln. The days when observations were made were all clear, sunny autumn days, when one might expect the locations to attract at least the normal complement of users.

The largest parking lots in this category belong to the fraternal organizations. The country club parking areas tend to be smaller and can be scattered across various lots rather than concentrated in a single area. Drumlin Farm has a moderate-size parking lot, with room for "overflow" parking on a grassy area in back of the primary parking lot.

The lots of the fraternal organizations tend to be almost empty for most of the workday; they begin to be active early in the evening, on nights when there are functions or meetings at the building, but not before the evening commute is largely over. The lots at the country clubs and Drumlin Farm reached at least 80 percent of capacity for at least a brief period during the day, and both the Drumlin Farm and the Maynard Country Club lots were almost full for a brief period in the middle of the day. At the country clubs, the activity peaked in the early afternoon, and remained high until after 3:00 P.M. At Drumlin Farm, the peak occurred between 10:00-11:00 AM, with activity declining gradually through the afternoon. On days of poor weather, these properties are no doubt considerably less busy.

5. CONCLUSIONS BY STATION

Littleton/Route 495 Station:

The best opportunities for off-site parking for this station would involve one or more of the office buildings on Foster Street or Taylor Street. Five of the properties observed during our drive-by tours appear at present to have ample surplus parking during the workday. [11] The sites closest to the station would be the most desirable for such use, although only the Hartford Office Supply site is within one-quarter mile of the station (295 Foster Street is just beyond one-quarter mile). None of the church sites, nor the Life Care Center site, are within a mile of the station, but St. Anne's Church has the largest surplus parking capacity of all the non-office-building sites for this station.

South Acton Station:

The largest surplus parking capacity appears to belong to the Kmart and Congregation Beth Elohim properties, both of which are within one mile of the station. Neither of the closest sites (Liberty Tree Farm and the South Acton Congregational Church) has any surplus parking, while sites located in Maynard or southwest Acton are over a mile away, or appear to have inadequate surplus parking capacity.[12] Likewise, none of the sites in West Acton has any surplus parking. The Wedgewood Realty Trust property, just north of the Acton/ Maynard town line on Route 27, is an office/industrial property which, like the Littleton office properties, is at less than full occupancy at present, and therefore may have some spare parking capacity.

West Concord Station:

Of the supermarket/retail area parking lots around this station, only the West Concord Plaza lot appeared during drive-by tours to have any surplus parking capacity during commuting hours, and it has only a small amount. With regard to churches and synagogues, Kerem Shalom, which has a moderate-sized lot, is the closest with any surplus daytime parking: the ones closer to the station either have no parking, or sponsor child-related daytime activities which fill their lots close to capacity.

Two other alternatives are promising, and should be explored: the first is the office/industrial property at 300 Baker Avenue; the second is the Elks Lodge site on Baker Avenue. The 300 Baker Avenue site is located within one-quarter mile of the station "as the crow flies," although the driving or walking distance using existing roadways and paths is longer. This site is currently at less than full occupancy and has at least a hundred unused parking spaces on a given workday. The somewhat isolated rear parking lot at the southern end of the site is almost adjacent to the track. This lot, if available for commuter use, would offer the best

[11] The three office buildings at 295, 300, and 305 Foster Street, and the Hewlett-Packard and Delta Design sites off Taylor Street. The Hartford Office Supply site at 265 Foster Street is adjacent to the station, but appears to be fully occupied, and to have not as much surplus parking capacity as the other locations.

[12] The Elks Lodge, on Powder Mill Road in Maynard, does have ample surplus parking capacity, but is well over one mile from the South Acton Station.

potential for commuters to walk between the station and the lot. If this site were under serious consideration as satellite commuter parking, a key issue would be to provide a safe route for pedestrians *adjacent to* the track, so that they are not tempted to walk *along* the track as a means of shortening this distance. The Elks Lodge site is visible directly from Route 2—an advantage in attracting commuters using that roadway—but accessed from Route 62 and Baker Avenue. Like other facilities belonging to fraternal organizations, this site appears to be mostly unused during the daytime, and to have an ample parking lot. The site is more than a quarter-mile from the station but within a half-mile.

Concord Station:

The Crosby's Market site is already in use, with a section allocated to commuter parking at the end of the lot closest to the street. The only other site within one-quarter mile of the station that appears to have surplus daytime parking is Concord Crossing, immediately adjacent to the train platform. This, of course, would be the ideal site because of its proximity. It is already posted with a prohibition against commuter parking. None of the sites investigated in or near Concord Center has any significant surplus parking capacity, although the Brooks Pharmacy plaza and Christian Science Church have some empty spaces during a large part of the day. The Keyes Street and Walden Street public parking lots, in particular, are at or close to capacity for most of the day.

Concord, unlike the other towns included in the study, does have an extensive compact center. It also has at least one apartment complex within the downtown (Milldam Square). Some kind of small bus or van connection between Concord Center and the Concord commuter rail station may be worth investigating. Such a service might start from the Keyes Road area, and pick up passengers en route to the train station. During mid-day, such a service might connect with the historic sites in Concord. Hanscom Field might also be included in a route which served the train station. We do not have current information on the status of the vehicle formerly used for the Concord Free Bus service; however, service to the station might represent a productive use for such a vehicle. It is not clear whether there actually exists demand for such a service. However, it is a possibility worth exploring, if the idea hasn't been examined already.

Lincoln Station:

Commuter parking at this station has recently been reconfigured, so that the small unpaved lot south of the track is now reserved for Lincoln residents, and a charge is levied for parking in the larger paved lot in back of the Depot Square commercial parking lot. Perhaps in consequence of this, the Depot Square lot is now signed with a prohibition against commuter parking, although it does appear to have small amounts of surplus parking during the daytime. There is no significant parking capacity at the Masonic Temple site or at St. Joseph's Church, and the Drumlin Farm site fills to capacity during midday hours. The other church within a mile of the station, St. Anne's Episcopal Church, has a parking lot of a moderate size; however, this church appears to sponsor child-related activities during the day, and part of its available parking is used for this purpose. No other sites were found within Lincoln offering much potential as shared-parking sites.

6. OVERALL CONCLUSIONS

The best candidates for satellite parking areas are sites that have surplus parking capacity *and* are located within the quarter-mile maximum desirable walking distance from the nearest station. The sites investigated in this study that fit these criteria are the office buildings at 295 Foster Street in Littleton and 300 Baker Avenue in Concord. Several other sites fit the distance criterion and have at least some surplus parking; these include Concord Crossing in Concord, Depot Square in Lincoln, and Hartford Office Supply in Littleton. Some or all of these might be good candidate sites if they were not already posted with commuter parking prohibitions.

Sites located beyond one-quarter mile would require commuters to transfer to a shuttle vehicle to access the station. The parking lots in this category that appear to have surplus capacity which might be made available for commuters are the other office buildings on Foster Street and Taylor Street in Littleton, the Kmart site on Route 27 in Acton, and four churches/synagogues: Beth Elohim in Acton, the Christian Science Church and Kerem Shalom in Concord, and St. Anne's Episcopal Church in Lincoln.

Another possible access alternative for the Concord train station might be creation of a local service to connect Concord Center with the station. This service would be worth considering because most potential patrons would not need to park their cars and transfer to the shuttle vehicle—they could simply walk from their residences and board the vehicle on the street. Such a service might have a market in Concord because of the compact nature of the downtown center, the relatively high residential concentration in the downtown condominium complex, the proximity of the condo complex to the town offices on Keyes Road and to the North Bridge and other historic sites which might be connected. In addition, the Town already owns an appropriate vehicle, formerly used to provide local bus service.

If towns decide to approach landowners with the idea of shared satellite parking for commuter rail, they will need to do so judiciously. It may be possible to negotiate arrangements that are mutually beneficial to commuters and site owners, as Concord town officials have already done in the case of the Crosby's Market site. For example, towns may decide to lease parking from private landowners, and pay for the lease fees by selling parking stickers for the lot in question to commuters. Alternatively, churches may wish to solicit donations informally from commuters who park in their lots during working hours. Some owners of unused and consequently unproductive private parking may be willing to operate de facto for-hire parking for use by commuters, if approached with this idea.

The terms of agreements to share parking must be tailored to the needs and conditions of the particular parking situation. Local officials are in the best position to be able to negotiate agreements which meet the needs of the private parking owner as well as those of commuters.

APPENDIX A

Literature Review on Shared Parking

In accordance with the scope of work, a literature review was conducted to document previous experience with parking facilities shared between commuters and other groups with complementary parking demands. Based on this review, there appears to be a great deal of interest and activity in many communities within the U.S. with regard to the general concept of multiuse parking, although only a small amount of this relates to daytime commuter use of private parking lots.

Most of the literature deals with the efforts communities have made to develop shared-parking ordinances to insure that *future developments* include complementary land uses which can take advantage of smaller amounts of required parking. Also, many of the planning efforts directed at shared parking have focused on the public agency or transit agency as the parking *provider,* with the private development as the parking *sharer,* rather than the other way around. A primary objective seems to be to minimize the supply of private parking which developers are allowed to provide for their own uses, in order to address the real and universal problem of free and abundant private suburban parking, which is such a deterrent to greater transit use.

The online TDM Encyclopedia[1] lists the kinds of complementary land uses that are likely to be good candidates as shared-parking sites:

Peak Parking Demand [2]

Weekday Peaks	Evening Peaks	Weekend Peaks
Banks	Auditoriums	Religious institutions
Schools	Bars and dance halls	Parks
Distribution facilities	Meeting halls	Shops and malls
Factories	Restaurants	
Medical clinics	Theaters	
Offices		
Professional services		

This table indicates the time of peak parking demand for different land use types. Parking can be shared efficiently by land uses with different peaks.

That reference also presents a sample shared parking ordinance which includes a parking occupancy table for different land uses (reproduced below). The table is used to identify the *minimum required* parking assumed to be required by different uses by time period, as a method of estimating the required parking for a mixed-use development. The table does *not* include transit or commuter rail station as an identified land use, but "institutional (non-church)" probably represents the demand characteristics of suburban rail stations most closely.

[1] Victoria Transport Policy Institute, "TDM Encyclopedia," updated May 27, 2003 (http://www.vtpi.org/tdm/tdm28.htm).

[2] Table is from reference 1, above.

Arrangements for shared use of parking facilities have been made informally in many communities: churches negotiate with department stores to allow Sunday-morning parking in the stores' vacant lots, or department stores negotiate with churches to allow overflow parking in church lots in the pre-Christmas rush. Some such arrangements are probably already in operation in some MAGIC communities: for example, the small police/fire department lot in Littleton is used by churchgoers at the First Unitarian Church on Sunday mornings.

Parking Occupancy Rates[3]

Uses	M-F 8am-5pm	M-F 6pm-12am	M-F 12am-6am	Sat. & Sun. 8am-5pm	Sat. & Sun. 6pm-12am	Sat. & Sun. 12am-6am
Residential	60%	100%	100%	80%	100%	100%
Office/warehouse/industrial	100%	20%	5%	5%	5%	5%
Commercial	90%	80%	5%	100%	70%	5%
Hotel	70%	100%	100%	70%	100%	100%
Restaurant	70%	100%	10%	70%	100%	20%
Movie Theater	40%	80%	10%	80%	100%	10%
Entertainment	40%	100%	10%	80%	100%	50%
Conference/Convention	100%	100%	5%	100%	100%	5%
Institutional (non-church)	100%	20%	5%	10%	10%	5%
Institutional (church)	10%	5%	5%	100%	50%	5%

This table defines, for each category of land use, the percent of that land use's basic minimum parking-capacity requirement that needs to be available during each time period.

With regard to more formalized arrangements, most interest in shared parking has to do with single parking lots which serve multiuse developments with complementary demand characteristics, such as those listed in the above table. In 1983, the Urban Land Institute published the *Shared Parking*[4] manual, which described the concept of shared parking and provided a basis for estimating the amount of parking that would be sufficient to accommodate shared uses. That manual still represents the basic reference for planners developing formal procedures for allowing shared parking to supersede minimum and/or maximum single-development parking requirements specified by zoning. Many of the references to shared parking on the Internet point to model ordinances developed by communities in the U.S. based on the ULI manual.

[3] Table 3 from reference 1, above. To determine the minimum number of spaces that would need to be provided in a proposed shared-parking facility, one uses the percentages in the table to calculate the minimum number of spaces needed during each time period for each land use category to be served by the facility. The total required is then summed over all land use categories for each time period. The final required *minimum* number of spaces to be provided by the developer is the number of spaces needed in the time period with the *largest* overall parking demand.

[4] Urban Land Institute, *Shared Parking*, 1983.

The ULI manual dealt primarily with private, mixed-use development projects seeking reduction of minimum parking requirements by being able to demonstrate that the different uses incorporated were time-complementary. However, the concept might also be applied areawide, by a municipality or local district, given careful planning.

An example is the Portland, Oregon, metropolitan area. That jurisdiction conducted a major study of shared parking to determine if and how such parking use could allow more dense growth to occur within the city's boundaries of allowable development.[5] The study included interviews with a wide range of stakeholders, including municipality staff, business owners and associations, neighborhood groups, and large parking generators, and identification of both obstacles to shared parking and methods to overcome the obstacles. Portland then published a "Shared Parking Manual," which is available on its website (http://www.metro-region.org). Portland, Oregon, and the TriMet Transportation District are probably the farthest advanced municipality in the U.S. in terms of offering shared parking. Several of the Portland examples involved shared use of park-ride facilities at or near transit stations.[6]

The idea of allowing developers to purchase parking rights in public parking facilities was evaluated by Shoup[7] in 1999. He calls these arrangements "in lieu" parking programs, and suggests that they are already operating in many cities in America and other countries. Under these arrangements, property developers are assessed a flat fee to be paid in lieu of providing the otherwise-required numbers of parking spaces. The municipalities can, if desired, use the collected fees to create publicly owned parking lots which can be used for multiple purposes, including commuter parking. Fair Lawn, New Jersey, has recently implemented such a plan, under which a business or new development can choose to purchase the right to park in a shared lot, in return for a relaxation on the amount of private parking such properties would be required to provide.

A later report by the Urban Land Institute[8] listed the advantages and disadvantages of this interpretation of shared parking:

- For developers, lower costs and greater area available for primary uses;
- For local government and the public, more efficient use of parking using less land area; attraction of mixed-use projects resulting in a more lively

[5] Resha, E. J. and Stein, H. S., "Shared Parking in the Portland Metropolitan Area" In Harmonizing Transportation and Community Goals - The Challenge for Today's Transportation Professional, ITE Conference Proceedings, March 1998.

[6] Many of the Portland examples cited in the literature involve surplus parking in public park & ride lots, with options for sharing offered to nearby residential and commercial developers, rather than the other way around. The transit option, which is the primary means of access to surrounding land uses, is light rail. There are also locations where commuters use privately-owned parking facilities (principally churches) on Mondays-Fridays only—these are list on Tri-Met's Park & Ride web page (http://www.trimet.org/parkandride/index.htm).

[7] Shoup, Donald, "In Lieu of Required Parking," Journal of Planning Education and Research, 18:4, 1999, pp. 307-320.

[8] Urban Land Institute, *Shared Parking Planning Guidelines, an Informational Report*, August 1995.

environment; reduction of traffic access points; and enhancement of trip reduction efforts.

The later ULI report also pointed out potential disadvantages of shared parking: possible parking shortages, especially if land uses change; inability to reserve spaces; difficulties associated with having shared ownership, including need to agree on maintenance and liability issues; and limitations in the ability to customize parking design or operations or to provide security.

That report contains one documented example of shared parking use by rail commuters at a suburban Toronto shopping center. In that case, a shopping center located close to the next-to-last station on a subway line was planning a 500,000 square foot expansion. The Toronto Transit Commission negotiated an agreement with the shopping center to jointly fund construction of a 1,200-stall parking facility to be made available to commuters during the day. During the evenings and weekends, parking was available for both shoppers and transit riders. The report suggests that the retail uses would have required more parking spaces than were provided (about 2,500), and that the resulting parking facility is now oversubscribed with transit riders, crowding out shopping center patrons. This is particularly a problem when there are night-time events downtown which generate a high park-ride demand. It cautions that "…[e]ven when the peak parking demand periods of two uses do not coincide, their high-demand periods can have a significant overlap."[9]

An example of a more successful shared parking structure is the Village at Overlake Station in Redmond, Washington. This project combined 308 moderate-income rental housing units and a day-care facility with a 536-space park-and-ride facility in which parking spaces are shared between commuters and residents. It was built as a joint project funded by the county, the local housing authority, and a private developer operating with tax-exempt financing and federal housing tax credits. Each housing unit receives a free transit pass as an incentive to use the bus service available at the park-and-ride lot. Interestingly, the new park-and-ride lot replaces a previous interim arrangement under which commuters parked at the local Presbyterian church.[10]

Other examples discovered online include a transit station in Minnesota with 330+ park-ride spaces, which shares an additional 130+ spaces with an adjacent movie theater;[11] a church parking lot in Pasadena, California, with which the local transit authority contracts to lease spaces for commuter parking during weekdays;[12] Dadeland South Metrorail station, built as a joint-development project which includes office, retail, a luxury hotel and a 3,500-space parking garage shared between the transit station and the other uses;[13] Symphony Center in Baltimore, a similar mixed-use development including a transit

[9] Ibid., p. 51.
[10] Described at http://www.metrokc.gov/kcdot/alts/tod/overlake.htm (viewed 12 November 2003).
[11] Described at http://www.mvta.com/apple.htm (viewed 12 November 2003).
[12] Described at http://www.mta.net/board/agendas/2003_05/planning/item7.doc; the spaces are made available to commuters through a paid parking permit program administered by the transit authority, with the revenues allocated to pay the cost of the lease.
[13] Described at http://www.co.miami-dade.fl.us/transit/metrorail/jointdev/dadeland_south.htm

station and shared parking;[14] and the Walnut Street transit station in Montclair, New Jersey, which shares its commuter parking lot with a soccer stadium located next door.[15] A similar shared-parking arrangement was proposed for a new light-rail transit station to be located next to the Mile-High Stadium in Denver; it is not known if this was ever implemented. In several of these examples, the parking to be shared was included as part of the transit station; the "sharers" were to be private users in developments located adjacent to the station.

It is worth noting that shared parking was an option considered for the Fenway area of Boston during the transportation studies conducted by Vollmer Associates during 2001. Also, the Town of Brookline is moving forward with shared parking opportunities in Brookline Village connected with proposed new developments near the MBTA station.

Finally, the transportation research community has recognized the dearth of material in the current literature on experience with shared commuter/private parking—successes and obstacles—and has begun to address this topic. Researchers at the University of South Florida are currently working on a study of shared parking as a mechanism to facilitate commuter park-and-ride operations, funded through the Transportation Research Board.[16] That study is due to be completed in the spring of 2004.

* * * * *

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[15] Described at http://www.2national.com/pressreleases/nytimes/nytimesaug32003.htm (viewed 12 November 2003).
[16] Center for Urban Transportation Research, University of South Florida, *Evaluation of Shared Use Park & Ride Impact on Properties*, Research Contract BC137-49, sponsored by Florida Department of Transportation Research & Development Office. Anticipated completion date: 3/31/2004. (http://rip.trb.org/browse/dproject.asp?n=7209).

