1. Introduction

Over the last two decades, the City of Somerville, Massachusetts has witnessed a marked increase in the number of cyclists on its streets. On a fair day in Davis Square, one is sure to catch sight of commuters with pannier-laden racks, folks ambling on vintage cruisers, spandex-clad road warriors, fixed gear aficionados, parents with young children in tow—people of different gender, age, and race riding bikes of all shapes and sizes. Similar surges in the size and diversity of the cycling population are being seen across the country, especially in urban areas. Increases in ridership observed in Somerville thus far have outpaced national trends and have generally corresponded with the expansion of the City’s bicycle facilities.

The most recent American Community Survey estimates indicate that the number of Somerville residents commuting by bike has increased three-fold over the past two decades. A 4.6% bike commuter share ranks Somerville well above the American nationwide and city averages of 0.5% and 0.8%, respectively. The City’s participation in Hubway, Boston’s forthcoming bike-share program, is likely to generate additional demand for bike-friendly streets.

In response to burgeoning interest in cycling, Somerville has answered with an initiative to increase the quality and extent of its bicycle
network. Working in partnership with the community and local bicycling organizations, such as MassBike and Friends of the Community Path, The City of Somerville and the Somerville Bicycle Advisory Committee (SBC) have projected an ambitious goal of doubling the number of bike commuters over the next decade, to reach 10% ridership by 2020. As a highly developed City of approximately 75,000 residents, consisting largely of high density residential, commercial, and industrial land uses\(^3\), a dramatic mode shift away from automobile-centric transport is certainly achievable. Yet while the City’s high density and transit access make it a prime candidate to support an active cycling population, a narrow, complex street network and high build-out will present a number of challenges in developing the necessary infrastructure to reach the City’s ridership goals.

This report presents one possible methodology for analyzing and prioritizing Somerville’s bicycling infrastructure needs over the next several years. It is intended to provide general recommendations for a phased approach to making physical improvements to the City of Somerville’s bicycle network based on priority zones, traffic patterns, and road dimensions. However, the City’s goals are unlikely to be met through infrastructure expansion alone. Creative campaigns to encourage new riders and reshape social norms will be critical in drawing riders from a wider demographic. Our study area covers the entire city of Somerville; however, we have included more detailed analysis of conditions in Davis Square, an area that we identified as being within a high priority zone for bicycle infrastructure improvements to reinforce its significance as a multi-modal transit hub. We hope our data, maps, and recommendations will assist the City of Somerville and bicycling advocacy organizations as they continue to push for the growth of bicycling in the City.
Promoting cycling is one of the simplest and most effective steps that a city can take to improve the health and well-being of its residents. Removing automobiles from the streets reduces congestion, noise and air pollution, and provides economic savings to residents. The additional physical activity gained by cycling, even for short trips, could go a long way to improve the overall health of residents. Despite all the benefits of cycling, many residents are fearful of the dangers posed by riding on busy urban streets. A report released by Portland, Oregon’s Office of Transportation contends that the most important component of increasing the cycling mode share is to “remove the element of fear associated with bicycling in an urban environment.”

To help understand what motivates people to ride, the report identified four primary groups of people based on their interest in riding bicycles for transportation in Portland (Figure 2-1). The first group, “The Strong and the Fearless,” are bicyclists who are unaffected by road conditions and will ride with or without bicycle infrastructure on the streets. The second group, “The Enthused and the Confident” are cyclists who are much more likely to ride when roads are designed to accommodate bicycles with sharrows and bike lanes. According to the report, this is the group that has driven recent increases in cycling. The third group, “The
Interested but Concerned,” consist of people who like riding bikes, but are fearful of the dangers of riding alongside automobiles on city streets. This group is the key to the future of cycling in the city; if roads can be made safe enough to combat their fears, cycling rates will increase significantly. The final group, “The No Way No How,” consist of people who will not become bicyclists under any scenario due to “topography, inability, or simply a complete and utter lack of interest.”

This categorizations suggest a tremendous untapped potential for the growth of cycling in urban areas, especially among the “Interested but Concerned” demographic. According to the Alliance for Biking and Walking, “an increase in bicycling and walking levels is strongly related to increased bicyclist and pedestrian safety.” For this reason, efforts to increase cyclist safety through the improvement and expansion of Somerville’s network of bicycle infrastructure will go a long way toward increasing ridership. Bicycling infrastructure needs to be developed in a manner that is accessible to all types of cyclists, from young children to seasoned bike messengers. The ultimate goal of a bicycle infrastructure network should be to make riding a bike “the most logical, enjoyable, and attainable choice for trips of a certain length for a large swath – if not the majority – of their populace.”