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APPENDIX B

License Plate Surveys at Five Fitchburg Line Commuter Rail Stations

MEMORANDUM

TO: **MAGIC File** **April 1, 2003**

FROM: **Alicia Wilson, Mary P. McShane, Paul Reim**

RE: **License Plate Surveys at Five Fitchburg Line Commuter Rail Stations**

During October-November 2002, license plate surveys were undertaken at five commuter rail stations on the Fitchburg Line, as part of the MAGIC Phase II study. The five stations included were:

Littleton
South Acton
West Concord
Concord
Lincoln

Parking utilization at all stations along the Fitchburg Line, including these five, is at or above capacity, and there is little community interest in allowing expanded station parking.[1] Instead, CTPS was asked to explore the concept of "shared parking" at existing church or commercial parking lots in the vicinity of the five stations, with possible feeder service via a shuttle system. The license plate surveys were undertaken to update information on the demand characteristics of each of the stations, including the distribution of town origins for both park-ride and dropoff commuter rail patrons.

At each station, one or more observers recorded license plate numbers of exiting dropoff patrons between the hours of 6 AM and 10 AM on a weekday morning. At several of the stations (South Acton and Lincoln), there are multiple lots; even at these locations, however, there is usually only one preferred drop-off location immediately adjacent to the tracks in one of the lots. At 10 AM, the observer then recorded the license plate numbers of all parked vehicles in each lot. The results were tallied separately, and then matched against Registry files to obtain the town where each vehicle is registered.

Obviously, there are limitations associated with these methods, most notably that the town of vehicle registration may not correspond to the actual trip origin. Some of the plates

[1] Construction of a major parking facility on a new site in Littleton, with direct access to and from Route 2 via a new set of highway ramps, has support within Littleton and other towns. However, significant environmental constraints on the preferred site make it unlikely that such construction will be advanced here in the near future.

recorded were from out of state, usually New Hampshire or Rhode Island. Most such plates were recorded so that the vehicle totals would be correct; but no conclusions were drawn about these vehicles in the analysis below.

The current results were compared with the results of the MBTA's Commuter Rail Passenger Survey of 1993 for consistency.

The results are summarized for each station below.

1. Lincoln Station

Lincoln has 3 separate parking lots available for commuter rail patrons, two of which are also available for mixed-use parking. **Figure 1** illustrates the layouts and driveway locations for the 3 lots. Lincoln Station is unusual in that the inbound and outbound platforms are on different sides of an intervening street (Lincoln Road). Consequently, all dropoff traffic occurs in Lot 3, the mixed-use parking area on the south side of Lincoln Road.

Altogether, 19 dropoff license plates and 159 parker license plates were recorded at the 3 lots on Tuesday October 22 between 6 AM and 10 AM. Of these 178, a total of 116 (or 65 percent) were matched with town of vehicle registration. The resulting distributions were then factored up to represent the totals. **Table 1** summarizes the towns of vehicle registration for these vehicles, using the factored totals.

The largest numbers of parked vehicles observed in all three lots were from Sudbury and Lincoln, with Wayland the next largest contributor. The unpaved lot south of the track (Lot 2) is primarily used by parkers from Sudbury; this lot fills the earliest of the three, by about 7:20 AM. Lincoln residents predominate in the main lot (Lot 1), where spaces are reserved for them, and the commercial lot next to the barbershop and other businesses. The main lot didn't fill up until later in the morning, while the commuter spaces in the commercial lot (Lot 3) weren't filled until after 9:30 AM. In this lot, the tandem spaces adjacent to the track were the last to fill. Some commuter use of the spaces in the commercial section of the lot was also observed, but this lot still had empty spaces left at 10 AM.

2. Concord Station

This station, located on Thoreau Street in Concord, also has a small mixed-use parking lot, with only about 23 spaces reserved for commuters. Another 45 spaces serve the retail uses which are located next to the track, including the uses occupying the former station building (see **Figure 2**). The commuter spaces in this lot (excluding the handicapped-designated spaces) filled up very early (by 7:00 AM), and there was considerably more dropoff traffic here than at Lincoln.

License plate data were collected at this station on Tuesday October 28, 2002 between 6:00 AM and 10:00 AM. Of the 41 recorded license plates at this station, 28, or 68 percent, were successfully matched; the match results were scaled up to the observed totals. At the

principal lot adjacent to the former station building, a total of 30 parked vehicles were observed, with a distribution of registration locations as shown in **Table 2**. In addition, a total of 11 dropoffs were observed. Concord itself is the primary town of origin for users of this station, with only a few other towns represented, notably Carlisle.

After the initial data collection, we were made aware that the Concord Planning Department has arranged for additional parking at several locations in the vicinity of this lot. These locations, and the approximate number of parking spaces at each, are listed below:

Cottage Lane area	approximately 28 spaces, unmarked, along track
Belknap Street lot	approximately 16 spaces in small lot
Crosby's Market parking	approximately 60 spaces in existing shopping center parking lot

In March 2003, license plate data were collected for these lots using the same methods as for the main Concord lot, although no dropoffs were expected or observed (all dropoffs take place adjacent to the platform at the main station location). A total of 95 parked vehicles were observed at the three auxiliary lot locations, as shown on **Table 2A**. Concord itself and Carlisle were the primary origin towns of the observed vehicles, according to Registry data.

3. West Concord Station

This station is located in the middle of the West Concord commercial area, and has a large parking lot. The lot is accessible via a single driveway, which also serves an assisted living community and a small industrial building (**Figure 3**). About 41 spaces in the lot are designated for Concord residents only; the remaining spaces are accessible to everyone and have a charge of $1.00 per day. In addition, there are a small number of metered short-term spaces located close to the entrance of the lot.

Data were collected at this station on October 23, 2002 between 6 AM and 10 AM. The non-resident spaces were filled by approximately 8:00 AM, while the resident-only spaces were filled by 8:15 AM. During the last hour of the observation period (9 to 10 AM), several vehicles were observed driving around the lot, searching for parking spaces which, by that time, were no longer available.

A total of 195 parked vehicles and 13 dropoffs were observed during this period. Matching efforts resulted in 74 percent of the license plates linked to town of registration. The totals were factored up to match the total number of observed vehicles. **Table 3** summarizes the results of this matching. The principal town sources of parked vehicles at this station are Concord, Maynard and Acton; these three towns represented over 60 percent of parked vehicles. Observed dropoffs were primarily from Acton, possibly from North Acton and/or the Route 2 corridor, for whom the West Concord station may simply be more convenient than the South Acton station.

4. South Acton

License plates were recorded at this station between 6 AM and 10 AM on Thursday, November 7, 2002. The South Acton station has two parking lots: a large, paved lot with a mixture of permit-parking and metered spaces, where the platform is located; and a small paved lot with a separate driveway, located approximately 200 yards south of the platform and accessible via a paved pedestrian path. **Figure 4** illustrates the layout of the two lots.

On the day when data were collected, 265 vehicles were observed parked in the large lot, which was effectively filled to capacity. 26 vehicles were parked in the smaller lot. In addition, there were 125 dropoffs at the platform, excluding people using shuttle buses. About 70 percent of the observed plate numbers were matched in the Registry database. The distributions obtained were factored to the observed totals for parkers in the permit and metered lots, and for dropoffs to yield the distribution of origins shown in **Table 4**, which provides separate tabulations for all the lots. The largest numbers of parkers and dropoffs represent vehicles with Acton registrations, while Boxborough, Stow, Hudson, Clinton and Harvard contributing the next largest numbers of parkers. These 6 towns together represented about 65 percent of the total parkers in the large and small lots.

The remainder of the parkers represented over 40 other towns, many of them beyond reasonable range of the station (e.g., Fall River, Springfield, Attleboro). These are vehicles which may belong to individuals who have moved since the last update of the Registry files two years ago. Some may be visitors or renters; some may be commercial vehicles registered at a business site but used for commuting; while others represent errors in data recording and/or transcribing.

Acton and Boxborough are the sources of the greatest numbers of dropoff vehicles, with Stow and Maynard also contributing a moderate share. These four towns represent almost 70 percent of the dropoff patrons, or 80 people. Again, the remainder of the recorded dropoff vehicles were registered in a large number of towns, most contributing only 1 to 3 dropoff patrons. The small lot was essentially filled before 7 AM, while the larger lot is almost filled by the departure of the 7:40 inbound train (3 metered spaces free, 4 resident spaces free).

At the same time as the parker/dropoff data collection, inbound passengers on the Maynard Shuttle were noted, as follows:

For 6:30 AM inbound train:	1 person
For 6:55 AM inbound train:	4 people
For 7:35/7:40 AM inbound train:	2 people
For 7:55 AM inbound train:	3 people
For 8:35 AM inbound train:	0 people

5. Littleton Station

Parking/dropoff data were collected at this station on Wednesday October 23, 2002 between 6 AM and 10 AM. The Littleton station has a single lot which is newly paved, and several dirt lots, including 2 which are informal parking areas. The paved lot has 53 spaces (including 3 HP spaces), while the dirt lots on Foster Street accommodate about 47-50 vehicles, depending on how efficiently parkers use the available space. **Figure 5** illustrates the layout of the station and parking areas. It is difficult to determine capacity at the dirt/informal lots, since people park randomly on the grassy areas as well as on dirt. The parking areas were judged to be close to full by 7:45 AM on the day when data were recorded, with the dirt lots first to fill up.

Table 5 summarizes the results of license plate analysis for this station. Littleton and Westford were the towns of registration for the greatest numbers of vehicles parked at this station, with Boxborough and Harvard also contributing several vehicles. These four towns represent 65 percent of the parked vehicles at the station. Of the 24 dropoff vehicles recorded, half had Littleton registrations, while 6, or 22 percent were from the adjacent towns of Boxborough and Westford.

6. Overall Station Parking and Dropoff Demand

Tables 6 and **7** summarize the arrival data at the five Fitchburg Line stations by mode of access and town of vehicle registration. It is worth repeating that many of the towns listed in the *bottom halves* of both tables are unlikely sources of rail patrons at these stations; they are not located in areas which represent the natural markets for the stations. There are a number of potential explanations for these data:

- they may represent errors in the license-plate-recording process (1 or more digits incorrectly recorded)
- they may represent commercial vehicles registered in the town where the driver's business or employment site is located
- they may represent vehicles belonging to visitors, or to persons who have recently moved to towns within the station market areas, since the license-plate database was last updated.

The towns listed in the top halves of both tables generally do represent reasonable market areas for the five stations investigated. The four towns where the stations are actually located (Acton, Concord, Lincoln and Littleton) represent the source of the greatest numbers of rail patrons, together with a small number of adjacent towns (Maynard, Boxborough, Stow, Sudbury, Westford, Harvard and Hudson). **Figures 6** and **7** show the distributions of vehicle origin towns, for park-riders and dropoff patrons respectively, at all stations.

7. Comparison with 1993 Commuter Rail Survey Results

Table 8 presents previous information on the origins reported by travelers boarding trains at the five Fitchburg Line stations in 1993. This information was derived from the

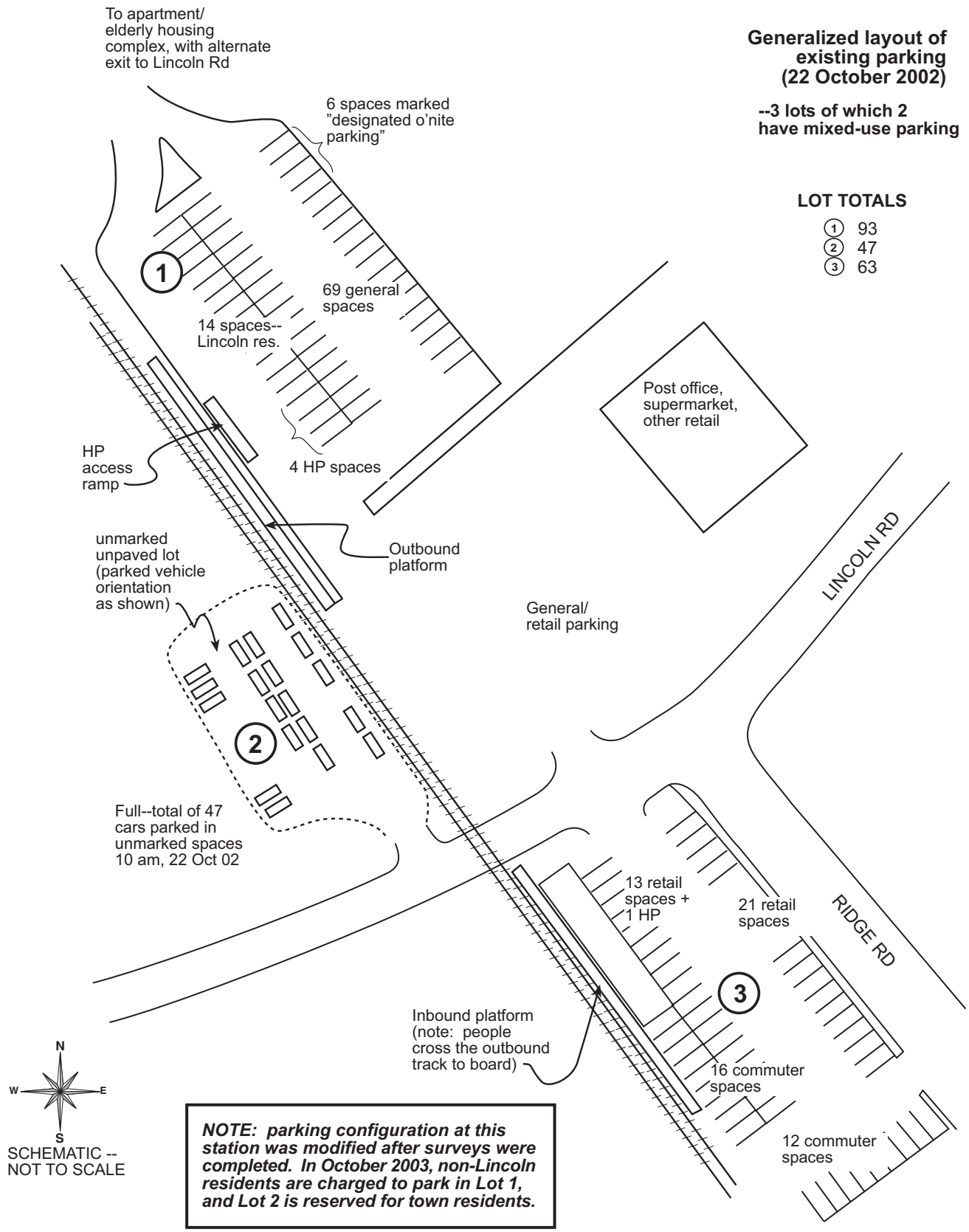
Passenger Survey conducted at that time on the entire system. The numbers in **Table 8** represent survey responses factored to represent the total inbound boarding count at each station. In **Table 9**, the results of the present license plate surveys are summarized in the same manner as those from the earlier survey:

- parkers and dropoff patrons are grouped together
- a category called "Other" is used to aggregate all vehicle origins not included in the primary list of market area towns

The two methods of data collection are very different. Nevertheless, the results are quite consistent. The same towns tend to be the primary contributors of commuter rail patrons at each station in both years, in the same proportions. The 1993 survey data represents all-day boardings, while the current license-plate data represents only the peak AM period (6 AM to 10 AM), so it is not practicable to compare total boardings directly. However, the totals are consistent with several assumptions:

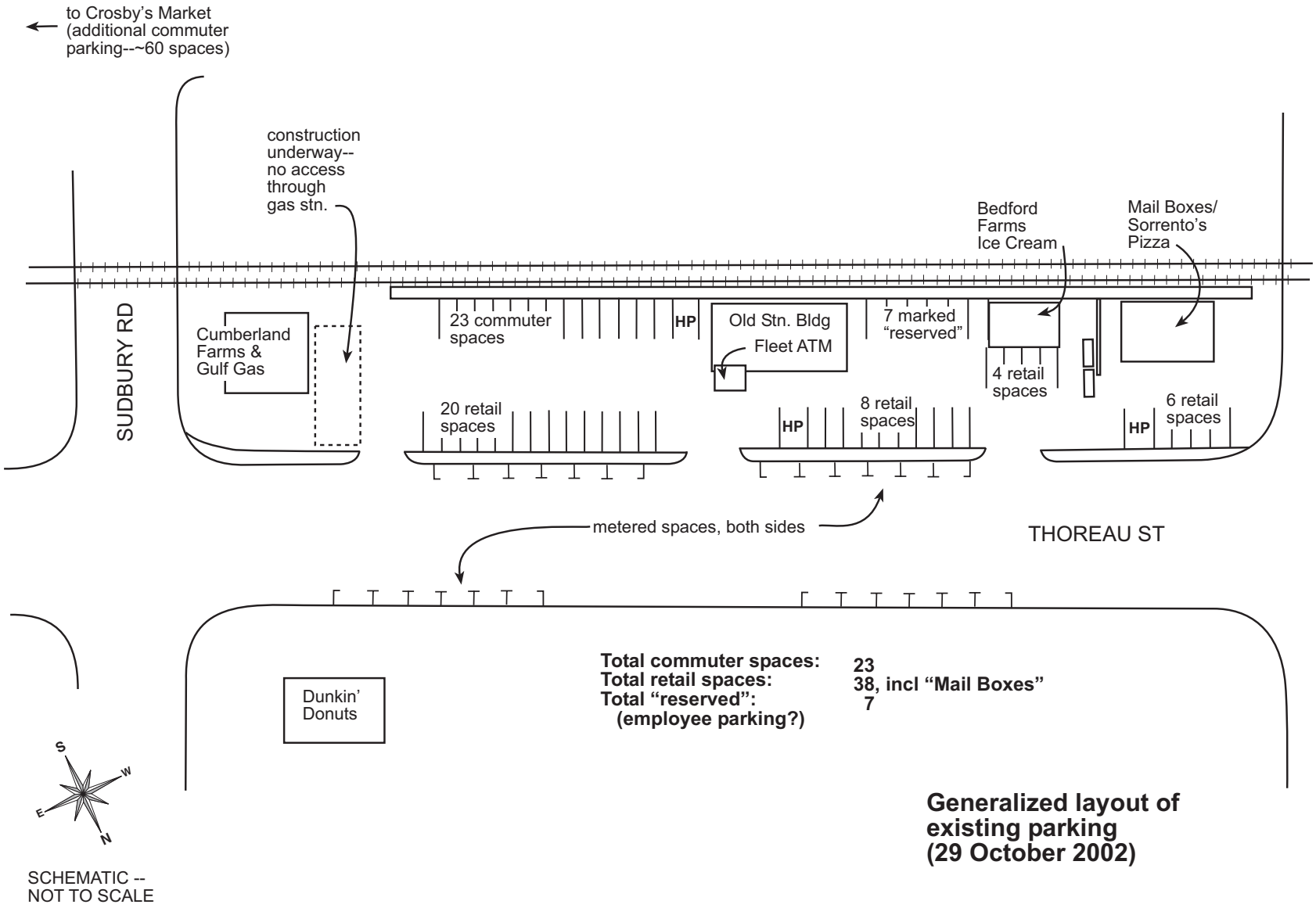
- that most patrons arrive during the AM peak period
- that overall demand for the existing train service has changed very little since 1993

FIGURES AND TABLES



CTPS
MAGIC
Subregional
Area Study

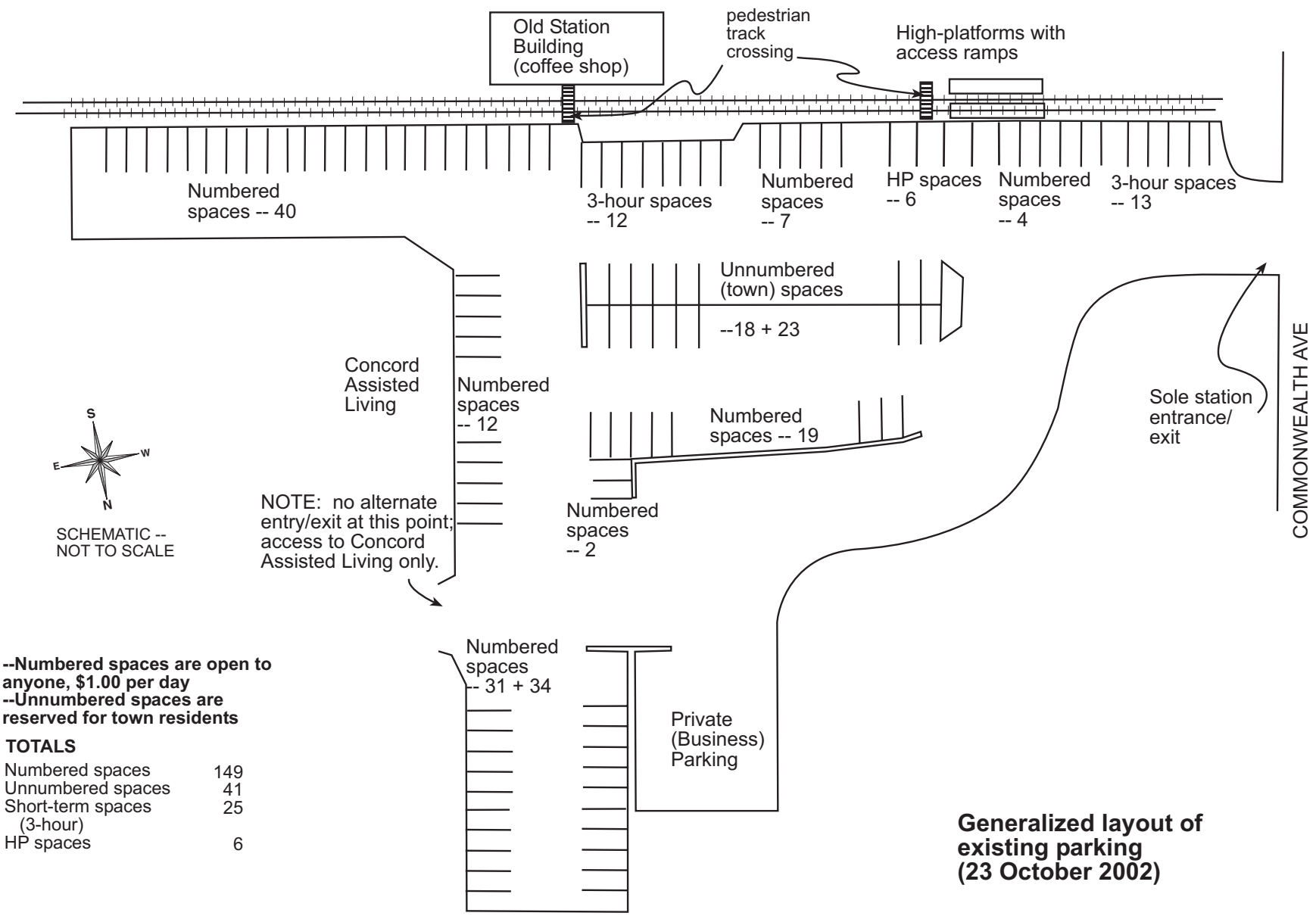
Figure 1
Lincoln Commuter Rail Station



Generalized layout of existing parking (29 October 2002)

CTPS
MAGIC Subregional Area Study

Figure 2
Concord Commuter Rail Station



--Numbered spaces are open to anyone, $1.00 per day
--Unnumbered spaces are reserved for town residents

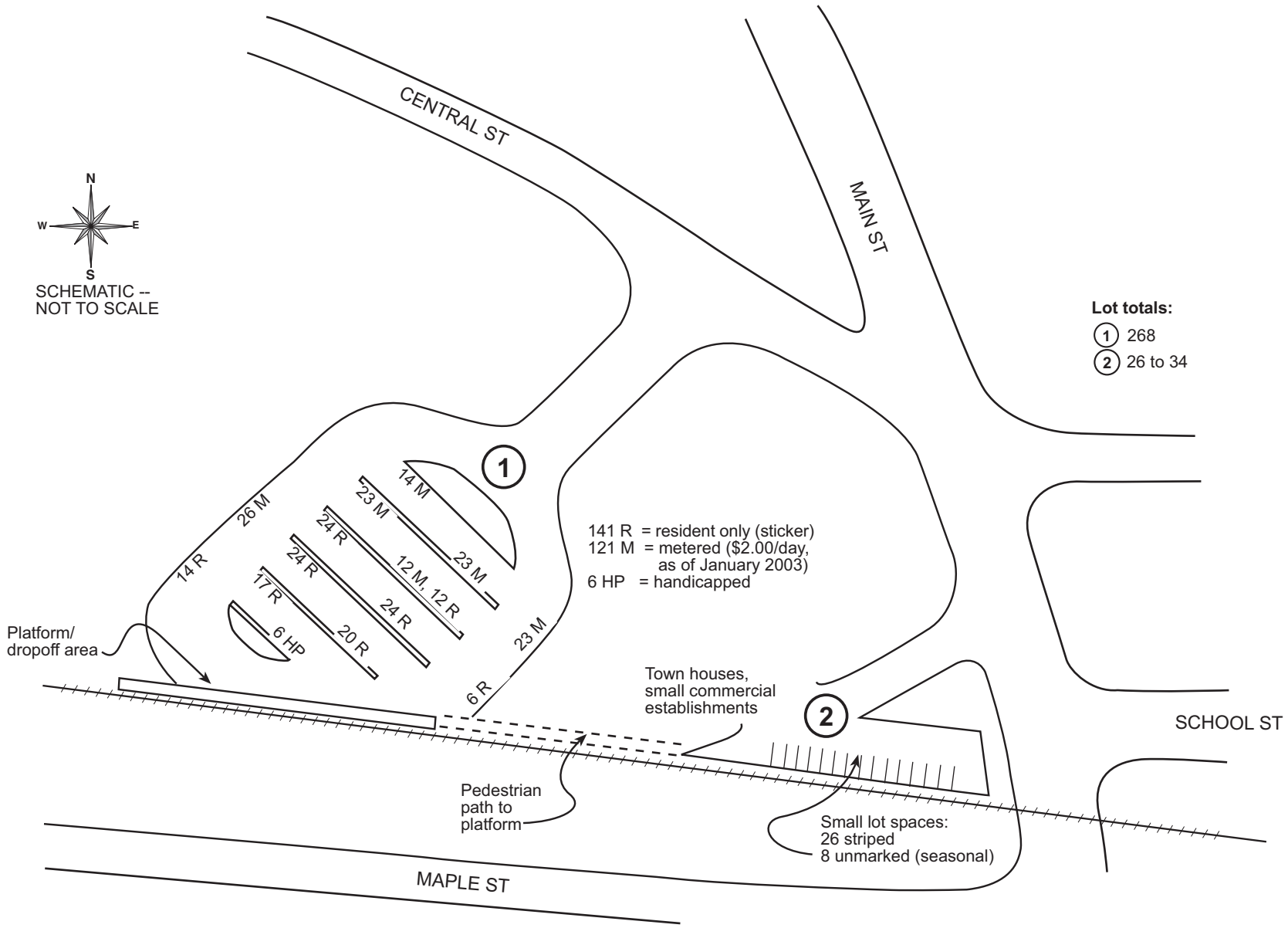
TOTALS

Numbered spaces	149
Unnumbered spaces	41
Short-term spaces (3-hour)	25
HP spaces	6

Generalized layout of existing parking (23 October 2002)

CTPS
MAGIC Subregional Area Study

Figure 3
West Concord Commuter Rail Station



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MAGIC
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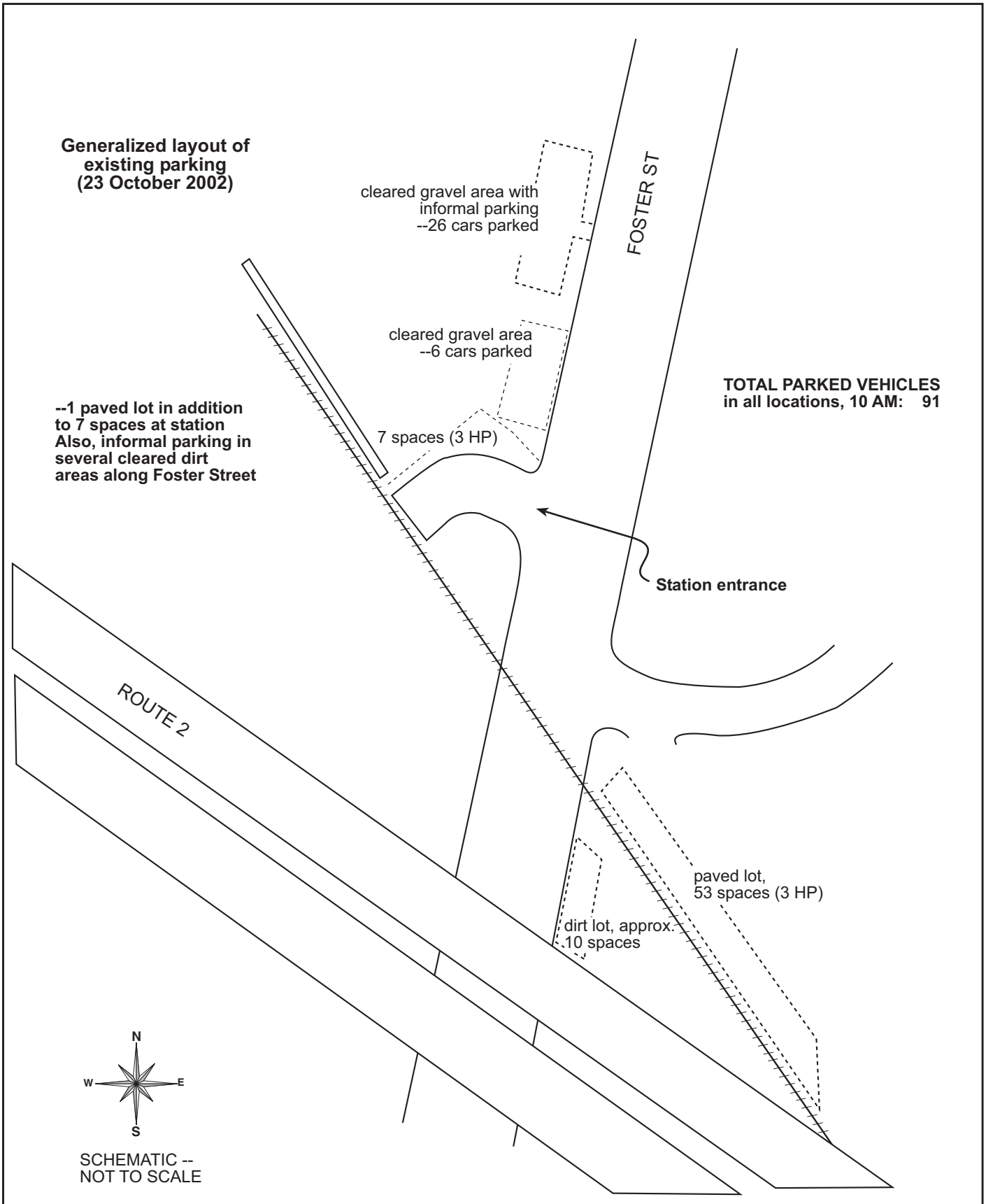
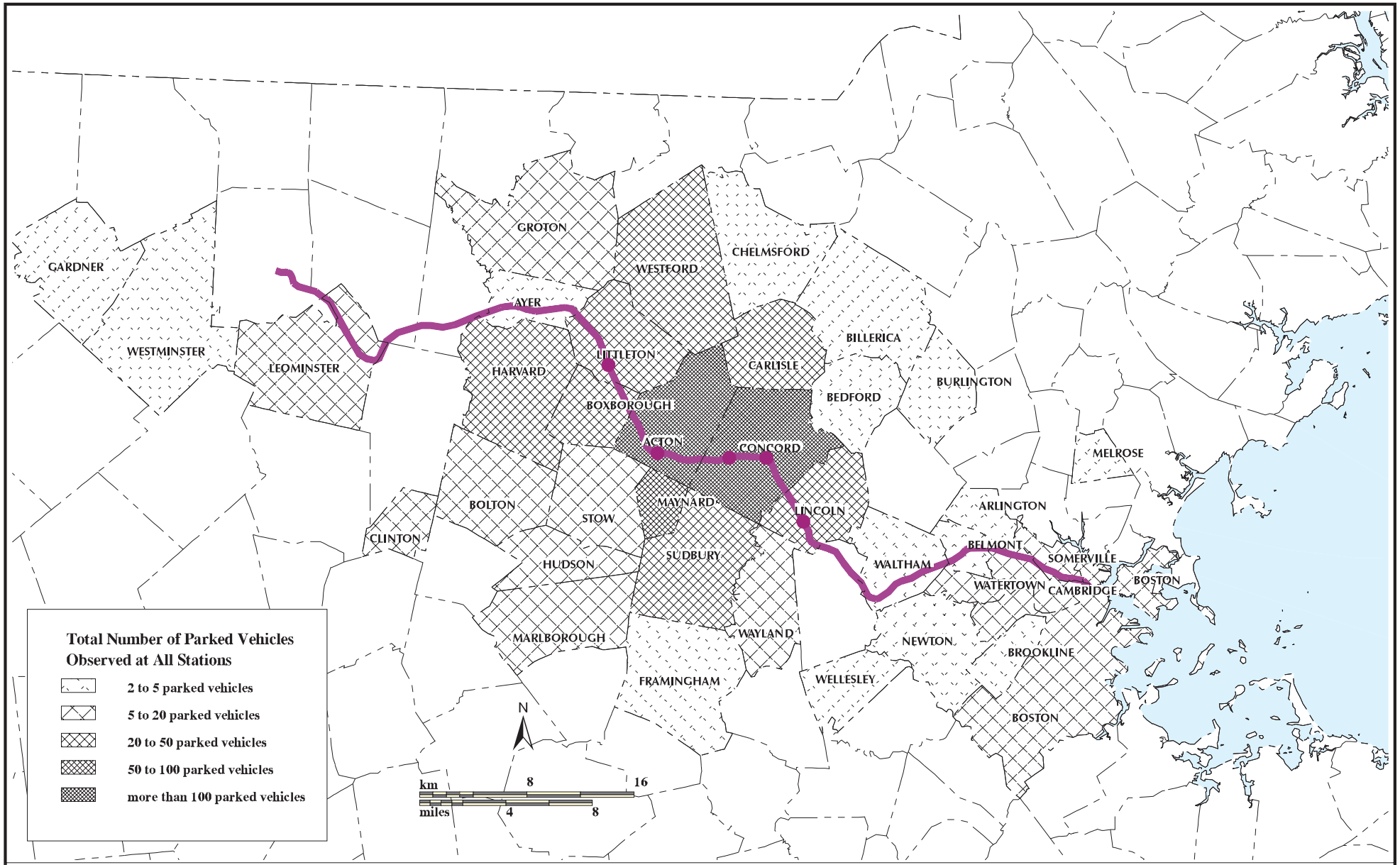
Area Study

Figure 4
South Acton Commuter Rail Station



CTPS
MAGIC Subregional Area Study

Figure 5
Littleton Commuter Rail Station



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MAGIC Subregional Area Study

Fitchburg CR Line--Stations

Figure 6
Towns of Vehicle Origin for All Park-Riders at Stations Investigated

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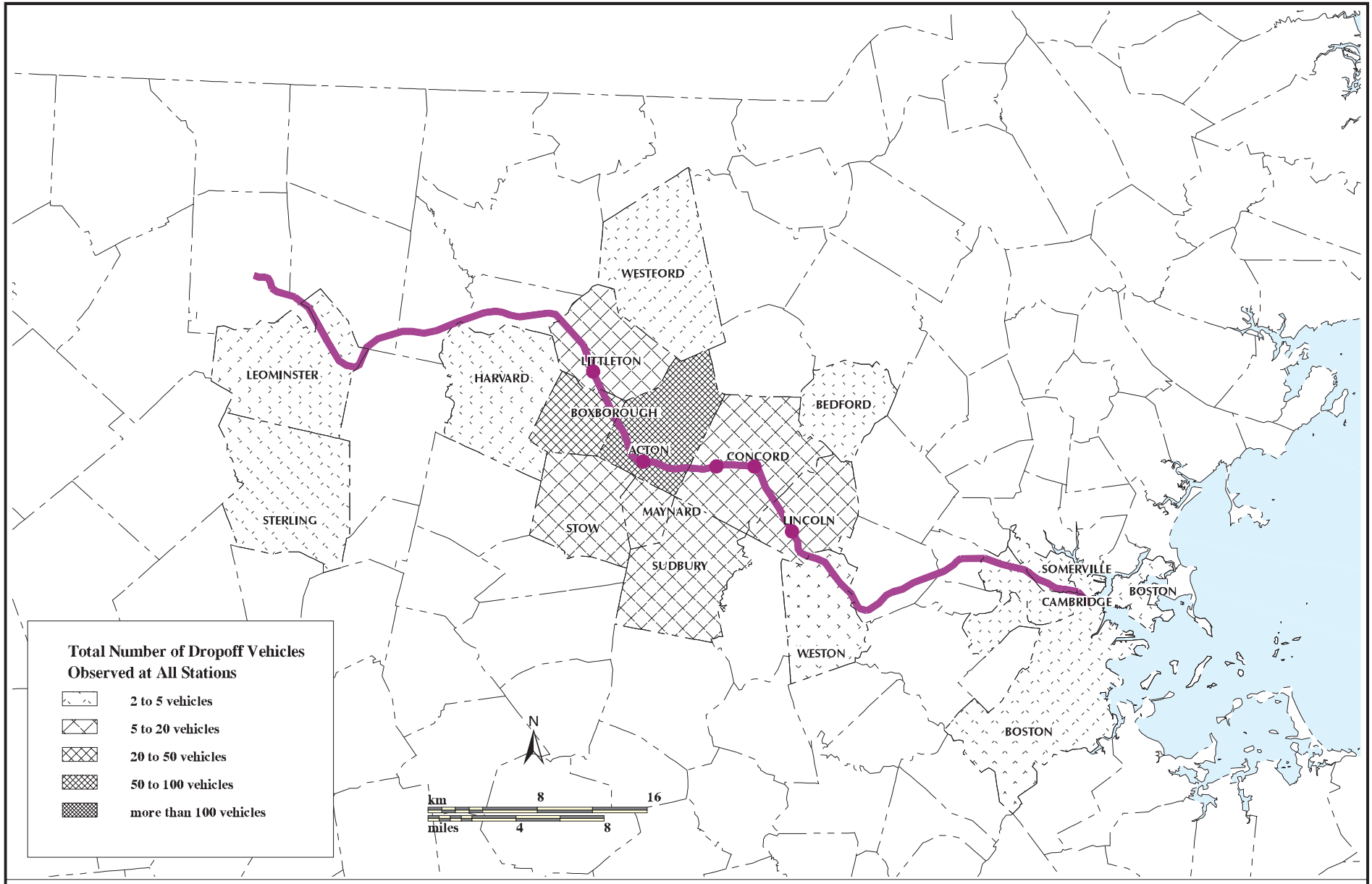

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MAGIC Subregional Area Study

Fitchburg CR Line--Stations

Figure 7
Towns of Vehicle Origin for Dropoff Patrons at Stations Investigated

TABLE 1
Lincoln Commuter Rail Station:
License Plate Survey, October 22, 2002

Town of Vehicle Registration	Number of Observed Vehicles				Percent of Total
	PARKED				
	Lot 1*	**Lot 2***	**Lot 3***	**Total**	**Percent**
Sudbury	19	20		39	25.7%
Lincoln	14	6	14	34	22.4%
Wayland	7	6	4	17	11.2%
Concord	6	2		8	5.3%
Hudson	3		2	5	3.3%
Maynard	3	2		5	3.3%
Acton	4			4	2.6%
Cambridge			4	4	2.6%
Marlborough	1	3		4	2.6%
Out-of-state		1	3	4	2.6%
Framingham	1	2		3	2.0%
Billerica			2	2	1.3%
Bolton		2		2	1.3%
Boston		2		2	1.3%
Brookline		2		2	1.3%
Burlington			2	2	1.3%
Lynn		2		2	1.3%
Newton		2		2	1.3%
Arlington	1			1	0.7%
Beverly	1			1	0.7%
Lancaster	1			1	0.7%
Littleton	1			1	0.7%
Newburyport			1	1	0.7%
Watertown			1	1	0.7%
Wellesley	1			1	0.7%
Westfield	1			1	0.7%
Winchester	1			1	0.7%
TOTAL PARKED	**65**	**52**	**33**	**150**	

*Lots are identified by number in Figure 1.