Boston is not exactly known as a bike-friendly city, but this perception is steadily changing. As a result of recent efforts to improve cycling conditions in the region, Bicycling Magazine...
has recently moved Boston off of its “Worst” list and onto the “5 for the Future” list. This is an encouraging sign that the efforts of local government officials and bicycling enthusiasts are paying off. If cities in the Greater Boston region hope to persuade more people to get out of their cars and onto bicycles, however, the bicycle must be more tightly woven into the physical and cultural fabric of the City. We hope the data, maps, and recommendations in this report can be used to help make Somerville’s bicycling infrastructure more expansive, safe, and appealing to cyclists of all types.
3. Data and Methods

This chapter explains data sources and methodologies used in our analysis, noting any limitations or uncertainties inherent in our findings. We especially highlight the use of Geographic Information Systems (GIS) in planning bike networks and infrastructure. However, while GIS is an effective tool to guide policy, we emphasize that it should only be one component within a robust planning process founded in community involvement and political investment in bike infrastructure.

I. Identifying Existing Bike Infrastructure

a. Bike paths, lanes, and sharrows

An online map maintained and updated by the Somerville Bike Committee (SBC) was crosschecked with a bicycle map produced by the City of Somerville in November of 2010 to identify existing bike lanes and sharrows. Markings on major arterials and collectors within one road mile of Davis Square were verified by field visits over the course of the study. Since roads beyond one mile from Davis Square were not field checked,
some recent changes may have been omitted from our analysis.

Bike lane and sharrow attributes were appended to the Massachusetts Department of Transportation (MassDOT) Roads datalayer\textsuperscript{12} using GIS software.\textsuperscript{13} The location and status of designated off-road bike trails was obtained through the Massachusetts Department of Conservation and Recreation (DCR) Bicycle Trails datalayer.\textsuperscript{14}

\textbf{b. Bike racks}

Geographic coordinates and the estimated capacity of bike racks on major arterials and collectors within one road mile of Davis Square were recorded with Garmin\textsuperscript{©} 60c handheld Global Positioning System (GPS) units between February 28th and March 7th, 2011. Collected points were subsequently converted into a GIS feature class. Recorded rack locations were typically within a 6-meter radius of their actual locations, as interpreted through a comparison with high-resolution orthoimagery\textsuperscript{15}, however, a few wider deviations were noted. Large discrepancies were rectified by manually adjusting feature locations to correspond more closely with the orthoimagery. While parking locations could be mapped more accurately with mapping grade GPS units, the simple handheld units were adequate for the relatively coarse scale of this analysis and allowed surveyors to cover a much larger area than would have been possible with bulkier, higher precision units.

To determine how bike racks and parking capacity was allocated between different land uses, rack features were spatially joined to the MassGIS 2005 Land Use datalayer\textsuperscript{16} and aggregated by land use.

\textbf{c. Signage}

Signage is a crucial element in any bicycle network, however, time constraints made a formal survey of existing signage infeasible for this study.
Instead, casual observations were made during frequent travels through the study area on bike and foot.

II. Proposed Bicycle Network Expansions

a. Bike paths, lanes, and sharrows

Various metrics from the MassDOT Roads datalayer were used to identify road segments suitable for new bike lanes or shared lane markings (e.g. sharrows). Criteria used for each query are shown in Table 3-1. Suitable parameters for on-road markings were obtained from design guidelines recommended by the National Association of City Transportation Officials\(^\text{17}\) and the Federal Highway Administration.\(^\text{18}\) The minimum desirable roadway surface width for installing bike lanes in two directions on a street with two vehicle lanes and parking on either side was determined to be 44 feet based on the sources mentioned above and communication with local transportation planners.\(^\text{19}\) Since MassDOT does not maintain data on parking lanes in their roads datalayer, all roads, both one and two-way, were assumed to have parking lanes on both sides, as is typical on most of the City’s streets. Although additional bike lanes could be added by eliminating on-street parking expanding street surface widths, we assumed that either scenario would be highly unlikely in the near term due to political and financial constraints.

Given the large number of road segments capable of accommodating lanes or sharrows, proposed markings were prioritized based on additional criteria. Bike lanes were considered a high priority on roads with average daily traffic (ADT) volumes of 3,000 or more vehicles per day. Since ADT data was limited for smaller roads that fit the criteria for sharrows, these segments were prioritized instead based on their functional classification. Specifically, roads classified as ‘urban minor arterial’ and ‘urban collector’ were deemed...
Table 3-1. Criteria used to determine road segments for potential bike lanes and sharrows.

<table>
<thead>
<tr>
<th>One-Way Road Bike Lanes</th>
<th>Two-Way Road Sharrows</th>
<th>Two-Way Road Bike Lanes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Surface Width</strong></td>
<td>≥ 30 feet</td>
<td>≤ 44 feet</td>
</tr>
<tr>
<td><strong>Speed Limit</strong></td>
<td>≤ 35 m.p.h.</td>
<td>≤ 35 m.p.h.</td>
</tr>
<tr>
<td><strong>Number of Travel Lanes</strong></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td><strong>Street Operation</strong></td>
<td>One-way traffic</td>
<td>Two-way traffic</td>
</tr>
<tr>
<td><strong>Existing Lanes or Sharrows</strong></td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td><strong>Functional Classification</strong></td>
<td>Urban Collector or Minor Arterial (High Priority) and Local (Low Priority)</td>
<td>Functional Classification</td>
</tr>
</tbody>
</table>
high priority, as they were more likely to be main thoroughfares, while those classified as ‘local’ were considered lower priority. No recommendations were made for one-way streets less than 30 feet in width, however, these streets may have high value as bike wayfaring or boulevard routes.