	DROPOFF**	
Lincoln	15	53.6%
Sudbury	5	17.9%
Cambridge	3	10.7%
Weston	3	10.7%
Canton	1	3.6%
Leominster	1	3.6%
TOTAL DROPOFF	**28**	

**All dropoffs at platform in Lot 3.

TABLE 2
Concord Commuter Rail Station:
License Plate Survey, October 28, 2002

Town of Vehicle Registration	Number of Observed Vehicles	Percent of Total
	PARKED	
Concord	17	56.7%
Carlisle	5	16.7%
Maynard	2	6.7%
Westford	2	6.7%
Ayer	1	3.3%
Bedford	1	3.3%
Chelmsford	1	3.3%
Wellesley	1	3.3%
TOTAL PARKED	**30**	
	DROPOFF	
Concord	6	54.5%
Bedford	3	27.3%
Leominster	1	9.1%
Pepperell	1	9.1%
TOTAL DROPOFF	**11**	

TABLE 2A
Concord Commuter Rail Station:
Supplementary License Plate Survey, March 25, 2003

Town of Vehicle Registration	Number of Observed Vehicles				Percent of Total
	PARKED				
	Crosby's Market	**Cottage Street**	**Belknap Street**	**Total**	
Concord	19	9	7	35	36.8%
Carlisle	19	2	1	22	23.2%
Acton	3	5		8	8.4%
Sudbury	5			5	5.3%
Harvard	2	2		4	4.2%
Bedford	2		1	3	3.2%
Westford	1		2	3	3.2%
Groton		2		2	2.1%
Lincoln	2			2	2.1%
Littleton		2		2	2.1%
Wayland	2			2	2.1%
Arlington	1			1	1.1%
Ashland	1			1	1.1%
Barnstable	1			1	1.1%
Boston		1		1	1.1%
Cambridge		1		1	1.1%
Maynard			1	1	1.1%
Medford	1			1	1.1%
TOTAL PARKED	59	24	12	95	

TABLE 3
West Concord Commuter Rail Station:
License Plate Survey, October 23, 2002

Town of Vehicle Registration	Number of Observed Vehicles	Percent of Total
	PARKED	
Concord	47	24.1%
Maynard	42	21.5%
Acton	31	15.9%
Littleton	7	3.6%
Sudbury	6	3.1%
Westford	6	3.1%
Groton	5	2.6%
Harvard	5	2.6%
Out-of-state	5	2.6%
Boxborough	4	2.1%
Stow	4	2.1%
Boston	3	1.5%
Gardner	3	1.5%
Hudson	3	1.5%
Leominster	3	1.5%
Marlborough	3	1.5%
Watertown	3	1.5%
Ashburnham	1	0.5%
Athol	1	0.5%
Cambridge	1	0.5%
Carlisle	1	0.5%
Hubbardston	1	0.5%
Medford	1	0.5%
New Bedford	1	0.5%
Newton	1	0.5%
Northborough	1	0.5%
Pepperell	1	0.5%
Saugus	1	0.5%
Springfield	1	0.5%
Waltham	1	0.5%
Westminster	1	0.5%
Weymouth	1	0.5%
TOTAL PARKED	**195**	
	DROPOFF	
Acton	5	38.5%
Maynard	2	15.4%
Athol	1	7.7%
Belmont	1	7.7%
Boston	1	7.7%

Boxborough	1	7.7%
Concord	1	7.7%
Woburn	1	7.7%
TOTAL DROPOFF	**13**	

TABLE 4
South Acton Commuter Rail Station:
License Plate Survey, November 7, 2002

Town of Vehicle Registration	Number of Observed Vehicles				Percent of Total
	PARKED				
	Permit Lot	**Meter Lot**	**Small Lot**	**Total**	
Acton	109	9	3	121	41.6%
Boxborough	4	16	4	24	8.2%
Stow		16		16	5.5%
Hudson		8	4	12	4.1%
Clinton		7	3	10	3.4%
Harvard		9	1	10	3.4%
Boston	4	3		7	2.4%
Cambridge	3	4		7	2.4%
Maynard		4	3	7	2.4%
Somerville	1	4	1	6	2.1%
Littleton		5		5	1.7%
Out-of-state		5		5	1.7%
Watertown		4	1	5	1.7%
Belmont	1	3		4	1.4%
Marlborough		3	1	4	1.4%
Melrose	3	1		4	1.4%
Westford	1	3		4	1.4%
Bolton			3	3	1.0%
Leominster		3		3	1.0%
Waltham	3			3	1.0%
Wellesley		3		3	1.0%
Springfield	1	1		2	0.7%
Andover	1			1	0.3%
Arlington	1			1	0.3%
Attleboro	1			1	0.3%
Beverly		1		1	0.3%
Brockton	1			1	0.3%
Brookline	1			1	0.3%
Burlington	1			1	0.3%
Chelmsford		1		1	0.3%
Cohasset	1			1	0.3%
Fall River		1		1	0.3%
Foxborough			1	1	0.3%
Gardner		1		1	0.3%
Groton		1		1	0.3%
Lexington	1			1	0.3%
Lynnfield	1			1	0.3%
Malden	1			1	0.3%
Marshfield		1		1	0.3%
Newton		1		1	0.3%

Orleans	1			1	0.3%
Peabody		1		1	0.3%
Quincy	1			1	0.3%
Sherborn		1		1	0.3%
Sterling			1	1	0.3%
Tewksbury	1			1	0.3%
West Boylston		1		1	0.3%
Woburn		1		1	0.3%
TOTAL PARKED	**143**	**122**	**26**	**291**	

	DROPOFF*	
Acton	50	40.0%
Boxborough	20	16.0%
Stow	10	8.0%
Maynard	7	5.6%
Concord	5	4.0%
Boston	3	2.4%
Harvard	3	2.4%
Leominster	3	2.4%
Somerville	3	2.4%
Sterling	3	2.4%
Arlington	1	0.8%
Bedford	1	0.8%
Cambridge	1	0.8%
Haverhill	1	0.8%
Hingham	1	0.8%
Hudson	1	0.8%
Littleton	1	0.8%
Lunenburg	1	0.8%
Manchester	1	0.8%
Marlborough	1	0.8%
Melrose	1	0.8%
Montague	1	0.8%
Newton	1	0.8%
Out of State	1	0.8%
Quincy	1	0.8%
Shirley	1	0.8%
Sudbury	1	0.8%
Westford	1	0.8%
TOTAL DROPOFF	**125**	

*All dropoffs at platform in large lot.

TABLE 5
Littleton Commuter Rail Station:
License Plate Survey, October 23, 2002

Town of Vehicle Registration	Number of Observed Vehicles	Percent of Total
	PARKED	
Littleton	34	37.4%
Westford	12	13.2%
Boxborough	7	7.7%
Harvard	7	7.7%
Clinton	4	4.4%
Ayer	3	3.3%
Groton	3	3.3%
Westminster	3	3.3%
Andover	1	1.1%
Berlin	1	1.1%
Bernardston	1	1.1%
Billerica	1	1.1%
Bolton	1	1.1%
Boston	1	1.1%
Braintree	1	1.1%
Brookline	1	1.1%
Cambridge	1	1.1%
Chelmsford	1	1.1%
Dracut	1	1.1%
Gardner	1	1.1%
Hubbardston	1	1.1%
Leominster	1	1.1%
Lowell	1	1.1%
Lunenburg	1	1.1%
Quincy	1	1.1%
Somerville	1	1.1%
TOTAL PARKED	**91**	
	DROPOFF	
Littleton	13	54.2%
Boxborough	3	12.5%
Westford	3	12.5%
Arlington	1	4.2%
Boston	1	4.2%
Harvard	1	4.2%
Maynard	1	4.2%
Shirley	1	4.2%
TOTAL DROPOFF	**24**	

TABLE 6
Distribution of Parking Lot Usage
By Town of Vehicle Registration

Town of Vehicle Registration	Numbers of Parkers at Commuter Rail Parking Lots					TOTAL
	Littleton	South Acton	West Concord	Concord	Lincoln	
Acton		121	31	8	4	164
Concord			47	52	8	107
Maynard		7	41	3	5	56
Littleton	34	5	7	2	1	49
Sudbury			5	5	39	49
Lincoln				2	34	36
Boxborough	7	24	4			35
Carlisle			1	27		28
Harvard	7	10	5	4		26
Westford	12	4	5	5		26
Hudson		12	3		5	20
Stow		16	4			20
Wayland				2	17	19
Boston	1	7	3	1	2	14
Cambridge	1	7	1	1	4	14
Clinton	4	10				14
Out of state		5	4		4	13
Groton	3	1	5	2		11
Marlborough		4	3		4	11
Watertown		5	3		1	9
Leominster	1	3	3			7
Somerville	1	6				7
Bolton	1	3			2	6
Gardner	1	1	3			5
Wellesley		3		1	1	5
Ayer	3			1		4
Bedford				4		4
Belmont		4				4
Brookline	1	1			2	4
Melrose		4				4
Newton		1	1		2	4
Waltham		3	1			4
Westminster	3		1			4
Arlington		1		1	1	3
Billerica	1				2	3
Burlington		1			2	3
Chelmsford	1	1		1		3
Framingham					3	3
Springfield		2	1			3
Andover	1	1				2

Beverly		1			1	2
Hubbardston	1		1			2
Lynn					2	2
Medford			1	1		2
Quincy	1	1				2
Ashburnham			1			1
Ashland				1		1
Athol			1			1
Attleboro		1				1
Barnstable				1		1
Berlin	1					1
Bernardston	1					1
Braintree	1					1
Brockton		1				1
Cohasset		1				1
Dracut	1					1
Fall River		1				1
Foxborough		1				1
Lancaster					1	1
Lexington		1				1
Lowell	1					1
Lunenburg	1					1
Lynnfield		1				1
Malden		1				1
Marshfield		1				1
New Bedford			1			1
Newburyport					1	1
Northborough			1			1
Orleans		1				1
Peabody		1				1
Pepperell			1			1
Saugus			1			1
Sherborn		1				1
Sterling		1				1
Tewksbury		1				1
West Boylston		1				1
Westfield					1	1
Weymouth			1			1
Winchester					1	1
Woburn		1				1
TOTAL	91	291	191	125	150	848

TABLE 7
Distribution of Dropoffs at Stations
By Town of Vehicle Registration

Town of Vehicle Registration	Numbers of Dropoffs at Commuter Stations					
	Littleton	South Acton	West Concord	Concord	Lincoln	TOTAL
Acton		50	5			55
Boxborough	3	20	1			24
Lincoln					15	15
Littleton	13	1				14
Concord		5	1	6		12
Maynard	1	7	2			10
Stow		10				10
Sudbury		1			5	6
Boston	1	3	1			5
Leominster		3		1	1	5
Bedford		1		3		4
Cambridge		1			3	4
Harvard	1	3				4
Westford	3	1				4
Somerville		3				3
Sterling		3				3
Weston					3	3
Arlington	1	1				2
Shirley	1	1				2
Athol			1			1
Belmont			1			1
Canton					1	1
Haverhill		1				1
Hingham		1				1
Hudson		1				1
Lunenburg		1				1
Manchester		1				1
Marlborough		1				1
Melrose		1				1
Montague		1				1
Newton		1				1
Out-of-state		1				1
Pepperell				1		1
Quincy		1				1
Woburn			1			1
TOTAL	24	125	13	11	28	201

TABLE 8
1993 Commuter Rail Passenger Survey:
Train Boardings By Reported Town of Origin
(Park-ride and Dropoff, All Day)

TOWN OF ORIGIN	Number of Boarders at Commuter Rail Stations						
	Littleton	South Acton	West Concord	Concord	Lincoln	Total	Percent
Acton		179	56	10		245	22.6%
Concord			82	97	9	188	17.4%
Maynard		30	34		17	81	7.5%
Sudbury					65	65	6.0%
Littleton	51		6	2		59	5.4%
Lincoln					52	52	4.8%
Stow		43				43	4.0%
Carlisle				42		42	3.9%
Harvard	9	16	6	5		36	3.3%
Boxborough	4	28				32	3.0%
Hudson		17			4	21	1.9%
Clinton		14	5			19	1.8%
Bolton	2	16				18	1.7%
Westford	6		9			15	1.4%
Chelmsford			5	7		12	1.1%
Wayland					11	11	1.0%
Bedford				10		10	0.9%
Marlborough					9	9	0.8%
Groton	7					7	0.6%
Framingham					3	3	0.3%
Greenfield				2		2	0.2%
Holden	2					2	0.2%
Shrewsbury	2					2	0.2%
Other	6	58	38	3	4	109	10.1%
TOTAL	**89**	**401**	**241**	**178**	**174**	**1083**	

TABLE 9
Autumn 2002 License Plate Surveys:
Park-Riders and Dropoffs by
Town of Vehicle Registration
(AM Peak Period [6 AM to 10 AM])

TOWN OF ORIGIN	Number of Vehicles						
	Littleton	South Acton	West Concord	Concord*	Lincoln	Total	Percent
Acton		171	36	8	4	219	20.9%
Concord		5	48	58	8	119	11.3%
Maynard	1	14	43	3	5	66	6.3%
Littleton	47	6	7	2	1	63	6.0%
Boxborough	10	44	5			59	5.6%
Sudbury		1	5	5	44	55	5.2%
Lincoln				2	49	51	4.9%
Harvard	8	13	5	4		30	2.9%
Stow		26	4			30	2.9%
Westford	15	5	5	5		30	2.9%
Carlisle			1	27		28	2.7%
Hudson		13	3		5	21	2.0%
Boston	2	10	4	1	2	19	1.8%
Wayland				2	17	19	1.8%
Cambridge	1	8	1	1	7	18	1.7%
Clinton	4	10				14	1.3%
Out-of-state plates		6	4		4	14	1.3%
Leominster	1	6	3	1	1	12	1.1%
Marlborough		5	3		4	12	1.1%
Groton	3	1	5	2		11	1.0%
Somerville	1	9				10	1.0%
Watertown		5	3		1	9	0.9%
Bedford		1		7		8	0.8%
Bolton	1	3			2	6	0.6%
Arlington	1	2		1	1	5	0.5%
Belmont		4	1			5	0.5%
Gardner	1	1	3			5	0.5%
Melrose		5				5	0.5%
Newton		2	1		2	5	0.5%
Wellesley		3		1	1	5	0.5%
Other	19	37	14	6	20	96	9.2%
TOTAL	115	416	204	136	178	1049	

*ancillary parking lots at Crosby's Market, Belknap Street and Cottage Street included.

MEMORANDUM

TO: **MAGIC Files** **December 10, 2003**

FROM: **Mary P. McShane**

RE: **Access Alternatives to MAGIC Stations**

This memorandum summarizes information about the potential for shuttle, feeder and other services to connect satellite parking facilities with commuter rail stations, as explored in the report to which it is attached. It is included principally because a separate Task 2 dealing with these issues was requested in the MAGIC Phase II Work Scope. Most of the Task 1 report deals with the identification of potential remote parking locations which might be suitable locations for such access, assuming the parking owners were amenable to such sharing. The best such sites are identified as those within walking distance of train stations, because these would not require an additional transfer by commuters; however, other lots are identified which meet the distance and weekday occupancy criteria specified in the study (i.e., within 1 mile, and relatively sparsely used during weekdays). Most of these latter lots would need to be served by some kind of van or bus connector to and from the train station.

Since the original development of the work program for the MAGIC Phase II study, another study (*Suburban Transit Opportunities,*[1] ongoing) has described in some detail the issues and opportunities associated with operating transit and paratransit-type services in suburban areas in general. That study provides extensive information about suburban services operating both within the Boston Metropolitan Region and throughout the country, and is the best source of information and ideas about feeder and shuttle services. This memorandum summarizes the basic characteristics of shuttle services to train stations as a subset of such suburban operations.

1. Desirable Shuttle Service Characteristics

The two most important characteristics are service reliability and short trip length.

A. Service reliability. This is probably most critical to the success of such a service. Typically, commuter rail services operate at frequencies of one-half hour or more in the peak direction during peak commuting hours, and much lower frequencies (every 1-1/2 to 2 hours) in the off-peak hours. Commuters need to know that any connecting service has a very high probability of reaching a train station in time for

[1] Santa Maria, Steven, et al., *Suburban Transit Opportunities Study*, CTPS, work in progress.

them to transfer to the next available train. Otherwise, they risk missing the train and being forced to wait 15 minutes or more for the next train.

B. **Short trip length**. In order to be certain of meeting each train, station access trips need to be scheduled and routed in such a way that they minimize the amount of likely interference by traffic tie-ups, grade-crossing closures, travel behind school buses and/or heavy trucks, and other events which impact service reliability. Also, shorter shuttle trips may represent less onerous components of the commuter's overall journey than would longer shuttle trips. Finally, a service which can be run reliably with one van or minibus will be considerably less expensive, and therefore more sustainable in the long term, than a service which requires two or more vehicles to meet a given round-trip schedule reliably. For that reason, it is probably true that shorter trips between a satellite lot and the train station will attract more riders. In addition, it may be possible to pick up riders curbside, in addition to park-riders, without incurring unacceptable delays if the shuttle route is short enough. For the parking lot study, we used one mile as the maximum desirable radius for remote lots.

Dedicated services, which travel *only* between the satellite lot and the train station, are probably the best way to operate such shuttle services at least during peak commuter periods. Services can be designed around the train schedules with no other constraints, in order to insure reliability. If the lot is close enough to the station (one-way travel time of up to five minutes), a schedule may not be needed—the vehicle can just shuttle back and forth between the station and the lot. If the lot is located at a greater distance, scheduled departures from the park-ride lot would need to include a comfortable cushion to be sure of meeting each train.

Also, a satellite lot located within a short distance of the train station (five to ten minutes) represents a reasonable choice for the *ad hoc* park-rider (one who arrives at the train station first, finds no available parking, and then searches for an alternative). Lots located at a greater distance from the train station are less likely to be used by such travelers, even if they know where to find such lots: the more likely patrons of such lots will be drivers who anticipate correctly that station parking will already be full, and don't even attempt to drive to the station first.