Proposed off-street bike paths or extensions of existing paths were inferred from the DCR Bike Trails datalayer. No additional paths were proposed given the highly site-specific and variable design requirements required.

III. Bike Safety

a. Identifying Crash Hot Spots

We obtained MassDOT crash data through the City of Somerville for four years, spanning from 2005 to 2008. The data represented roughly 75% of the total crashpoints that were successfully geocoded to their incident location. Therefore, a number of crashes may not be represented in this analysis. The presence of crash “hot spots” was investigated through a method described by Truong and Somenahalli in their study of GIS techniques to identify significant spatial relationships between pedestrian-vehicle crash hot spots and bus stops. A severity index was computed for each bike and pedestrian crash point in order to give more severe crashes greater weight in the cluster analysis.

\[
SI = 3.0X_1 + 1.5X_2 \times 1.0X_3
\]

Where:

- \(X_1\) = total number of fatal crashes
- \(X_2\) = total number of crashes with non-fatal injuries
- \(X_3\) = total number of crashes with property damage only

Finally, the ESRI Arcgis tools Spatial Autocorrelation and Hot Spot Analysis tools were used to assess the significance of spatial clustering.
IV. Bike Theft

Similar techniques to those described above could be used to identify hot spots for bike larceny, however, attempts to acquire the necessary data from the Somerville Police Department were unsuccessful. Annual crime reports from the neighboring City of Cambridge were analyzed for general trends in reported larcenies.

V. Developing Priority Regions

Priority areas to assist in focusing future investments in bike infrastructure were developed based on methods adapted from bike share feasibility studies commissioned by the Cities of Seattle\textsuperscript{22} and Philadelphia.\textsuperscript{23} Raster layers were produced for ten selected indicators of bicycle infrastructure demand and suitability. The specific parameters used in this analysis are shown in Table 3-2. Some indicators varied slightly from those used in the bike share feasibility studies, however, the majority were relevant to both analyses.

Each resulting indicator raster was reclassified into ten levels, with higher values representing the highest demand/suitability for infrastructure. Values for some indicators, such as topography, were inverted during the reclassification process, as higher slope angles corresponded with a lower suitability score. Morning and evening bike counts were combined to represent one indicator.

Next, a composite raster of the ten indicator layers was created through a simple weighted sum algorithm. Most indicators were assigned a weight of one, although topography and proximity to parks were weighted lower as they were presumed to have a less significant effect on infrastructure suitability. Suitability scores ranging from 19.5 (least suitable) to 65 (most suitable) in the resulting raster were reclassified and grouped into four priority regions.
Table 3-2. Table of selected indicators, including sources and analysis parameters.

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Scale</th>
<th>Metric</th>
<th>Buffer</th>
<th>Reclassification</th>
<th>Weight</th>
<th>Data Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population Density</td>
<td>Census Tracts</td>
<td>Population per acre</td>
<td>n/a</td>
<td>None</td>
<td>1</td>
<td>U.S. Census Bureau, 2005-2009 American Community Survey 5-Year Estimates</td>
</tr>
<tr>
<td>Group Quarters Population</td>
<td>Census Tracts</td>
<td>Group quarter population per acre</td>
<td>n/a</td>
<td>None</td>
<td>1</td>
<td>U.S. Census Bureau, 2005-2009 American Community Survey 5-Year Estimates</td>
</tr>
<tr>
<td>Job Density</td>
<td>Census Block Groups</td>
<td>Jobs per acre</td>
<td>n/a</td>
<td>None</td>
<td>1</td>
<td>U.S. Department of Transportation, Research and Innovative Technology Administration, Census Transportation Planning Package (CTTP) 2000</td>
</tr>
<tr>
<td>Retail Job Density</td>
<td>Census Block Groups</td>
<td>Retail jobs per acre</td>
<td>n/a</td>
<td>None</td>
<td>1</td>
<td>U.S. Department of Transportation, Research and Innovative Technology Administration, Census Transportation Planning Package (CTTP) 2000</td>
</tr>
<tr>
<td>Rapid Transit and Trains</td>
<td>10 meter cell size</td>
<td>Proximity distance</td>
<td>500 meters</td>
<td>Invert</td>
<td>1</td>
<td>Boston Regional Metropolitan Planning Organization, Central Transportation Planning Staff (2006) via MassGIS</td>
</tr>
<tr>
<td>Bus Transit</td>
<td>10 meter cell size</td>
<td>Proximity distance</td>
<td>500 meters</td>
<td>Invert</td>
<td>1</td>
<td>Boston Regional Metropolitan Planning Organization, Central Transportation Planning Staff (2007) via MassGIS</td>
</tr>
<tr>
<td>Existing and Potential Bike Corridors</td>
<td>10 meter cell size</td>
<td>Proximity distance</td>
<td>500 meters</td>
<td>Invert</td>
<td>1</td>
<td>Based on data from Massachusetts Department of Transportation (2008) via MassGIS</td>
</tr>
<tr>
<td>Bike Traffic</td>
<td>10 meter cell size</td>
<td>Density *</td>
<td>0.2 km² radius</td>
<td>None</td>
<td>0.5</td>
<td>City of Somerville (2010), Spring 2010 pm Count</td>
</tr>
<tr>
<td></td>
<td>10 meter cell size</td>
<td>Density *</td>
<td>0.2 km² radius</td>
<td>None</td>
<td>0.5</td>
<td>City of Somerville (2010), Spring 2010 pm Count</td>
</tr>
<tr>
<td>Parks</td>
<td>10 meter cell size</td>
<td>Proximity distance</td>
<td>500 meters</td>
<td>Invert</td>
<td>0.5</td>
<td>Massachusetts Executive Office of Environmental Affairs (2010) via MassGIS</td>
</tr>
<tr>
<td>Topography</td>
<td>10 meter cell size</td>
<td>Slope angle</td>
<td>n/a</td>
<td>Invert</td>
<td>0.5</td>
<td>MassGIS Digital Elevation Model, 1:5,000 (2005)</td>
</tr>
</tbody>
</table>

* Each road segment was appended with the total bike count from the nearest count station through a spatial join. A density function, weighted by bike traffic volume, was used to represent general bike traffic distribution over the study area.
4. Analysis and Findings

This chapter reports on the current status and potential additions to bike infrastructure in Somerville— including on and off street bikeways, markings, and parking structures. A review of available crash and theft data is followed by a suitability analysis for infrastructure expansion using ten selected indicators.

I. Bike Paths, Lanes, Shared Lane Markings, and Signage

Currently, bike lanes and sharrows are painted along approximately 3.3% and 4.9% of all of Somerville’s roadways, respectively. We used available MassDOT data on roadway surface width, lanes, travel directions, speed limit, average daily traffic, and functional classification, as well as appended data on existing bicycle infrastructure, to identify road segments suitable for new lanes or sharrows (Figure 4-1).

Without significant alterations to the streetscape, an additional 7.1 km of bike lanes could be added, including 4.3 km of high priority and 2.8 km of lower priority lanes based on ADT data. In general, narrow road widths and the ubiquity of on-street parking throughout the City present limited opportunities for the installation of additional bike lanes. As expected, however, there are abundant opportunities to add sharrows or other shared lane markings and signage. We identified 22.9 km of high priority roads for shared markings. A map
of all existing and proposed bike paths, lanes, and markings are shown in Figure 4-22. Given the City's limited funding, however, we hope that our analysis will be helpful in prioritizing resource allocation for network improvements.

We present this simple, GIS-based survey method as a valuable initial step to identify and visualize potential bicycle network expansions, recognizing however, that its resolution is largely limited by the accuracy and completeness of MassDOT road and traffic data. More advanced network analysis techniques and additional data would be necessary in planning less standardized bike routes, such as bike boulevards, wayfinding routes, and trails.

In general, signage with information specifically pertaining to cyclists is abundant on the Community Path, but scarce on most roadways. In
Figure 4-2. Existing and proposed bike paths, lanes, and sharrows.

Map by Nally and Quinn, 2011
Projected Coordinate System: NAD 83 Massachusetts State Plane

Analysis and Findings
the next chapter, we make suggestions for additional signage that could be added to enhance route finding and safety.

II. Parking

Approximately 217 designated parking structures are located within a one-mile street network surrounding Davis Square with an approximate combined capacity of 1,024 bicycles (Figure 4-3). When overlaid with a land use map, we determined that most parking features are located within commercial and public land uses (Table 4-11; Figure 4-4). Parking features represented an array of bike rack types. In both Davis Square and throughout the Tufts campus, where demand for bike parking is highest, the majority of racks are unlikely to serve their design capacity due to limitations inherent in their design. So called “undulating” rack was especially prevalent despite being listed as a non-preferred rack type in Somerville’s Bicycle Parking & Installation Guide For Development and Redevelopment Projects.

During our bike rack surveys, we noted that many high-capacity racks were empty despite a high volume of bikes parked in the surrounding area. In such instances, the majority of riders had opportunistically locked their bikes to an array of structures, including parking meters, signs, and streetlights, rather than choosing to lock up at

<table>
<thead>
<tr>
<th>Land Use</th>
<th>Bike Racks</th>
<th>Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commercial</td>
<td>114</td>
<td>498</td>
</tr>
<tr>
<td>Urban Public/Institutional</td>
<td>68</td>
<td>412</td>
</tr>
<tr>
<td>Multi-Family Residential</td>
<td>26</td>
<td>62</td>
</tr>
<tr>
<td>Participation Recreation</td>
<td>5</td>
<td>34</td>
</tr>
<tr>
<td>Transitional</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>Industrial</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>217</strong></td>
<td><strong>1024</strong></td>
</tr>
</tbody>
</table>

Table 4-1. Rack abundance and capacity by land use.
Figure 4.3. Bike rack location and capacity within 1 road mile of Davis Square.