At non-peak times of the day, vehicles used for commuter shuttle service may go farther afield, serving multiple functions, such as senior transportation to shopping and other activities, after-school student transportation, or other purposes, in order to maximize their use. Based on the MAGIC station parking surveys conducted in 2002-2003, though, it would appear that at present spaces remain available in most of the existing lots until after about 8 AM. If this is so, it may the case that the greatest need for supplementary train station parking occurs late in the peak period (after 8:30 am) or later in the day. To accommodate these travelers, it may be desirable to maintain dedicated shuttle service for a greater part of the day, rather than diverting the vehicles to serve other uses.

Ideally, such services would operate at no, or low, cost to commuters. This would be possible if alternative funding were identified to cover the operating costs of the service. In this event, a charge might be imposed and used to reimburse the parking-lot owner for use of his lot, rather than to pay for the shuttle service. Passes for use of the service might be sold to commuters on a monthly basis, but *ad hoc* use of the service, by persons who choose this alternative after finding station parking fully occupied, should also be encouraged.

2. Likely Operators and Modes of Operation

There is not a lot of experience with shuttle services connecting parking lots and commuter rail stations in the Boston area, from which to draw conclusions about modes of operation; but there is some relevant experience, documented in the recent CTPS *Suburban Transit Opportunities Study*. Based on experience in this region and elsewhere, the most likely originators and operators of these kind of services would be local communities. Local operation allows such services to be monitored directly by local officials, and to be tailored as necessary to meet changing service demands and commuter rail service changes. Local transit-type services which *do* exist in this area, such as the L'Express service in Lexington, the Bedford Local bus, the Concord Community Bus, and others, might serve as the institutional model for developing such shuttle services. One or more local businesses might be approached regarding their willingness to provide financial support for such a service; businesses might be amenable to such support if their employees or customers are potential users of the service.

Vehicles used only for dedicated shuttle service between a train station and remote lot would not require a dispatcher. Vehicles which are deployed to serve other uses may require a dispatcher (who may be the driver himself) for these other uses, and may require advance reservations to be made. This is how the Bedford Local Bus service operates.[2] If two individuals are required to operate dispatched service, the dispatcher might be a town employee, with a volunteer or contracted driver, to maximize service flexibility.

Programs exist through which Federal funds can be requested to purchase vehicles for such services. If towns own the vehicles, they are likely to have greater latitude in scheduling such vehicles and in identifying multiple uses for them. Such vehicles would preferably be small (minibus or van), lift-equipped, and energy-efficient. Drivers might be recruited from town residents; if the peak-period commuter service were combined with mid-day service to seniors or other town residents, the same drivers might be available for both types of service. This kind of operation would certainly be less costly than contracted service with a private operator: estimates of the cost of this latter kind of service, obtained in an earlier study, ranged from about $300 to $600 per day for only part-time (6 hours per day) service.

For such a service to attract many patrons, considerable publicity, signing, and promotion are required. Such publicity would include flyers posted at train stations, ample signing of the route to the satellite parking site, clear and visible identification of the shuttle vehicle, as

[2] Although that service does not begin operation until 9 AM, too late for most commuters.

well as newspaper publicity. Information about the service should be provided on the town website. If curbside pickups are permitted en route, locations where these are allowed should be clearly marked. Amenities, such as coffee and newspapers, might be provided at the satellite parking lot site, if the private owner were amenable. At retail parking sites, such services might be offered by convenience stores to commuter customers in the morning period, while these sites might also benefit in the evening through business from returning commuters. In general, the experience of parking at a satellite lot and riding a connector shuttle should be made as pleasant and reliable as possible in order to attract the maximum number of riders.

As suggested in the full report, it appears that such services are most successful when they have full support and sponsorship within the local communities they serve. The reader is directed to the full *Suburban Transit Opportunities* study for additional information and recommendations about such services. These are general guidelines for such services: the first consideration is the identification of a private parking-lot owner willing to allow shared parking at his site. Once this is accomplished, the specifics of the kind of connecting service required to link this site with the commuter rail station can be determined in more detail.

MEMORANDUM

TO: **MAGIC Files** **Rev. 27 February 2004**

FROM: **Mary P. McShane**

RE: **Proposed Concord—Sudbury Bikeway**

1. Introduction

This memorandum summarizes data-gathering and analysis activities performed in support of the proposed Concord—Sudbury Bikeway project, a proposed reuse of an EOTC-owned railroad right-of-way. The section currently being examined extends from Route 2 west of the Concord Rotary in Concord, to Route 20 in Sudbury, a distance of approximately 8 miles.

The railroad right-of-way (ROW) is a portion of the former Lowell Secondary Line, which extended from Lowell to Framingham, and was in active rail use up until the early 1980s. After service was discontinued, the line was divided into two sections, to be developed separately as trails. The northerly section of the line, between Lowell and Westford, is about 7.5 miles in length. As of this writing, design on that section has been completed and it has been advertised for construction. Construction bids are currently scheduled to be opened on November 25, 2003.[1] Progress on the section between Concord and Sudbury has lagged behind the northerly section until now.

The present memorandum presents a brief update of the Lowell—Sudbury Bicycle Path Feasibility Study of 1987, produced jointly by CTPS, the Metropolitan Area Planning Council, and the Northern Middlesex Area Commission, as it pertains to the section in Concord and Sudbury. The intent of the memorandum is to present current information on traffic volumes and the incidence of crashes on the roadways which intersect the right-of-way in the two towns.

The following two sections explain the general nature of the data that were available. In the fourth section, for each ROW/roadway intersection, a description of the intersection and its vicinity are given and the data on the roadway's traffic volumes and crashes are presented.

[1] As of February 2004, this has not yet happened, but is anticipated within several weeks.

2. Traffic Volumes

The CTPS traffic count database was searched to identify locations for which traffic count data are available at or close to the point of intersection with the right-of-way. Most of the counts obtained were from MassHighway's traffic count program, including special counts and one permanent count station (on Route 2 east of the rotary). A trail would be expected to experience peak activity on weekend days in non-winter months. Unfortunately, most of the traffic counts obtained had been conducted on weekdays, since weekday peak-hour conditions are typically the times of greatest traffic demand.

Hourly traffic demand on weekend days tends to be lower, but it is frequently more continuous than weekday traffic, with high levels often extending throughout the afternoon hours. This is especially true in areas of high commercial activity, such as near shopping centers or in dense downtown areas. However, only the Main Street area in West Concord Village and Route 20 in Sudbury near Sudbury Farms come close to this description within this corridor.

3. Crash Data

Information about the crash history of roadway locations adjacent to the rail corridor was also obtained, from two sources:

a. Massachusetts Registry of Motor Vehicles crash records: These records are based on reports filed by local police departments and persons involved in vehicle crashes. They provide useful summary information on types, times, and general conditions of crashes, although the format allows only limited inferences to be drawn on the specific causes and contributing factors associated with individual accidents. These data were searched to identify all crashes reported on streets intersecting the right-of-way. The five latest years for which data are available (1995 through 1999) were included in the search. The information obtained for each location is summarized in the fourth section of this memo.
b. Police department reports: These are the individual reports stored in local police departments. Each department typically has its own filing system for storing and accessing these reports by location and/or date. The Concord Police Department was visited on March 28, 2003. Attempts to visit the Sudbury Police Department to perform similar crash data analysis were unsuccessful, but the Sudbury Traffic Safety Officer reviewed an earlier draft of this memorandum; his comments are appended. Examination of the individual crash reports is desirable because, compared with the Registry of Motor Vehicles records, these contain much more specific information on the circumstances surrounding each event, and allow more informed inferences to be made, for particular locations, regarding the causes of crashes and potential safety improvements.

4. Intersecting Streets

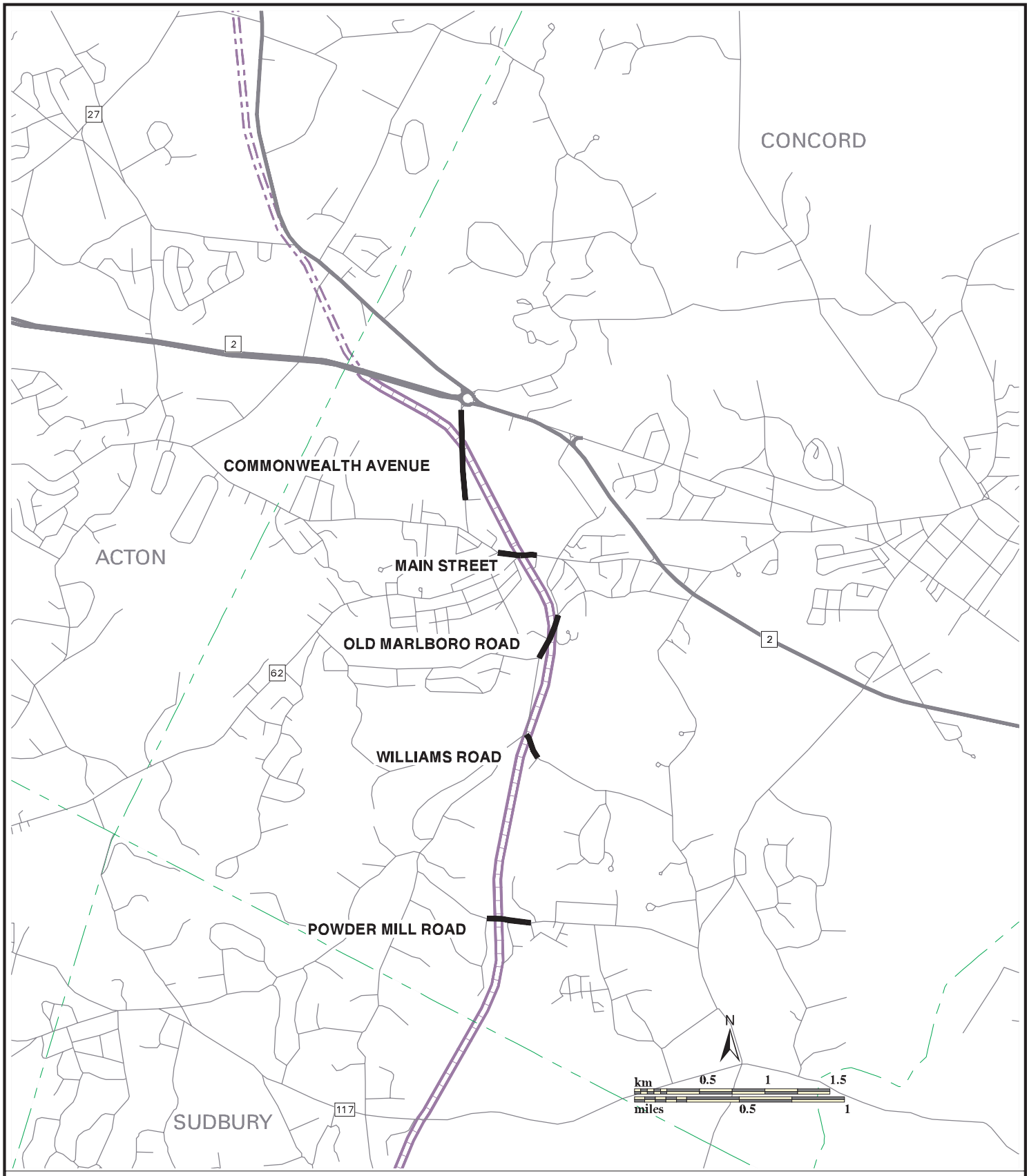
Figures 1 and 2 show the area of the right-of-way and identify the intersecting streets, which are listed in Table 1.

Of these roadways, the one which represents the greatest obstacle is Route 2 in Concord, which is essentially a limited-access roadway in this section, with two lanes in each direction and 6— to 10—foot shoulders on the right side only. Because of its high volumes and high speeds, it is unlikely that Route 2 could be modified to incorporate an at-grade trail crossing. Therefore, it must be assumed *either* that the northern terminus of a north-south trail will stop short of Route 2, *or* that a solution involving grade separation can be incorporated into long-term plans for an upgrade to this section of Route 2.

Discussions of all the roadways south of Route 2 which intersect the proposed trail are presented below.

* * * * *

a. **Commonwealth Avenue, Concord.** This street connects the Concord Rotary with the West Concord Village area. On the section north of Laws Brook Road, there are no shoulders and no defined on-street parking—residents park by straddling the edge of the travel lane and the slightly elevated sidewalk area. The travel lanes appear to be about 15 feet wide. The abutting land uses in this section are primarily single-family homes, as far north as the railroad right-of-way. Just northeast of the right-of-way, the street abuts the Massachusetts Correctional Facility, with parking and ancillary buildings on the northwest side of the street. The horizontal alignment of Commonwealth Avenue is tangent, with no curves; although the railroad right-of-way crosses at an angle, there are no obvious sight distance problems which might represent potential hazards to trail users. The only exception is the short cul-de-sac residential driveway abutting Warner's Pond and meeting Commonwealth Avenue at the railroad crossing, but this is not busy enough to represent an issue. There are no traffic signals between Laws Brook Road and the rotary. The speed limit is 30 mph in this section.



CTPS
MAGIC Subregional Area Study

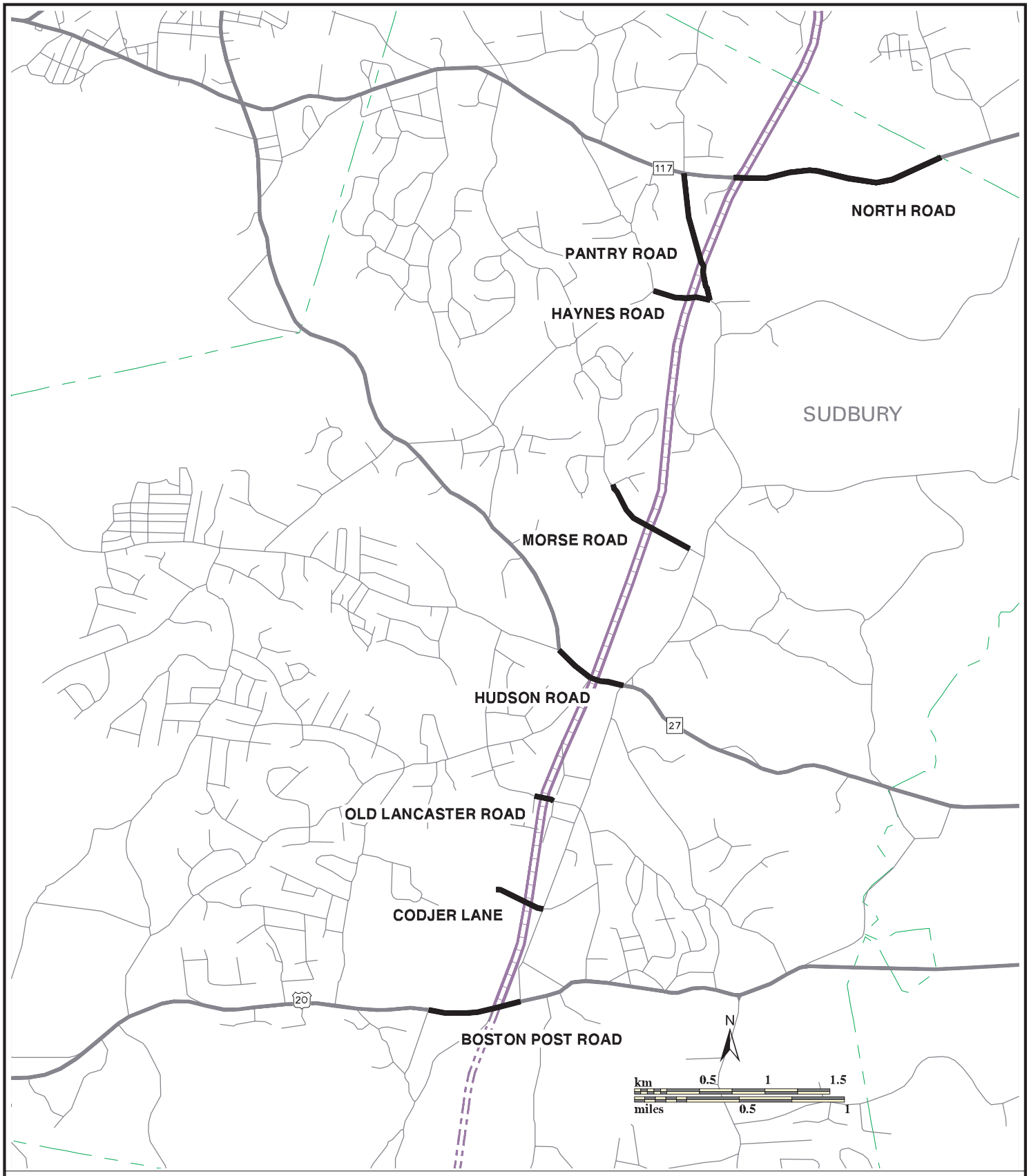
Framingham-Lowell Railroad ROW

Concord-Sudbury portion

Other ROW segments

Figure 1
Framingham & Lowell ROW--Intersecting Streets, Concord

March 03, 2004 /lycon/tadwork/magic/s62102/amls/pl_m2-01bik.aml



CTPS
MAGIC Subregional Area Study

Framingham-Lowell Railroad ROW

Concord-Sudbury portion

Other ROW segments

Figure 2
Framingham & Lowell ROW--Intersecting Streets, Sudbury

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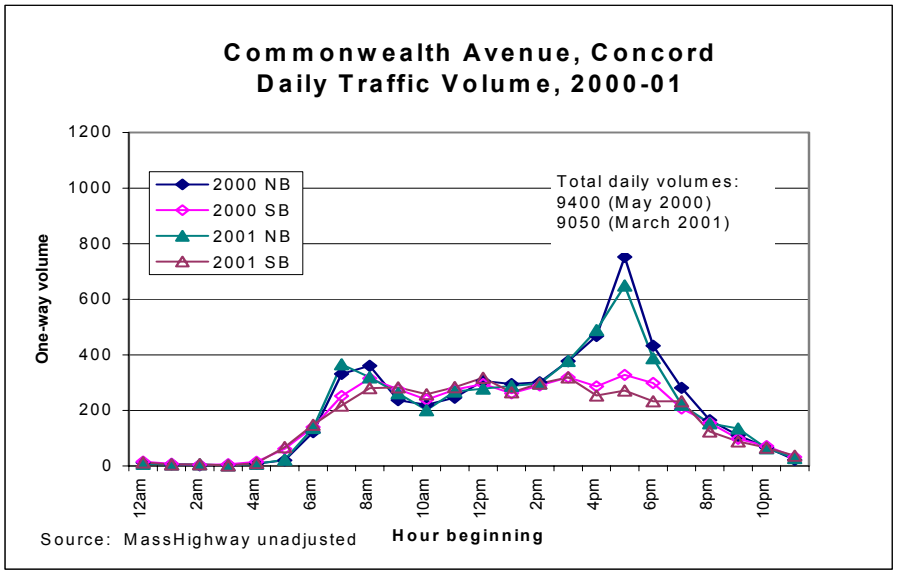
TABLE 1
Roadways Crossed by Concord—Sudbury Right-of-Way

	Administrative System (Jurisdiction)	Functional Classification	No. of Travel Lanes	Posted Speed Limit, mph
CONCORD				
Common-wealth Ave	Town	Urban collector	2	30
Main St	Town	Urban extension of rural minor arterial	2	25
Old Marlboro Rd	Town	Urban collector	2	30
Williams Rd	Town	Local	2	30
Powder Mill Rd	Town	Local	2	20
SUDBURY				
North Rd	Town	Urban minor arterial	2	40
Pantry Rd	Town	Urban collector	2	30
Haynes Rd	Town	Urban collector	2	25
Morse Rd	Town	Local	2	25
Hudson Rd	Town	Other urban principal arterial	2	30
Old Lancaster Rd	Town	Urban collector	2	30
Codjer Lane	Town	Local	2	25
Boston Post Road (Route 20)	MassHighway	Urban extension of rural minor arterial	2	35

Traffic volumes: MassHighway traffic counts were performed on Commonwealth Avenue, Concord in May 2000 and March 2001. The graph below illustrates the daily variations observed during these counts: high northbound volumes are noteworthy in the evening peak hour, with a slight morning peak in the same direction; at non-peak times, volumes are fairly steady, at about 300 vehicles per hour in each direction. The total daily volume in both directions is between 9,000 and 9,500 vehicles.