Map by Nally and Quinn, 2011
Projected Coordinate System: NAD 83 Massachusetts State Plane

Analysis and Findings
Figure 4.4. Bike parking capacity by land use.

Map by Nally and Quinn, 2011
Projected Coordinate System: NAD 83 Massachusetts State Plane
a nearby rack. Even though the total volume of parked bikes during our surveys were probably considerably below warm weather volumes, our casual observations nonetheless seem to indicate a clear preference to park in certain locations over others. We posit that this behavior is not motivated by an aversion to utilize the designated bike racks, but rather is influenced by perceptions of convenience and safety related to the placement of the parking structure. Throughout the winter months, fallen and plowed snow rendered many racks inaccessible long after the roadways had been cleared.

III. Ridership and Demographic Data

As discussed Chapter 1, the number of Somerville residents riding to work has increased significantly over the last decade. Five-year data from the 2005 to 2009 American Community Survey estimate that of Somerville residents who commute by bike, motorcycle or taxi, 26% have no other vehicle available, 22% are non-white, and show a very even distribution among income classes. Roughly 66% of commuting cyclists are male. These statistics are comparable to national averages reported in the Bicycling and Walking in the United States 2010 Benchmarking Report, with slightly higher percentages of females and minority riders. Increases in the number of women commuting to work by bicycle may be especially telling, as female ridership is often considered an indicator of street safety.

Biannual bicycle counts organized by SBC since 2009 provide more spatially nuanced data on bike traffic volumes at many of the City’s major intersections, thruways, and the Community Path during peak commuting hours. One potentially significant demographic not captured by existing Census and count data, however, are the number of cyclists utilizing the roadways for non-commuting purposes, particularly those utilizing trails and...
roadways on off-peak hours and weekends. Data on rider gender and behavior, such as helmet use, could also be valuable in planning education and outreach programs.

**IV. Crash Hot Spots**

A statistical analysis of the distribution of bicyclist and pedestrian crashes from 2005-2008 did not reveal spatially significant clustering over the study area. We suspect, however, that more long-term crash data might reveal areas with higher crash rates. Figure 4-5 shows crash points as weighted by the calculated severity index.

**V. Incidences of Theft**

No data on bike theft was obtained for Somerville, however, the 2010 Annual Crime for the City of Cambridge, reports the highest incidences of bike thefts occurring around major transit hubs, including Porter, Inman, Harvard, and Central Squares. Reported larcenies were also higher during the summer months from July through August, when more bikes were likely to be parked outside.

**VI. Using Indicators to Map Priority Regions for Bicycle Network and Infrastructure Expansion**

Ten indicators of bicycle infrastructure suitability were used to generate tiered priority regions for future investment. As noted in our methods, indicators and analysis methods were adapted from two bike share feasibility studies, with slight modifications as noted in Table 3-2. Our intent was create to holistic, rational, and defensible prioritization strategy. Selected indicators include:

- Population Density
- Group Quarters Population
- Job Density
- Retail Job Density
Analysis and Findings

Figure 4.5. Bike and pedestrian crash severity.

Crash Severity
- 1.0
- 1.0 - 1.5
- 1.5 - 3.0

Priority Zones
- 1: High
- 2
- 3
- 4: Low

Map by Nally and Quinn, 2011
Projected Coordinate System: NAD 83 Massachusetts State Plane
• Rapid Transit and Trains
• Bus Transit
• Existing and Potential Bike Corridors
• Bike Traffic Distribution
• Parks
• Topography

The following series of maps displays spatial variations in each indicator across the study area on a one to ten scale, with ten representing the highest suitability/demand for infrastructure (Figures 4-6 through 4-16). The composite raster shown in Figure 4-17 represents the weighted sum of each indicator raster. The data was then reclassified into four levels (Figure 4-18) representing their relative priority for future infrastructure enhancements.
Analysis and Findings

Figure 4.6. Population Density

Map by Nally and Quinn, 2011
Projected Coordinate System: NAD 83 Massachusetts State Plane
Group Quarters Population Density

Figure 4-7.

Map by Nally and Quinn, 2011
Projected Coordinate System: NAD 83 Massachusetts State Plane
Analysis and Findings

Job Density

Figure 4.8.

Map by Nally and Quinn, 2011
Projected Coordinate System: NAD 83 Massachusetts State Plane

Suitability Score

- 1-Low
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9
- 10-High
Retail Job Density

Map by Nally and Quinn, 2011
Projected Coordinate System: NAD 83 Massachusetts State Plane
Rapid Transit and Trains

Map by Nally and Quinn, 2011
Projected Coordinate System: NAD 83 Massachusetts State Plane

Analysis and Findings
Figure 4-11. Bus Transit

Map by Nally and Quinn, 2011
Projected Coordinate System: NAD 83 Massachusetts State Plane

Suitability Score
- 1-Low
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9
- 10-High

Kilometers
0 0.5 1 1.5 2
Analysis and Findings

Existing and Potential Bike Corridors

Figure 4-12.

Map by Nally and Quinn, 2011
Projected Coordinate System: NAD 83 Massachusetts State Plane
Figure 4-13. Bike Traffic (Spring 2010 am)

Suitability Score

1-Low
2
3
4
5
6
7
8
9
10-High

Map by Nally and Quinn, 2011
Projected Coordinate System: NAD 83 Massachusetts State Plane
Analysis and Findings

Figure 4-14.

Bike Traffic (Spring 2010 pm)

Suitability Score
1-Low
2
3
4
5
6
7
8
9
10-High

Map by Nally and Quinn, 2011
Projected Coordinate System: NAD 83 Massachusetts State Plane
Analysis and Findings

Parks

Figure 4-15.

Suitability Score

Map by Nally and Quinn, 2011
Projected Coordinate System: NAD 83 Massachusetts State Plane
Topography

Figure 4.16.

Map by Nally and Quinn, 2011
Projected Coordinate System: NAD 83 Massachusetts State Plane
Analysis and Findings

Weighted Sum Raster

Figure 4-17.

Map by Nally and Quinn, 2011
Projected Coordinate System: NAD 83 Massachusetts State Plane
Analysis and Findings

Priority Zones

Figure 4-18.

Map by Nally and Quinn, 2011
Projected Coordinate System: NAD 83 Massachusetts State Plane
5. Recommendations

Despite laudable progress thus far, the City of Somerville will face considerable challenges in meeting its “10 in 2020” goal of 10 percent of the population commuting to work by bicycle by the year 2020. Success will demand overcoming financial and political constraints to provide continued investment in non-motorized transit and the creative application of innovative planning and community outreach solutions. This chapter draws on the findings from this and other studies, as well as examples from other cities, to propose a series of recommendations grouped around four main themes:

- Bicycle network and infrastructure improvements
- Rethinking circulation, signaling, and signage through Davis Square
- Strategies to increase bike ridership
- Theft Prevention

Priority regions delineated in the previous chapter could serve as a road map for the implementation of new infrastructure and assist in targeting areas for outreach programs.
I. Proposed Bicycle Network and Infrastructure Improvements

a. Street markings, signage, and streetscape retrofits

Somerville boasts an extensive network of bike lanes and shared lane markings that continue to expand and form new linkages. In addition, The Community Path provides a dedicated bike and pedestrian corridor through a densely populated “commuter village”.

In the short term, opportunities to accommodate additional bike lanes into the existing streetscape are limited. However, recommendations for potential expansions are shown in Figure 5-1. Based on our GIS analysis, even aggressive reductions in parking and travel lane width are unlikely to greatly increase the available space for additional bike lanes. Thus, dedicated bike lanes may be most feasible on parallel boulevard routes or on sections of main thoroughfares where on street parking can be eliminated. While attempts to remove on-street parking or narrow travel lanes on a widespread basis are unlikely to be successful, targeted efforts on road segments that are not adjacent to businesses may be more feasible. Additionally, more long-term changes could include retrofits to the sidewalk and right of way area beyond the existing road surface.

b. Parking infrastructure

There is a tendency to think about bicycle infrastructure only in terms of designated paths and markings on and off the roadways. That is, efforts are primarily focused on improvements along bicycle routes with less consideration of what happens at origins and destinations. In urban areas, however, bike lanes and markings are dependent on a variety of supporting infrastructures to create a functional transportation network. Lack of a safe or sheltered place to park their bike may discourage many would-be bike commuters or cause them to

Recommendations
Figure 5-1. Priority zones for bike infrastructure expansion.

Map by Nally and Quinn, 2011
Projected Coordinate System: NAD 83 Massachusetts State Plane
Somerville also has a number of unconventional intersections that present real challenges to planners. These intersections will require additional analysis and careful design to allow for safe and efficient bicycle passage. This case study represents the first step in analyzing the behaviors of bicyclists in one of these complex intersections—Davis Square.

Davis Square is a heavily-traveled hub for pedestrians, bicyclists and automobiles, located at the intersection of several major thoroughfares; Holland St., College Ave., Highland St. and Elm St., as well as more minor roads, including Day St. and Dover St. The Somerville Community Path, a multi-use rail trail, crosses directly through Davis Square and continues on either side.

We conducted two surveys of the intersection to record the number and path of bicyclists in order to gain a better understanding of the specific challenges and safety concerns faced by riders. Our surveys illustrate the most heavily used routes through Davis Square (see next page). During the morning commute, a majority of cyclists traveled southeast on Holland, crossing the intersection to continue southeast on Elm. Riders traveling south on College onto either Elm or Dover, as well as cyclists traveling west on Highland and across to Holland, also represented a large share of riders. As anticipated, in the evening, the direction of bicyclists changed, with a majority of riders traveling west on Highland and crossing the intersection onto Holland.