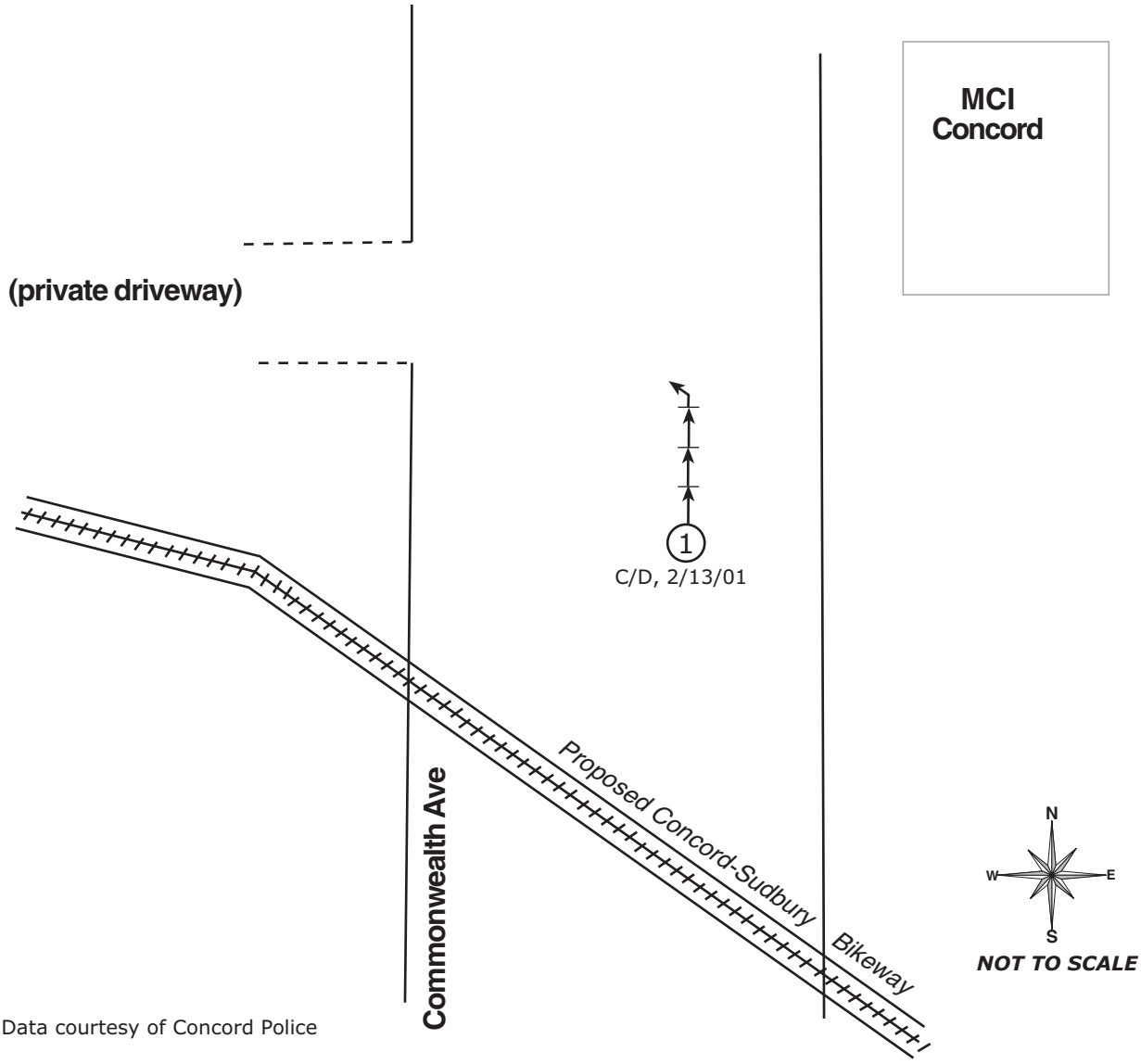


Crash data: Police data for this location identified only one accident over the three-year period 1999 to 2002, directly adjacent to the railroad right-of-way—a multiple-vehicle rear-end collision which occurred in 2001 (see Figure 3). The state Registry data can't easily be focused to consider only the immediate vicinity of the right-of-way.

However, *all* crashes occurring on this section of Commonwealth Avenue and *not* ascribed to a particular intersection were obtained from the database, and are summarized in Table 2. The street is approximately 3,100 feet in length, so many of these are probably located some distance away from the right-of-way.

Most crashes for which information is available involved turning or parking vehicles: either rear-end collisions when one vehicle had stopped to turn, or angle collisions between through and turning or parking vehicles. This suggests at least that ample warning signs should be placed some distance in advance of a trail crossing in both directions, and possibly that additional control might be warranted here to accommodate trail users.

Figure 3
Collision Diagram
Commonwealth Ave S of Rotary
Concord



Data courtesy of Concord Police

SYMBOLS	TYPES OF COLLISIONS	ROAD SURFACE/LIGHTING
Moving Vehicle	Head On	C Dry, Clear
Backing Vehicle	Angle	W Wet
Pedestrian	Rear End	S Snowy, Icy
Parked Vehicle	Sideswipe	O Other
Injury	Broadside	D Daylight
Fatality		N Dark/No Lights
Fixed Object		L Dark/Lighted
Out of Control		
(#) Number of Accidents		

CTPS

TABLE 2
Commonwealth Avenue, Concord
5—Year Vehicle Crash Summary

	Type of Crash				
	Unknown	Rear-End	Angle	Head-on	TOTAL
1995	3	5	4		12
1996	2	5	3		10
1997	2	1	6		9
1998	1	3	4	1	9
1999	1	3	4		8
TOTAL	9	17	21	1	48

b. **Main Street, Concord**. The point where the right-of-way crosses Main Street is just east of the intersection of Main Street and Commonwealth Avenue, and about 50 feet west of the entrance to the West Concord Plaza shopping center. This is one of the busiest commercial locations in Concord, on both weekdays and weekends. Main Street through this area is narrow because two lanes are provided on the westbound approach to Commonwealth Avenue. There is no on-street parking in front of West Concord Plaza and the fire station, but Commonwealth Avenue west of the intersection has on-street metered parking on both sides of the street. There appears to be frequent turnover at these parking spaces. In addition, the presence in close succession of driveways serving the shopping center, the West Concord fire station, Westgate Park and other uses complicates operations in this short stretch of roadway. The intersection of Main Street and Commonwealth Avenue is signalized, with sidewalks and pedestrian crosswalks on all approaches; and pedestrian activity appears to be considerable here.

At present, the former rail right-of-way is not marked on the street or within the area it traverses between the principal West Concord commuter rail lot and the south side of Main Street. However, its path can be followed: through the commuter rail lot, across the most easterly pedestrian crossing of the commuter rail track, through the small park area between the Club Car Café and the shopping plaza parking lot, across Main Street at the crosswalk, and in between the Exxon station and the Hamwey & Sons carpet store on the south side of Main Street. The traffic light at the Commonwealth Avenue/Main Street intersection is already equipped with a pedestrian call button, so that only minimal additional traffic control would be required.

Traffic volumes: There are no traffic counts in existing databases for this location.

Crash data: Figure 4 displays the results of analysis of data obtained from Concord Police records for this location. As the diagram makes clear, there is a great deal of

activity at this location, offering many opportunities for vehicle conflicts with pedestrians, cyclists, and other vehicles. The single location where many of these conflicts occur is at the entrance to the West Concord Plaza. At this location, a total of 8 incidents were recorded in police files over a three—year period, including 1 collision between a vehicle exiting the plaza driveway and a cyclist traveling the wrong way on Main Street. West of this location, about where the right-of-way crosses Main Street almost within the intersection with Commonwealth, there are fewer incidents; and those that were recorded appeared to involve rear-end collisions at the traffic signal.

Data were also obtained from the Registry crash database for the years 1995 through 1999 for the intersection of Commonwealth Avenue and Main Street, and for the entrance to the West Concord Plaza. As discussed above, these data are more difficult to pinpoint to exact locations and causes than are the police forms. However, they do provide an overview of the kinds and severity of crashes in the vicinity. Table 3 summarizes the findings of that data review.

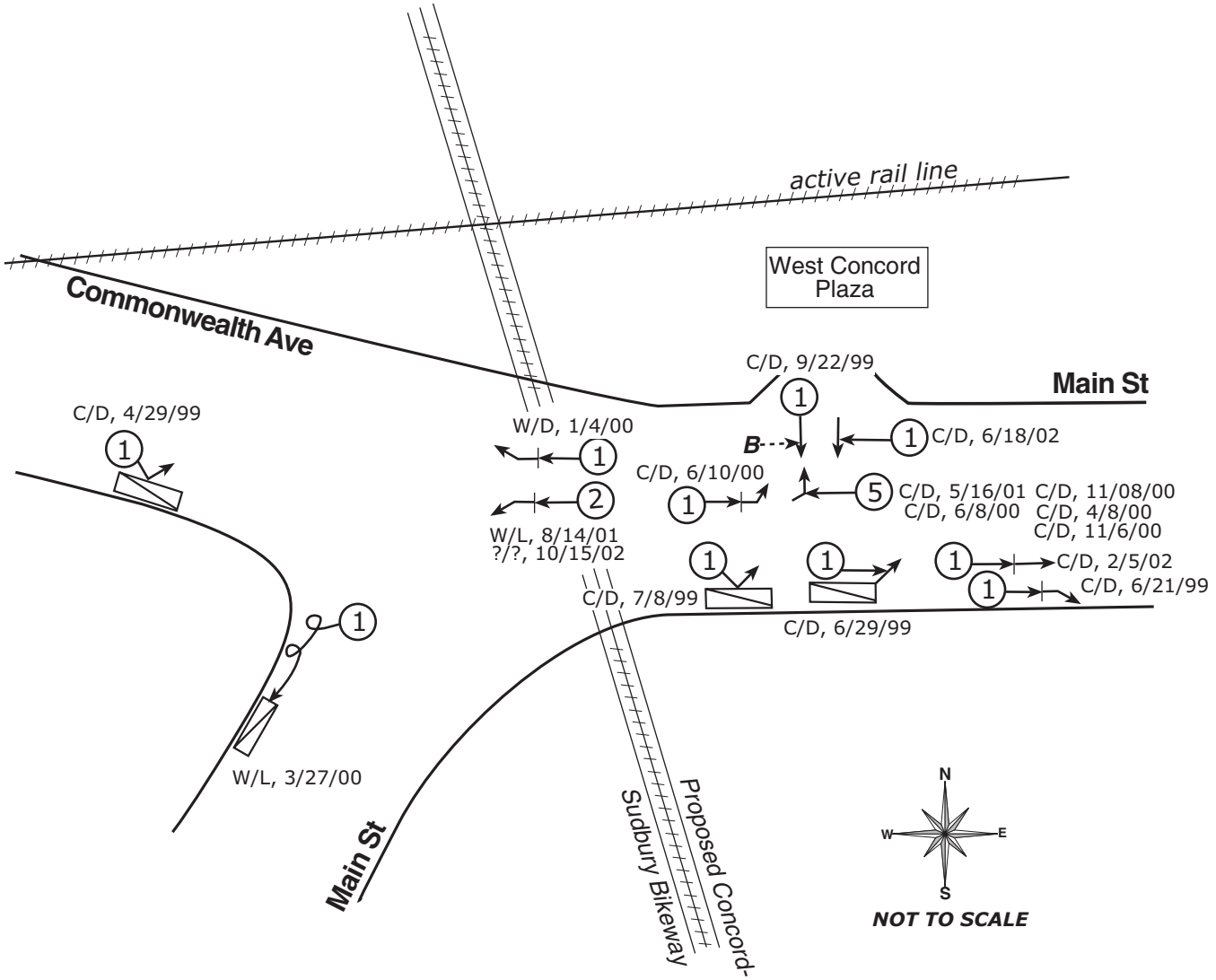
TABLE 3
Commonwealth Avenue at Main Street, Concord
5—Year Vehicle Crash Summary

	Type of Crash				
	Unknown	Rear-End	Angle	Head-on	TOTAL
1995		2	2	1	5
1996	1	1			2
1997		3	4	1	8
1998	1	5	7		13
1999	2	7	6		15
TOTAL	4	18	19	2	43

Of the 43 incidents in the database, 7 involved collisions with parked vehicles, 1 involved a pedestrian, and 1 a bicycle (as mentioned above). Eight occurred on a wet roadway surface, so that they may have involved skidding. In this busy area, with heavily-used on-street parking, frequent pedestrian activity, and no room to alter the roadway profile, there is little that can be done to reduce such conflicts.

c. **Old Marlboro Road, Concord.** The right-of-way crosses Old Marlboro Road on a sharp angle at a point just south of the road's intersection with Cottage Street. The crossing is adjacent to the driveway of South Meadow Ridge, a residential development located on the crest of a hill, with a long driveway connecting to Old Marlboro Road.

Figure 4
Collision Diagram
Main St at Commonwealth Ave (West Concord)



Data courtesy of Concord Police

B⇢ = bicycle, riding against traffic

SYMBOLS	TYPES OF COLLISIONS	ROAD SURFACE/LIGHTING
Moving Vehicle	Head On	C Dry, Clear
Backing Vehicle	Angle	W Wet
Pedestrian	Rear End	S Snowy, Icy
Parked Vehicle	Sideswipe	O Other
Injury	Broadside	D Daylight
Fatality		N Dark/No Lights
Fixed Object		L Dark/Lighted
Out of Control		
(#) Number of Accidents		

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On the south side of the road, the right-of-way skirts the base of the hill and continues southward across a private unpaved road that appears to provide access to the Concord Country Club. Old Marlboro Road in this area is a two-lane suburban arterial street, with narrow shoulders, no parking, and relatively few intersecting streets. There are intermittent sidewalks on the west side of Old Marlboro Road as far south as Harrington Road. The street has horizontal curves both north and south of the crossing. This fact, combined with the density of vegetation and the gradual upward slope of the terrain from north to south, suggests that ensuring adequate sight distance for oncoming vehicles would be a primary objective in the design of a future trail crossing here. Old Marlboro Road is posted for 35 mph speeds south of Harrington Road and 25 mph near Cottage Road.

Traffic volumes: There are no traffic counts in existing databases for this location.

Crash data: Police records for this location showed a total of 3 crashes in this area during the period 1999 through 2002 (Figure 5). All 3 were rear-end collisions in which vehicles waiting to turn left onto Cottage Street were struck from behind by through vehicles; one such rear-end crash involved three vehicles. The most likely factors associated with these collisions were high speeds and limited sight distance because of the roadway curve. There is a "Blind Driveway" warning sign facing northbound Old Marlboro Road drivers just before Cottage Road. While 3 crashes in a period of three years do not in themselves present a major safety issue, the types of crashes suggest the desirability of paying attention to both roadway speeds and sight distance in design of a trail crossing.

The Registry database does not list any incidents at this location for the years 1995 through 1999.

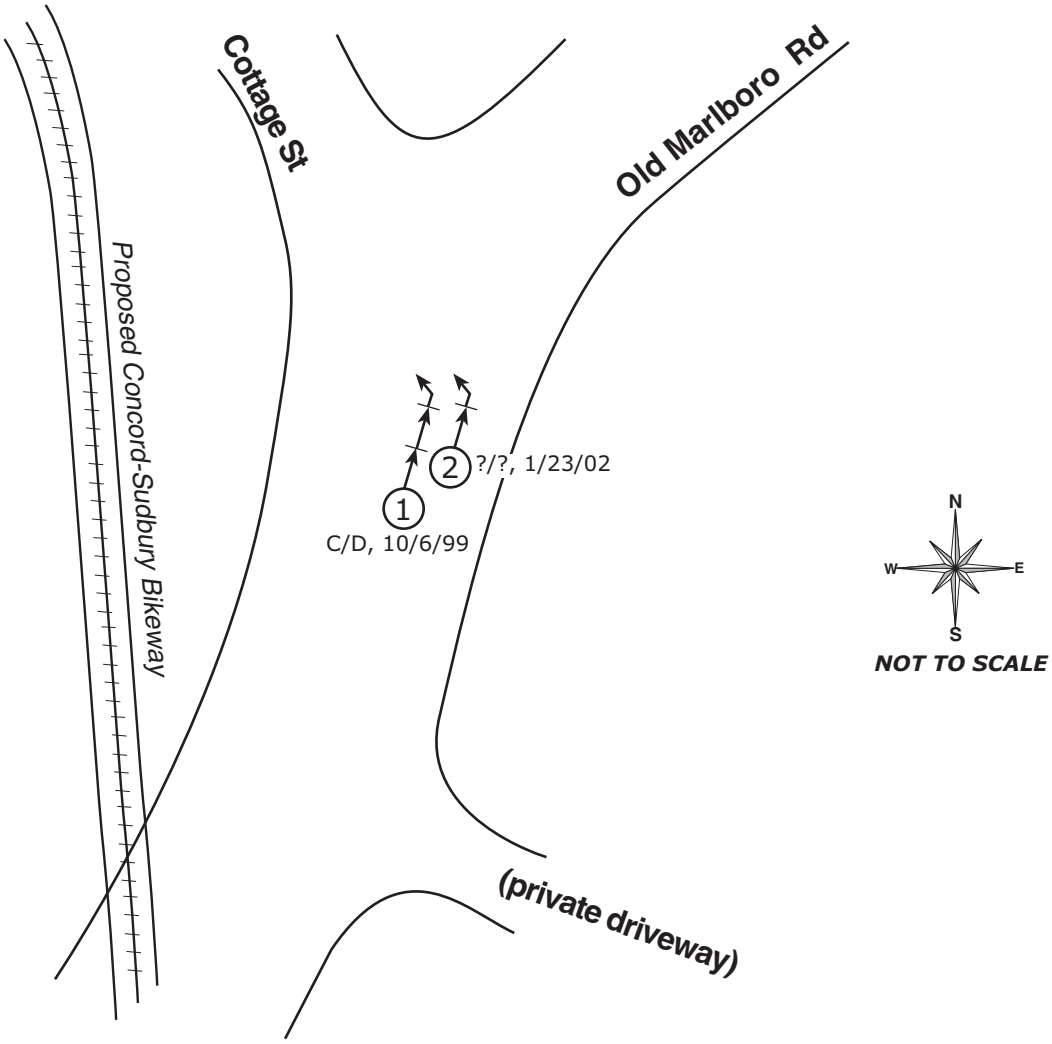
d. **Williams Road, Concord**. The right-of-way crosses Williams Road just south of its intersection with Old Marlboro Road, and just north of the intersection of Williams Road and the driveway of a private residence. The horizontal curvature of Old Marlboro Road is considerably more pronounced at this location than is the curvature farther north at South Meadow Ridge, but this should represent less of an issue for trail users making the crossing at Williams Road. The Williams Road approach to Old Marlboro Road is not striped or marked—there is no stop line on Williams Road, for example, although there is a stop sign.[2] This is an issue on a minor suburban roadway only because Old Marlboro Road is sharply curved at this point. Williams Road itself is a residential collector street which connects the arterial streets Old Marlboro Road and Old Road to Nine Acre Corner (ORNAC). Both Old Marlboro Road and Williams Road in this area are posted for 30 mph speeds. The area Williams Road traverses is of low density, so that traffic volumes are low. There are several golf courses in the area, including the Concord Country Club, so that weekend traffic on Williams Road may be similar to that on weekdays.