Rethinking circulation, signaling, and signage through Davis Square

Recommendations
Recommendations

Percent of Bikers
- 1.2% - 1.5%
- 1.51% - 2.5%
- 2.51% - 5%
- 5.01% - 10%
- 10.01% - 20%
- 20.01% - 40%

Map by Nally and Quinn, 2011
Projected Coordinate System, NAD 83 Massachusetts State Plane

Morning Commute

Evening Commute
While additional data collection to account for factors such as street dimensions, signal phasing, and emergency vehicle access is needed, this survey represents the first step in prioritizing improvements to the intersection. For example, along the most heavily traveled route overall, from Holland to Elm Street, the travel lanes at the stoplight are too narrow to comfortably accommodate both automobiles and bicycles. Conversion of the right turn lane to a bicycle zone with clearly defined road markings to separate uses, and other amenities, such as bicycle hand rails, could help make stopping at this traffic light more comfortable to bicyclists.

During the surveys, we observed bicycles using a variety of approaches taken by cyclists to navigate from one end of the Community Path, across the intersection, to the other. Many bicyclists using the Community Path were forced to get off their bikes and walk across the intersection using sidewalks and crosswalks, essentially becoming pedestrians. A few bicyclists were more creative in their approach and jogged or rode diagonally across the intersection. Any improvements to Davis Square’s bicycling infrastructure should account for bicyclists trying to cross the intersection to reach the Community Path, through better signage and road (or sidewalk) markings that direct people along the safest and most convenient route across the intersection.

More long-term and ambitious efforts to improve pedestrian and bike passage should consider restrictions on vehicle traffic through the Square. Potential strategies include closing Day and Dover streets to through traffic, with the exception of taxis, to create a more continuous pedestrian and bike corridor from Holland to Elm Street. A phased closure of College Avenue to vehicle traffic between Powderhouse and Davis Squares, perhaps initiated by its conversion to a one-way northbound road, could transform this short, but heavily traveled segment into a transit and pedestrian-oriented retail corridor. The existing streetscape could then be retrofitted to accommodate high volumes of bicyclists and pedestrians, and serve as a potential streetcar route linking Davis Square to the planned Green Line extension.
ride less frequently. There is increasing awareness that the cost of even the most expensive bike parking facilities are modestly priced in comparison to the cost and space required for automobile parking.

While a quick GPS survey of racks proved useful in our analysis, we recommend that the City of Somerville train volunteers to use higher precision instruments to create a city-wide database of bike parking features, including complimentary data on rack type and condition. Maintaining this data could be useful in tracking compliance with a potential bike parking zoning ordinance, as well as assist in quickly identifying racks in need of maintenance or replacement in accordance with priority regions for infrastructure expansion.

Observations made during our bike rack survey suggest the critical importance of placement in ensuring an optimal utilization of available parking capacity. Placement criteria should evaluate the convenience, safety, and snow accumulation of potential parking locations. A Report by the Association of Pedestrian and Bicycle Professionals offers comprehensive guidance for the selection and placement of bike racks. The report suggests locating racks intended for short term parking along a “desire line” from an adjacent bikeway. Ideally, the rack should be no more than 50 feet, or a 30 second walk, from the destination and be closer than the nearest car parking space. Somerville’s own Bicycle Parking & Installation Guide For Development and Redevelopment Projects is an excellent resource for guidance on rack selection and enumerates the City’s zoning requirements pertaining to bike parking.

Davis Square, where much of the existing parking infrastructure is aging or not meeting its design capacity, could be retrofit to showcase a variety of parking accommodations. Sheltered bike racks could draw additional riders that are reluctant to expose their bikes to the elements. In some cities, sheltered bike racks have incorporated
into curb extensions, doubling as traffic calming features (Figure 5-2). Additionally, enclosed bike lockers or controlled rooms or cages offer higher security in areas prone to theft. This is especially relevant on the Holland Street T entrance, where racks are largely obscured from the public view. Leasing lockers or equipping them with on-demand payment systems could help recuperate purchase and installation costs.

c. Repair stations

Public bike repair stations, which provide riders with essential tools and a mounting rack to perform simple maintenance, have begun sprouting up across the MIT Campus and three have recently been installed in other areas locations around Cambridge. Pumps, tire gauges, allen wrenches, and screwdrivers are typically amongst the array of tools secured to the repair station by long, flexible cables. Cambridge estimated the cost of a repair station around $1,000.\textsuperscript{33} The City may install additional racks in the future if the existing ones are well used.

Somerville could consider drafting a zoning article requiring large housing developments, retail, or office spaces to install bike repair stations, similar to existing provisions for bike parking. On or off-site repair stations could also be recommended as counterbalancing amenities for development or redevelopment expected to exacerbate vehicle traffic on City roads.