[2] Old Marlboro Road in this area has recently been repaved, and it may be intended to add pavement markings in the area of Williams Road.

Figure 5

Collision Diagram

Old Marlborough Rd at Cottage St, Concord



Data courtesy of Concord Police

SYMBOLS	TYPES OF COLLISIONS	ROAD SURFACE/LIGHTING
Moving Vehicle	Head On	C Dry, Clear
Backing Vehicle	Angle	W Wet
Pedestrian	Rear End	S Snowy, Icy
Parked Vehicle	Sideswipe	O Other
Injury	Broadside	D Daylight
Fatality		N Dark/No Lights
Fixed Object		L Dark/Lighted
Out of Control		
Number of Accidents		

CTPS

Traffic volumes: No traffic count data exist for the Old Marlboro Road/Williams Road intersection or for Williams Road itself. However, for reasons mentioned above, it is unlikely that volume on Williams Road exceeds three or four thousand vehicles per day, typical of suburban collector streets.

Crash data: A total of 3 crashes were recorded by the Concord Police at this location between 1999 and 2002 (Figure 6). All 3 involved single vehicles going out of control on the curve of Old Marlboro Road. While the crashes didn't directly involve Williams Road or the proposed trail alignment, they signal the existence of speed and sight distance issues on Old Marlboro Road. Because the Williams Road approach essentially flows into Old Marlboro with little channelization or definition, these issues also affect this approach.

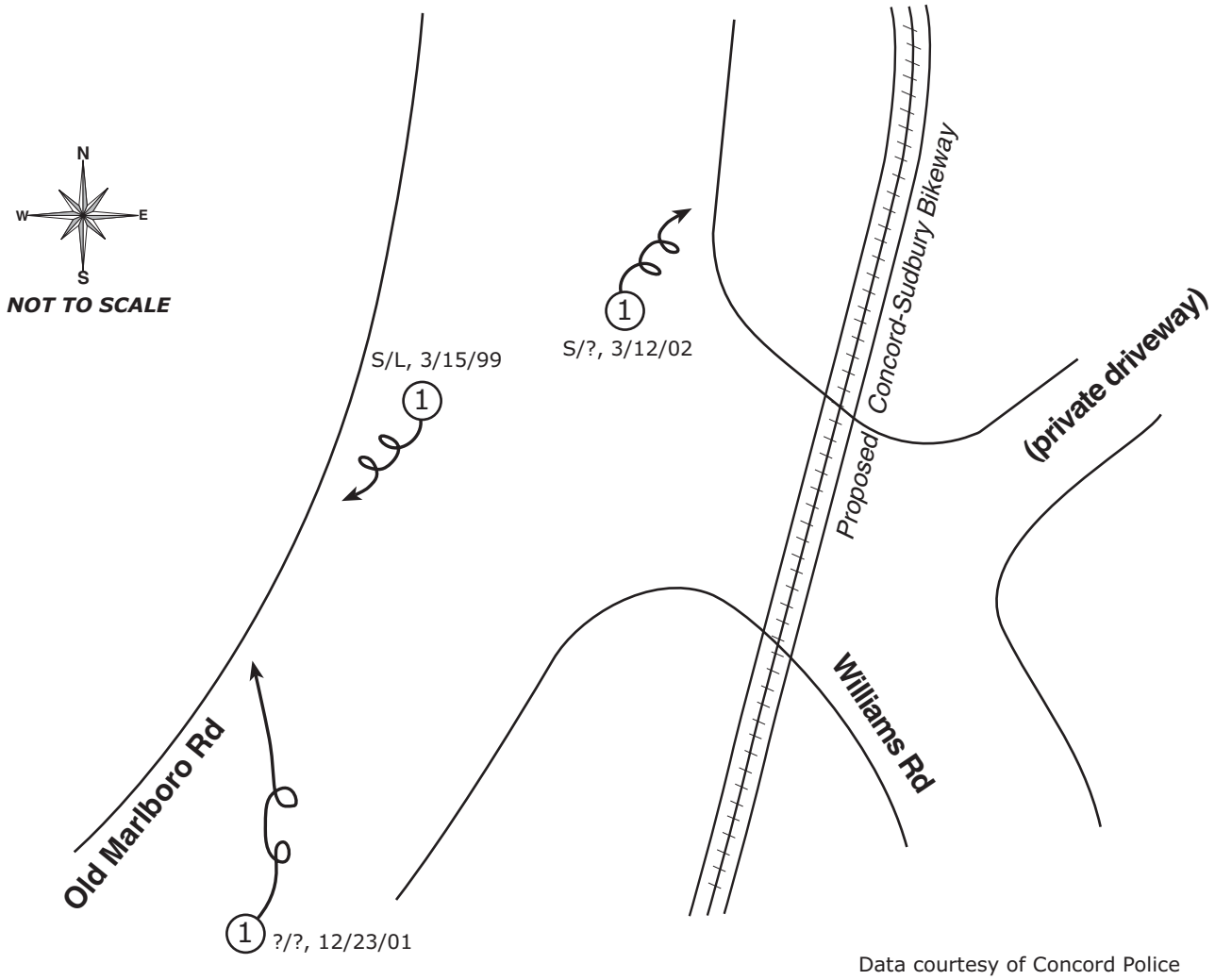
The Registry data show a total of 5 crashes at this location over the period 1995 through 1999. Of these, 2 involved multiple vehicles, while 2 others involved single vehicles losing control and hitting trees or curbing. Two of these collisions happened at dusk or after dark, while two occurred on wet pavement. Table 4 summarizes the crash types at this location.

TABLE 4
Old Marlboro Road at Williams Road, Concord
5—Year Vehicle Crash Summary

	Type of Crash				
	Unknown	Rear-End	Angle	Head-on	TOTAL
1995			1	1	2
1996	1				1
1999			1	1	2
TOTAL	1		2	2	5

e. Powder Mill Road, Concord. This location is not an at-grade crossing: Powder Mill Road crosses over the right-of-way on a bridge. Two short residential streets flank the right-of-way on the south side of the road: Mitchell Road/White Avenue and Stone Root Lane. It is not clear if access to the trail could be provided at this location; it may be easier to do this via Plainfield and Dover Roads and the town-owned land south of White Pond. Powder Mill Road itself is a narrow, primarily residential street with no shoulders, posted for 30 mph along most of its length, except near the bridge over the railroad right-of-way (20 mph). It has no sidewalks west of the bridge, but a sidewalk exists across the bridge on the north side and beyond. Like Williams Road, it carries limited traffic, principally providing access for local residences and schools, as well as access to White Pond.

Figure 6
Collision Diagram
Old Marlborough Rd at Williams St
Concord



Data courtesy of Concord Police

SYMBOLS	TYPES OF COLLISIONS	ROAD SURFACE/LIGHTING
Moving Vehicle	Head On	C Dry, Clear
Backing Vehicle	Angle	W Wet
Pedestrian	Rear End	S Snowy, Icy
Parked Vehicle	Sideswipe	O Other
Injury	Broadside	D Daylight
Fatality		N Dark/No Lights
Fixed Object		L Dark/Lighted
Out of Control		
(#) Number of Accidents		

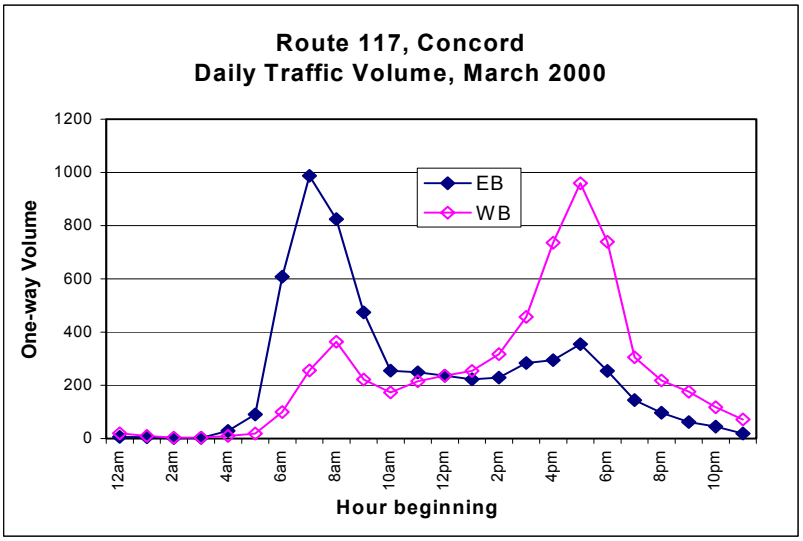
CTPS

Traffic volumes: There are no traffic counts in existing databases for this location.

Crash data: No records of crashes on Powder Mill Road were found either in the Concord Police files or in the Registry database.

f. **North Road, Sudbury**. The most northerly crossing in Sudbury is of North Road, which is Route 117. Route 117 is a town-owned roadway which serves as an important east-west arterial serving towns in this area. It has no shoulders or sidewalks, and there are trees and telephone poles very close to the paved way, with sloping terrain on both sides of the roadway. The speed limit on Route 117 at this location is 40 mph. A private road has been constructed immediately adjacent to the right-of-way north of North Road; it crosses the track, which is still partly in place, approximately 1,200 feet north of North Road, to provide access to land owned by the "Fairview Development Corporation." On the southern side of the road, the right-of-way again traverses wooded areas (the Davis Farm conservation land) as far as the next intersection.

Traffic volumes: There are no counts available to us for Route 117 in Sudbury; but a MassHighway count location on Route 117 in Concord over the Sudbury River is approximately 2 miles east of the railroad right-of-way crossing. Volumes here are likely to be similar to those at the more westerly location, or possibly a bit higher. The graph below illustrates the strongly directional nature of traffic volumes on Route 117: almost 80 percent of the volume in the morning peak hour is headed eastward, while 74 percent of the evening peak hour volume is traveling west. It also illustrates that this is



predominantly a commuter route: traffic volumes fall to relatively low levels outside of peak commuting hour, and the daily peak hour (5:00 to 6:00 PM) represents 11 percent of total daily volume.[3] The total daily volume is about 11,700 at the Concord location.

As mentioned above, weekend traffic count data are particularly difficult to find in existing sources. However, the ATR count performed by MassHighway at the Route 117 Concord location included a Saturday morning. That partial-day count appeared to exhibit the same tendency toward a short, sharp AM eastbound peak hour as did weekday traffic, with an hourly volume of 1,000+ vehicles recorded in the eastbound direction. Whether this was an anomaly, or represented typical Saturday morning conditions, is unknown. Also, no afternoon data exist, so it is not clear that the high westbound PM peak hour traffic phenomenon also repeats on Saturdays at this location.

Crash data: Because no crash records could be tied to the location on North Road where the proposed trail crosses, Registry data were queried to identify records on North Road for which no cross-street was identified. This obviously overrepresents the likely experience of incidents in the vicinity of the crossing, but it may give a sense of the general magnitude and types of vehicle crashes typically occurring on the road. In addition, the intersection of North Road with nearby Pantry Road was also queried.

Of the 33 incidents recorded on North Road itself between 1995 and 1999, 15 involved collisions between motor vehicles in transit. Most of the remainder, however, were collisions with fixed objects adjacent to the road or represented vehicles which simply went off the road or overturned. It is possible that high speeds were associated with some portion of these latter incidents, particularly because over one-third of them involved injuries in addition to property damage. In addition, about one-third of the incidents occurred in wet or snowy weather, suggesting that skidding may have contributed to the damage. The narrowness of the pavement and the lack of horizontal clearance on both sides of the roadway are undoubtedly also contributing factors.

At the intersection of North and Pantry Roads, 2 of the 20 incidents recorded were rear-end collisions; the remainder were all angle collisions between motor vehicles. None involved pedestrians or cyclists. Vehicles involved in these incidents typically were turning right or left, were stopped at stop signs, or were starting up after having stopped. Without further information on sight distances and traffic control, it is difficult to establish likely contributing factors to these incidents; but high speeds are probably involved in some or all of them. About half appear to involve vehicles heading in the eastward direction, impacting vehicles heading northward or westward. Here too, wet roadway conditions appear to have contributed to about one-third of the reported crashes.

g. **Pantry Road and Haynes Road, Sudbury**. These are two crossings located within 500 feet of each other. Both streets are two-lane suburban streets: Pantry Road in Sudbury

[3] This compares with typical peak-hour factors between 5 and 8 percent on roadways with more constant traffic flows throughout the day. Such roads usually have schools, shopping areas, and other activities which tend to generate traffic at non-peak hours.

is the extension of Old Marlboro Road in Concord and shares the characteristics of that roadway: no sidewalks, no or narrow shoulders, trees and telephone poles very close to the paved way. Haynes Road is a short, residential street which also provides access to the Haynes Elementary School. The posted speed limits on Pantry and Hayes are 30 and 25 mph, respectively. Neither street appears to present problems for future crossings of a trail.

Traffic volumes: There are no traffic counts in existing databases for these locations.

Crash data: The Registry database was queried to obtain crashes on Pantry Road, on Haynes Road, and at the intersection of Pantry and Haynes. No particular geometry or operational problems could be identified from the additional information regarding these incidents (i.e., weather, speed, geometry or other issues). Table 5 summarizes the crash incidence for these locations. Note again that the data for Pantry Road and Haynes Road represent any locations along either street where no cross street or landmark was identified—they do not represent just the crossing area itself.

TABLE 5
Pantry Road/Haynes Road Area,* Sudbury
5—Year Vehicle Crash Summary (1995—1999)

	Type of Crash				
	Unknown	Rear-End	Angle	Head-on	TOTAL
Pantry Rd	5		3	1	9
Haynes Rd	7		1	1	9
Intersec-tion of Pantry at Haynes	2	5	1	3	11
TOTAL	14	5	5	5	29

*Data not restricted to immediate vicinity of the proposed trail ROW; see explanation in text.

h. **Morse Road.** Like Haynes Road, Morse Road is a short street with no sidewalks or shoulders, essentially providing access to local residents. Because of the proximity of the General Nixon School, as well as the Lincoln—Sudbury High School and Great Meadows National Wildlife Refuge, all on the east side of Concord Road, this location may become an important point of access to a future trail.

Traffic volumes: There are no traffic counts in existing databases for this location. Because of the nature of the road, it is anticipated that volumes will be typical of those

for residential collector roadways, not exceeding about six to eight thousand vehicles per day.

Crash data: Because the grade crossing is located somewhat away from the intersection with Concord Road, only crashes listed as occurring on Morse Road with no cross-street were tabulated. As with other such tabulations, the data thus obtained represent the entirety of Morse Road, not just the crossing location. The crashes reported during the five-year period were all angle crashes, and a large number of them (11 out of 20) involved single vehicles which ran off the road, hitting a fixed object. This is most likely attributable to the sharp curves which occur at several points on the road, including a reverse curve which begins just west of the grade crossing. As with locations in Concord, sight distance is likely to be an issue here. A future at-grade trail crossing will need to be provided with advance signing, particularly for eastbound vehicles in the vicinity of Hilltop Road. Table 6 summarizes the crash data for this location.

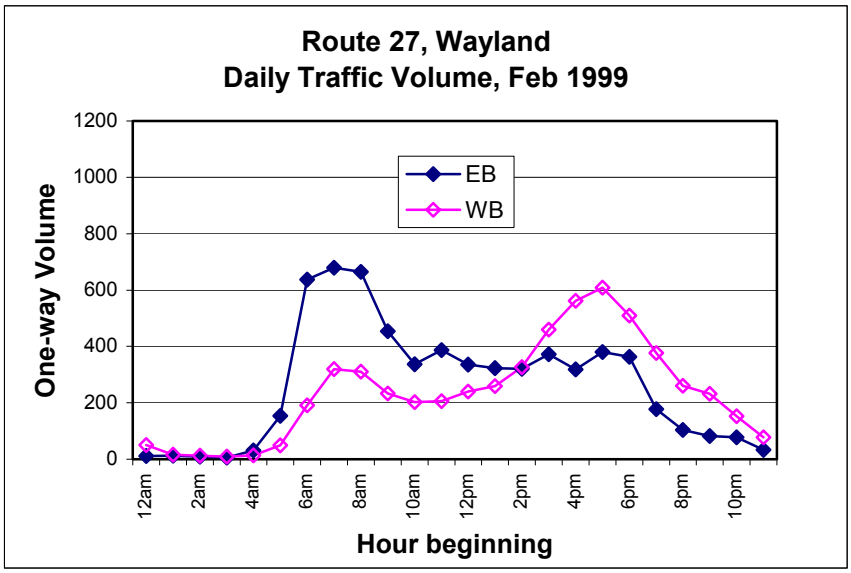
TABLE 6
Morse Road, Sudbury
5—Year Vehicle Crash Summary

	Type of Crash				
	Unknown	Rear-End	Angle	Head-on	TOTAL
1995	2		1		3
1996	3		2		5
1997			1		1
1998	3		1		4
1999	5		2		7
TOTAL	13		7		20

i. **Hudson Road.** Hudson Road is Route 27, a major arterial street connecting Sudbury and Wayland with Route 20 and the regional road network. Hudson Road has two lanes, has narrow shoulders, and is posted at 30 mph near the crossing. There are limited sidewalks only on the south side. The railroad right-of-way crosses Hudson Road immediately east of the intersection of Route 27 and Peakham Road, adjacent to the exit driveway from a small retail area (Village Green Shops). It is also about one thousand feet west of the Hudson Road/Concord Road signalized intersection, where the Sudbury Town Hall is located. The principal issues associated with a crossing at Hudson Road are likely to be traffic speeds on Hudson Road and the avoidance of conflicts with vehicles turning right from Peakham Road or exiting the shopping center. This is another location where it might be worth investigating deviating from the right-of-way. Consolidating trail user movements into traffic movements from the Village Green driveway or Peakham Road, would minimize the number of adjacent crossing points on Hudson Road and allow for safer operation.

Traffic volumes: There are no traffic counts on Route 27 in Sudbury or Maynard. The closest count is north of Route 126 in Wayland. Volumes on Route 27 fluctuate a great deal depending on location and the presence of feeder routes. The location north of Route 126 in Wayland (average 1999 daily traffic volume: 11,600) is likely to be more representative of conditions in Sudbury than are other count locations south of Route 126 (average 1999 daily traffic volume: 25,000), or south of Route 20 (average 1999 daily traffic volume: 16,400).

The graph below shows the daily fluctuation in weekday traffic volumes at the Wayland location. Route 27 at this location serves commuter traffic which creates noticeable peaks in the morning (eastbound direction) and evening (westbound direction). This is also true of the crossing location in Sudbury. Beyond the commuter peaks, volumes in each direction did not exceed 400 vehicles per hour in 1999.