Figure 5-2. Sheltered bike rack doubling as a bump-out (Photo: John Luton; Source: APBP, 2010)
II. Social Marketing Strategies to Increase Bike Ridership

Infrastructure improvements alone will not be enough to reach Somerville’s goal of 10% bicycle commuters by 2020. Physical improvements to the bicycle network should be accompanied by a public outreach campaign in partnership with other City departments, bicycle advocacy groups, and neighborhood organizations. Such efforts should consist of educational programs for bicyclists and motorists to encourage safety and promotional activities to build strong public acceptance for bicycling. There is ample literature available from cities around the world describing various methods being used to promote bicycling; this section will give a general overview of some common approaches.

In 2009, the San Francisco Municipal Transportation Agency (SFMTA) released a Bike Plan, which called for a multifaceted outreach campaign that focused on promoting bicycling to “diverse age, income, and ethnic populations”.

The plan advocated for the distribution of complementary printed bicycle route maps, bicycle related events, a web-based bicycle trip planning system, and the posting of route network maps in high-visibility public locations. In addition to promotion, the plan calls for the

Figure 5-3. Repair rack in Cambridge, MA. (Photo: Andy Metzger; Source: Wicked Local Bike Blog, March 31, 2011)
distribution of educational materials through a free 50-page handbook that “covers urban riding skills, including advance techniques for lane positioning and intersection movements, tips for using transit, riding at night, riding in inclement weather, information on road users’ rights and responsibilities, bicycle fit and equipment, proper helmet use, simple maintenance checks and secure bicycle parking”. We believe Somerville should implement a similar approach; making educational information readily available to bicyclists (or potential bicyclists) will increase their comfort level on the roads and help recruit additional riders. The League of American Bicyclists, a national nonprofit advocacy and educational organization, is another excellent source for ideas related to bicycling promotion and education. Information about their educational programing and event ideas can be found on their website.

The above ideas represent some commonly used promotional strategies currently being used throughout the United States. We also encourage the City of Somerville to think of even more innovative ideas that challenge today’s automobile-focused culture. The city of Malmo, Sweden provides an excellent illustration of a very non-traditional, but very successful series of promotional events. The campaign, called “No Ridiculous Car Trips,” was aimed at people making trips by car of less than 5 kilometers. In 2003, the city conducted a survey that found that 50 percent of all car trips were less than 5 kilometers in distance. This struck city officials as problematic since trips of that distance could easily be made by bicycle or public transit. Instead residents were clogging up the streets with automobiles. The “No Ridiculous Car Trips” campaign sought to highlight the impracticality of short car trips are and offer an alternative in the form of bicycling. Rather than a simple paper campaign, Malmo used a highly-visible and sometimes confrontational approach that consisted of street performances and even a
city-wide contest inviting residents to write about their most ridiculous car trips – the winner received a new bike. Officials described their “tongue-in-cheek” approach to bicycle promotion as being highly effective. Over the last 15 years, the share of bicycles on the road increased from 20% to 30%.

III. Theft Prevention

Higher rates of bike theft are a seemingly inevitable consequence of growth in the cycling population. Seeing bicycles draped with large, cumbersome locks, or worse, a frame locked securely to a rack with all of its components removed, could be a major deterrent to would-be riders. In response, a number of cities are exploring more sophisticated and targeted techniques to catch thieves. First, bicycle theft hot spots could be better identified by analyzing spatial and temporal data bike larceny. Next, “bait bikes” equipped with GPS tracking devices can be deployed in high-incident locations and tracked in the event that the bike is stolen. Bait bikes programs have been started in cities and campuses across the country, leading to numerous arrests, including many offenders with extensive criminal histories. While GPS unit costs about $1,000, along with a monthly monitoring fee, the sum is relatively nominal relative to reported
property losses due to bicycle theft from campuses or urban areas.⁴⁰

IV. Conclusion

Since its dramatic redevelopment in the 1970’s with the extension of the MBTA Red Line, Davis Square has emerged as one of the most vibrant transit hubs in the greater Boston area and an oft-cited showcase for transit-oriented development. In this report we have analyzed various aspects of the existing bike transit network serving Somerville, noting proposed alterations and additions in the foreseeable future. Significant expansions in bike infrastructure over the last decade have bestowed considerable benefits on a growing cycling population, while simultaneously advancing the community’s broader goals to enhance livability and promote economic, social, and environmental sustainability. We hope that our recommendations and prioritization methodology will assist the City of Somerville in continuing to improve the multimodal character of its streets and making bicycling a safe, efficient, and enjoyable transit mode for all of its residents.


6. Ibid, p. 3.


13. ESRI ArcGIS Version 9.3.2 was used in all GIS analyses.


25. U.S. Census Bureau, 2005 to 2009 American Community Survey
27. Baker, 2009
30. A more comprehensive review and citations of indicator significance can be found in the University of Washington’s Bike Share Feasibility Study (2010, pp. 9-19)—see reference 22
31. Ideas given by classmate A. Likuski, personal communication, April, 21 2011.
34. San Francisco Municipal Transportation Agency.
35. Ibid, Ch. 4-4.
38. Ibid.