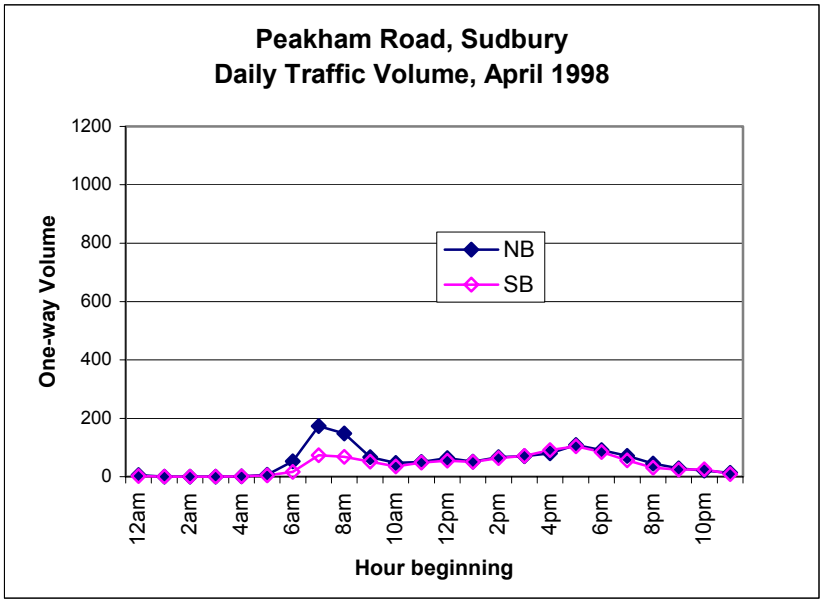
Crash data: There are no crashes listed in the database for Hudson Road, except at the intersection with Old Lancaster Road, an unsignalized intersection about one mile west of the crossing. At Old Lancaster Road, 12 incidents were recorded during the five-year period examined, of which 5 were rear-end collisions; the remainder were angle collisions. Almost all incidents involved two motor vehicles, and no pedestrians or cyclists were involved in any of them.

j. **Old Lancaster Road.** Old Lancaster Road is primarily a residential street with no sidewalks or shoulders which connects Union Avenue/Concord Road with Hudson Road. The posted speed limit on the street is 30 mph. The railroad right-of-way crosses Old Lancaster Road approximately one thousand feet west of Union Avenue/Concord Road, close to several homes and sheltered on both sides by trees. The horizontal alignment of Old Lancaster Road in this area is fairly straight, so that sight distance should not be a major issue here as long as the crossing is properly signed. Old

Lancaster Road does have a sharp horizontal curve about a thousand feet west of the crossing, in the vicinity of the Town Engineering Department; in addition, Old Lancaster Road is not aligned as a through street at its intersection with Union Avenue/ Concord Road. West of the crossing and the curve, Old Lancaster Road meets Peakham Road in a four-way stop-sign-controlled intersection which has limited sight distance.

Traffic volumes: No traffic count data are available for Old Lancaster Road. However MassHighway has a count location on Peakham Road north of Austin Road, where conditions are similar to those on Old Lancaster Road. The Peakham Road location was counted in 1998 (average daily traffic: 2,100) and 2001 (average daily traffic: 1,500). The graph below shows the daily fluctuation in the 1998 volume: volumes stay below 200 vehicles per hour in each direction for most of the day at this location. This is most likely true of Old Lancaster Road as well.

Crash data: As discussed above, Old Lancaster Road in the immediate area of the right-of-way crossing does not have sharp curves, and the view of the right-of-way is not completely obscured by trees. Consequently, use of the right-of-way as a trail should not generate safety concerns, as long as the approach is adequately signed.



Review of the Registry crash database for Old Lancaster Road did unearth a total of 47 crash incidents over the five-year period; however, almost all of these occurred at nearby intersections, with few, if any, located near the grade crossing.[4] Table 7 presents the total numbers of crash incidents at different locations on Old Lancaster Road.

[4] For reasons discussed above, it is impossible to say definitively that there were no crashes near the crossing, because RMV data typically do not provide precise enough location identifiers away from intersections and easily-identifiable and citable land uses. However, the number of crashes reported at *any* location on Old Lancaster Road away from intersections is not high.

k. **Codjer Lane**. At one time, Codjer Lane was reportedly a through street connecting with Horse Pond Road. In recent years, however, the portion west of the right-of-way has served effectively as a driveway for the Cavicchio Greenhouse property, while the remainder of the street provides residential access for a small number of houses. Consequently, there is no through traffic on the street. Traffic volumes and safety will not be major concerns at this location.

Traffic volumes: There are no traffic counts in existing databases for this location.

TABLE 7
Old Lancaster Road, Sudbury
5—Year Vehicle Crash Summary
at All Reported Locations (1995—1999)

	Type of Crash				
	Unknown	Rear-End	Angle	Head-on	TOTAL
Old Lancaster/Colonial Rd	1	0	0	0	1
Old Lancaster/Concord Rd	0	5	6	0	11
Old Lancaster/Goodmans Hill Rd	2	0	0	0	2
Old Lancaster/Hudson Rd	2	5	5	0	12
Old Lancaster/Meadow Dr	1	0	1	0	2
OldLancaster/Peakham Rd	1	0	3	0	4
Old Lancaster/Pokonoket Rd	1	0	0	0	1
Old Lancaster/Winsor Rd	1	0	0	0	1
Old Lancaster (no cross st.)	9	0	2	2	13

Crash data: The only crash records which appear in the Registry database for Codjer Lane are at its intersections with Union Avenue (a total of 9 reported) and Concord Road (1 reported). Of the Union Avenue crashes, 3 were rear-end collisions and 1 was an angle collision; the rest were not identified. These intersection accidents are most likely associated with limited sight distance from Codjer Lane onto Union Avenue, and relatively high speeds on Union Avenue.

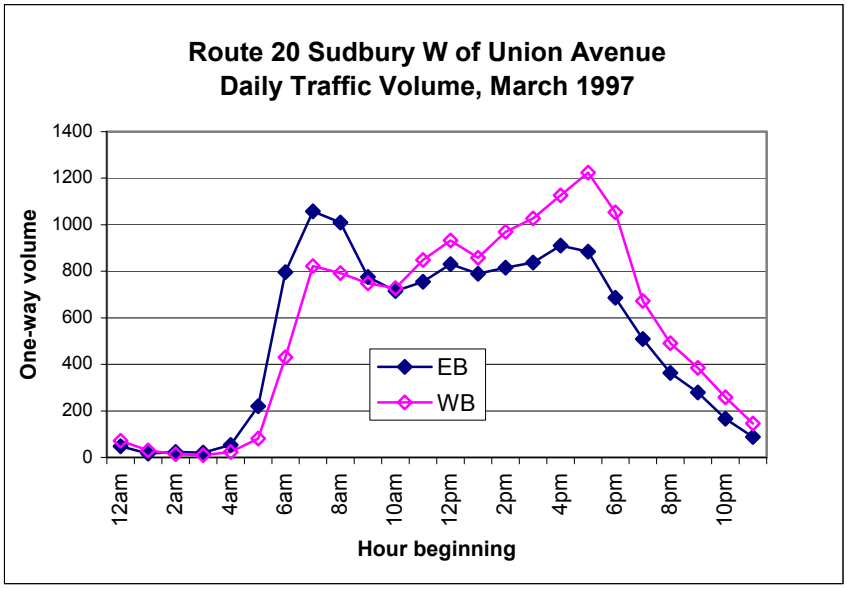
l. **Route 20 (Boston Post Road)**. Route 20 is a major arterial, with one lane in each direction in Sudbury, which provides access to the regional roadway network for Sudbury and adjoining towns. The railroad right-of-way crosses Route 20 immediately east of the newly-signalized intersection with Nobscot Road, and just west of the driveway/entrance area of a shopping center on the south side of Route 20 (Sudbury Farms/Friendly's). This location has high traffic volumes and conflicting traffic movements associated with its proximity to both the busy intersection with Nobscot Road and the numerous driveways in the area. These include, in addition to Sudbury

Farms/Friendly's, a house-and-garden store which is included in the new traffic signal, a drive-through bank window, a gas station, and several other uses. Nobscot Road has been realigned to create a T intersection with Route 20, and the Route 20 approaches include turning lanes in both directions. The railroad crossing has a rubberized surface, and it cuts across the three-lane cross-section of Route 20 on the westbound approach.

The Nobscot Road signal is one of three traffic signals within one-half mile along Route 20; it was designed to be coordinated with the signal replaced at Route 20 and Union Avenue. The new traffic signal at Nobscot includes pedestrian buttons, and there are new sidewalks on Route 20 on both sides, as well as on Nobscot Road. The preferred way for trail users to cross Route 20 would be to deviate slightly from the railroad right-of-way on the existing sidewalks, and to use the new pedestrian crossing. This may be costly in terms of intersection operations (i.e., reducing level of service for vehicles), but it will probably be the safest way to operate.

Just north of the Route 20 crossing, the Concord—Sudbury right-of-way crosses the MBTA-owned Central Massachusetts (Mass.) railroad right-of-way, which has also been proposed for use as a trail. CTPS completed a trail feasibility study of the Central Mass. right-of-way in April 1997.

Traffic volumes: Traffic counts were performed on Route 20 in conjunction with the Functional Design Report for the installation of new signals at Nobscot Road and Union Avenue. At this location, the average daily traffic (1997) was 26,400 vehicles. The graph below shows the hourly distribution of volumes at this location. As the diagram indicates, Route 20 experiences high volumes at this location relative to its capacity for a large portion of the day, not just at peak hours. This suggests the importance of Route 20 as a major arterial for general traffic, not just commuter traffic. In addition, because the right-of-way crossing is close to the Sudbury Farms shopping area and Friendly's Restaurant, it is likely that Saturday and Sunday volumes will exhibit the same sort of pattern, with chronically high traffic volumes throughout the daytime.



Crash data: A total of 58 crashes were recorded at the intersection of Route 20 and Nobscot Road in the period 1995 through 1999. Of these, 36 were angle crashes, and 16 were rear-end collisions. The traffic signal installed since that time should help to reduce the number of such incidents; however, data are not yet available on conditions since the signal was installed.

TELCON MEMO

DATE: **6 August 2003** **TIME:** **9:30 am**

BETWEEN: **M. McShane** **AND** **Offr. Ronald Conrado, Town of Sudbury Traffic Safety Officer**

PH# 978 443-1042

SUBJECT: **Review of Draft Concord-Sudbury Bikeway Memo**

Offr. Conrado called to give his comments on the draft memorandum sent to the Sudbury Police Department. The Department had been unable to accommodate my request to do a review of crash records at the intersections along the proposed bikeway, but had agreed to do a preliminary review of the draft memorandum, and note any safety issues relevant to any intersection that were not addressed in the draft.

Offr. Conrado had read the memo, and commented briefly on each intersection:

1. North Road – This is a heavily-trafficked roadway, but mainly for commuter hours in the morning and evening. The crossing location is at the bottom of a hill, but the road is fairly straight. Sight distance should not be a problem as long as the foliage is cut back during the appropriate seasons. Years ago, there used to be a problem location about 200-300 yards east of the crossing (Davis Corner)—a sharp curve; but this location was redesigned, the road curvature realigned, and it hasn't been a problem since.

2. Pantry Road – This location should not be a problem as long as it is properly signed in both directions and foliage is cut back as needed to allow adequate sight distance.

3. Haynes Road – Like Pantry Road, should not be a problem as long as signing is provided and foliage cut back.

4. Morse Road – This is a residential street, which tends to be used as a "cut-through" by people avoiding Concord Road. There are several horizontal curves on the road, which people nevertheless drive at high speeds. Adequate advance signing should be provided for a crossing at this location.

5. Hudson Road – This roadway also carries a lot of traffic, but people tend to slow down a bit here because of the traffic signal at Concord Road and the activities in the town center. The Police haven't experienced a lot of safety problems at this location. The intersection of Peakham and Hudson has had several accidents.

6. Old Lancaster Road – The principal concern voiced with regard to this location was the presence of heavy truck traffic generated by the Town Highway Department, located at the curve on Old Lancaster Road. Again, though, this shouldn't represent a major problem as long as the crossing is signed, and the foliage is cut back somewhat to allow adequate sight distance.

7. Codjer Lane – This is a low-volume road, essentially a driveway to the Cavicchio property. It carries a few trucks, but this should not be a problem for a crossing.

8. Route 20 – There is a pedestrian button at the new signal, so that this is an adequate crossing of Route 20. There's not a lot of speed on Route 20 at this location, because traffic is heavy just about all day long.

26 November 2002

Mr. David Carbonneau
Senior Civil Engineer
Town of Lexington
1625 Massachusetts Avenue
Lexington, MA 02420

Dear Dave:

Enclosed are printed results of traffic counts undertaken by the MassHighway in September at the intersections of Massachusetts Avenue with Pleasant Street and Maple Street. The printouts attached give 15-minute totals of counts on all approaches, as well as hourly summaries provided by MassHighway in their standard format, with adjustment factors included.[1] At one location, a faulty count obtained on September 10-12 was redone on the 24th, and the recount is incorporated into these results. I'm also sending along a disk with a spreadsheet which contains all the counts. We converted these from MassHighway's format to make them more readable, but will happily send you the original *.prn files if you want those.

We received these data from MassHighway last month, and plugged the numbers into the TEAPAC warrant analysis software. We don't have an updated version of this—in our version, the software reports the results in terms of the old (pre-2000) warrant numbers. Since the volume thresholds of the warrants haven't changed, it is easy to convert these to the warrant definitions of Chapter 4C of the new MUTCD Manual.[2] Tables 1 and 2 below translate these results into the current warrant-number format, and present the back-up volume data for each warrant met. It is clear that all *volume* warrants are easily met.

Warrants which we did not have data to analyze are shown with an asterisk (*). We did *not* make any assumptions about accident numbers or types at either location, since we didn't compile accident data for either one. Likewise, we are not familiar with Lexington's experience with "other potential remedies" at either location. We *did* assume that "…a signal would not interrupt progressive flow" at either intersection location, since I am unaware that there *is* progressive flow operating on Massachusetts Avenue at present.

Hope that this information will be of assistance to the Town of Lexington as it considers possible remedies for the issues at both locations.

Sincerely,

(original signed)

Mary P. McShane

[1] Available on request.
[2] Available on-line at the following address:
http://mutcd.fhwa.dot.gov/HTM/millennium/12.28.01/four_highway_traffic_signals/MUTCD_4A-4D.htm#chapter4C

TABLE 1
Route 4/225 at Massachusetts Ave, Lexington
Warrant Analysis

	Signal Warrants	**Status**
Warrant 1	Eight-Hour Vehicular Volume Condition A: Minimum Vehicular Volume Condition B: Interruption of Continuous Traffic	 Met Met
Warrant 2	Four-Hour Vehicular Volume	Met
Warrant 3	Peak Hour	Met
Warrant 4	Pedestrian Volume	*
Warrant 5	School Crossing	*
Warrant 6	Coordinated Signal System	*
Warrant 7	Crash Experience	*
Warrant 8	Roadway Network	*

*not enough information to make a judgment.

Backup information for volume warrants met:

Warrant 1 Analysis – Condition A: Minimum Vehicular Volume

Start Time	1715	1615	1515	815	1815	1415	715	1115	Req.
Minor Volume	819	666	631	619	598	590	513	404	150
Major Volume	1468	1402	1459	1402	1392	1231	1132	1124	500
Warrant Met?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	8

Number of 1-hour periods meeting the warrants 15

Condition B: Interruption of Continuous Traffic

Start Time	1645	1745	745	1445	1545	1845	1345	1045	Req.
Minor Volume	794	724	717	673	620	477	417	404	75
Major Volume	1463	1478	1373	1432	1386	1223	1102	1055	750
Warrant Met?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	8

Number of 1-hour periods meeting the warrants 14
Signal will not seriously disrupt progressive traffic flow Yes

>> WARRANT 1 IS MET <<

Warrant 2 Analysis - Four Hour Vehicular Volume

Start Time	1730	1630	1430	730	1530	1830	830	1130	Req.
Minor Volume	786	752	647	637	609	521	479	404	-
Minor Reqrmt	80	80	80	80	80	80	80	83	<--
Warrant Met?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	4

Number of 1-hour periods meeting the warrants 14

>> WARRANT 2 IS MET <<

Warrant 3 Analysis - Peak Hour: Category A, Delay

Start Time	1715	1615	1515	815	1815	1415	715	1115	Req.
Minor Volume	819	666	631	619	598	590	513	404	100
Major Volume	2287	2068	2090	2021	1990	1821	1645	1528	650
Warrant Met?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	1

Number of 1-hour periods meeting the warrants 15
STOP sign delay for minor approach (must exceed 4 hours) 4

Note: no information available on hours of STOP sign delay here.

Category B, Volume

Start Time	1645	1745	745	1445	1545	1845	1345	1045	Req.
Minor Volume	794	724	717	673	620	477	417	404	-
Minor Reqrmt	106	103	118	110	116	144	175	189	<--
Warrant Met?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	1

Number of 1-hour periods meeting the warrants 14

>> WARRANT 3 IS MET (on Category B, possibly also on Category A)<<

TABLE 2
Massachusetts Ave at Maple Street, Lexington
Warrant Analysis

	Signal Warrants	**Status**
Warrant 1	Eight-Hour Vehicular Volume Condition A: Minimum Vehicular Volume Condition B: Interruption of Continuous Traffic	 Met Met
Warrant 2	Four-Hour Vehicular Volume	Met
Warrant 3	Peak Hour	Met
Warrant 4	Pedestrian Volume	*
Warrant 5	School Crossing	*
Warrant 6	Coordinated Signal System	*
Warrant 7	Crash Experience	*
Warrant 8	Roadway Network	*

*not enough information to make a judgment.

Backup information for volume warrants met:

Warrant 1 Analysis – Condition A: Minimum Vehicular Volume

Start Time	815	715	1415	1515	1215	1715	1315	1115	Req.
Minor Volume	890	867	628	521	517	494	491	483	150
Major Volume	2225	1819	1471	1696	1401	1737	1316	1323	500
Warrant Met?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	8

Number of 1-hour periods meeting the warrants 15

Condition B: Interruption of Continuous Traffic

Start Time	730	830	1430	1230	1130	1330	1730	1530	Req.
Minor Volume	928	790	670	511	498	495	492	460	75
Major Volume	2006	2064	1574	1393	1339	1285	1724	1691	750
Warrant Met?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	8

Number of 1-hour periods meeting the warrants 14
Signal will not seriously disrupt progressive traffic flow Yes

>> WARRANT 1 IS MET <<

Warrant 2 Analysis - Four Hour Vehicular Volume

Start Time	815	715	1415	1515	1215	1715	1315	1115	Req.
Minor Volume	890	867	628	521	517	494	491	483	-
Minor Reqrmt	80	80	80	80	80	80	80	80	<--
Warrant Met?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	4

Number of 1-hour periods meeting the warrants 14

>> WARRANT 2 IS MET <<

Warrant 3 Analysis – Peak Hour: Category A, Delay

Start Time	800	700	1500	900	1400	1300	1200	1700	Req.
Minor Volume	961	703	609	550	549	515	499	491	100
Major Volume	3194	2244	2305	2185	1925	1862	1894	2235	650
Warrant Met?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	1

Number of 1-hour periods meeting the warrants 15
STOP sign delay for minor approach (must exceed 4 hours) 4

Note: no information available on hours of STOP sign delay here.

Category B, Volume

Start Time	730	830	1430	1230	1130	1330	1730	1530	Req.
Minor Volume	928	790	670	511	498	495	492	460	-
Minor Reqrmt	100	100	100	116	121	129	100	100	<--
Warrant Met?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	1

Number of 1-hour periods meeting the warrants 14

>> WARRANT 3 IS MET (on Category B, possibly also on Category A)<<